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SCROFULOSIS

GERMAN TUBERCULOSIS CLASSICS

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EGBERT MORLAND, M.D., B.Sc.

SCROFULOSIS

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BY

PROF. DR. G. CORNET

BERLIN AND REICHENHALL

Translated from the Second German Edition

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NEW YORK

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PREFACE TO THE SECOND EDITION.

The First Edition of my "Scrofulosis" has been exhausted for nearly seven years. Circumstances have prevented my following it up sooner with a new edition. During this time many of my observations have been based on firmer grounds through the assiduous work of numerous investigators, and many questions have found new and better elucidation.

I hope this edition may find as friendly a reception as its predecessor.

Professor Dr. Georg Cornet.

Berlin and Reichenhall.
March, 1912.

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ERRATA.

P. 40, line 3 from bottom, *for* " Sabotta," *read* " Sobotta."
P. 93, line 10 from bottom, *for* " Boch," *read* " Bock."
P. 103, line 4 from top, *for* " Goehedini," *read* " Gehedini."
P. 105, line 7 from top, *for* " Bidert," *read* " Biedert "; and line 7 from bottom, *for* " Sabotta," *read* " Sobotta."
P. 143, line 17 from top, *for* " Müller," *read* " Möller."
P. 148, line 23 from bottom, *for* " Bierdet," *read* " Biedert."
P. 156, line 12 from top, *for* " Martin, Kircaner," *read* " Martin Kirchner."
P. 160, line 7 from top, *for* " Mars," *read* " Martins."
P. 187, line 16 from top, *for* " Spindler," *read* " Spieler."
P. 200, line 4 from top, *for* " Hayshi," *read* " Hayashi "; and lines 3 and 4 from bottom, *omit* " (for further information, see vol. xxi, ch. iv, pp. 403-406)."
P. 201, line 7, *for* " Eangl," *read* " Tangl."
P. 239, line 7 from top, *for* " Grover," *read* " Grober."
P. 240, line 14 from top, *for* " Bacinsky," *read* " Baginsky."
P. 243, line 14 from top, *for* " Tlantenga," *read* " Platenga."
P. 246, line 19 from bottom, *for* " Bren," *read* " Brem."
P. 255, line 3 from top, *for* " Arvonade," *read* " Aronade."
P. 257, line 7 from bottom, *for* " Kietz," *read* " Krietz "; and line 12 from bottom, *for* " Peschorner," *read* " Beschorner."
P. 263, line 16 from bottom, *for* " Children under 10 are given 0·2—0·5—1·5 mg.," *read* " Children under 10 are given 0·2—0·5—1—5 mg."
P. 264, line 3 from top, *for* " Hans," *read* " Hans Hans."
P. 265, line 9 from top, *after* " connected with it " *insert* " (Citron and others) "; line 10, *after* " contra-indicated " *insert* " or only permissible in weak solutions (Comby, ½ per cent.; Baldwin, 3 per cent.; Citron, ¼ per cent., and Calmette), and even absolutely contra-indicated for slighter cases."
P. 288, line 12 from top, *for* " Planteng," *read* " Platenga."
P. 293, line 17 from bottom, *for* " Montin," *read* " Monti."
P. 371, line 4 from top, *for* " Cantini," *read* " Cantani."
P. 393, line 11 from bottom, *for* " Balmanns-Squire," *read* " Balmanno Squire."

INTRODUCTION.

ALTHOUGH the discovery of the tubercle bacillus has created a true conception of the nature of Tuberculosis, on which to construct a sure diagnosis and etiology of the disease, opinions as to the nature of Scrofulosis are still widely divergent.

Some recognize in Scrofulosis nothing but a slowly progressing localized Tuberculosis, others consider it an independent disease from the beginning, due to a certain disposition or dyscrasia, which in its course often presents tuberculous complications. This difference of conception explains the contradictory nature of the clinical, statistical and experimental reports which it is not easy to put in a clear form.

Step by step we seem to be coming nearer to this goal; the differentiation of tubercle bacilli of human and bovine extraction has contributed to make many phenomena intelligible which hitherto have been unexplained.

DISTRIBUTION.

It is almost impossible to form even an approximately correct conception of the distribution of scrofulosis. The reports of older writers do not help us, because they continually call struma and other diseases scrofulosis.

Even at the present time the conception of scrofulosis is too vague for us to ascribe to it any special feature.

One doctor regards almost every acute superficial inflammation or swelling of the glands as scrofulosis, whilst another ascribes to it only the affections of a distinctly scrofulous nature.

According to Ritter, among 20,000 children there were generally about 90 per cent. with scrofulous symptoms; according to Volland, among 2,000 children about 90 per cent. had also scrofulous swelling of the glands of the neck.

The statistics of mortality to which we owe such valuable conclusions concerning tuberculosis of the lungs, do not afford us much information respecting scrofulosis. In the Prussian statistics, which are otherwise so useful, scrofulosis and rickets were, until 1902, represented in common, and from that time onwards, as in the statistics of other states, those suffering from scrofulosis, who later have died from tuberculosis of the lungs or of bones, or of miliary tuberculosis, have been included under this heading. Owing to this state of affairs I would refrain from quoting statistics which would only lead to false conclusions.

D'Espine has estimated the number of deaths from scrofulosis, according to Lebert, at 21 per 1,000 of the total mortality, and 6 per 1,000 of the rich to 34 per 1,000 of the poor. If these figures were correct one might come to some conclusion about the decrease of scrofulosis; its extent in Bavaria amounts at the present time to about 5 per 1,000; in Prussia it forms, inclusive of rickets, 4 to 5 per 1,000 of the general mortality.

OCCURRENCE ACCORDING TO AGE AND SEX.

From clinical observation we are better acquainted with its occurrence according to age and sex than we are with its general distribution.

Scrofulosis is almost exclusively a disease of the period of development, as is confirmed by doctors of all times; it does not rest on any statistical error, like the theory of predisposition to tuberculosis at the prime of life, but is founded on fact. As it is just this point which is important for our explanation of the nature and origin of scrofulosis it requires special consideration.

Of older authors Baumès emphasizes the fact that scrofulosis hardly ever appears for the first time after the 18th or 20th year. Lebert places the greatest frequency between the 3rd and 15th year. Scrofulous skin affections and otitis are very rare after puberty. Ruete, Birch-Hirschfeld, Henoch, and others, also more recent authors, say the same.

Its appearance in later life rests on quite different conditions: the so-called "prison-scrofula," from the former unhealthy state of prisons.

Sex influences its occurrence to a certain extent, and there is a preponderance, even if only slight, in the female sex[1] and greater frequency up to puberty. Dolaeus observes that scrofulous swellings occur oftener in the female sex than in the male, and sees therein "a punishment for the vanity of women who love to adorn their necks with all kinds of jewellery."

Ruete and Wunderlich expressly state that the female sex is oftener attacked with scrofulosis than the male.

According to Garré, the relation of male to female sufferers from scrofulous glands is as 2 to 3; according to Wohlgemuth (in 430 cases) about 12 to 13.

Unfortunately as to age and sex there are only a few researches of limited extent, the details of which do not afford us sufficient foundation on which to base an opinion. As fuller and more reliable examples we quote the following: Monti, in the Polyclinic in Vienna between 1863 and 1897, observed a total of 8,128 scrofulous children. Of these there were 3,880 under 5 years of age, 362 under 1 year of age, 75 infants under 6 months, 2,107 between 5 and 9, and 2,141 between 9 and 14 years of age. Of these 8,128, 3,731 were boys and 4,397 girls.

[1] Only severe cases of bone and joint affections appear to preponderate in boys, because traumatic causes occur much more often than in girls.

Rabl, of Bad Hall, during thirty-two years, observed in hospital and private practice 11,796 cases of scrofula.

Age	Male	Female	Total
1-5	389	291	680
6-10	2,228	2,718	4,946
11-15	1,642	2,020	3,662
16-20	417	694	1,111
21-25	371	279	650
26-30	244	121	365
31-40	145	69	214
41-50	88	54	142
51-60	16	10	26
	5,540	6,256	11,796

Rabl has included cases of joint tuberculosis in older persons as belonging to scrofulosis; this accounts for the extraordinarily high figures in later years. One gathers from this how much the numbers depend upon the subjective impressions of the observer.

Both summaries founded on about 20,000 cases show conclusively that scrofulosis especially affects children (over puberty the numbers are much smaller[1]), and that especially in distinctly scrofulous forms up to 15-20 years of age the number of boys affected as compared with girls is as 5 to 6.

In dealing with such large numbers many errors must result arising from outside circumstances. For reasons easily to be understood, fewer young children are sent to a place like Hall than to the general hospitals of a large town. The smaller the numbers in such statistics the greater the accidental sources of error. Summaries of only a few hundred cases give contradictory results and lead to faulty conclusions We can only arrive at a true result by comparing similar reports. In the summary by Neumann, who in his Polyclinic observed a total of 624 scrofulous children (205 under 5 years of age, 286 between 5 and 10 and 133 between 10 and 14), no preponderance of the female sex was noted.

[1] The cases of gland scrofula mentioned by Wohlgemuth are as follows :—

Under 5 years	47·4 per cent.
5-10 ,,	20·8 ,,
10-20 ,,	20·0 ,,
Over 20 ,,	11·8 ,,

SECTION I.

Etiology of Scrofulosis.

CHAPTER I.

HISTORICAL SURVEY.

NAME.

The term "Scrofula" is derived from the Latin scrophula, a translation of the Greek word χοιρας, of the same stem as σκροφω ("I grub up"), and signifies a young pig (Virchow). The reason of the term χοιραδες, or scrophulæ, lies in the resemblance which the neck, enlarged by the swollen glands and forming a continuous outline with the lower jaw and shoulders, bears to the full contour of the pig's neck. Others attribute the term to the fact that the glands of the pig's neck are particularly abundant, that pigs especially suffer from the disease, or that the χοιραδες are as numerous as a pig's litter. With very little claim to probability the term has been derived from the χοιραδες, the rocks at Tarentum, the glands of the neck in the scrofulous being considered as irregular as the rocks in the Straits of Tarentum.

The Latin term "scrophulae" was in olden times and the Middle Ages not often used; χοιραδες was generally translated by strumae (from strumere, to build up). Only in recent times, chiefly through Cullen and Hufeland, the term "Scrofula" came more and more into use, and the term "Struma" was limited to swellings about the thyroid. In England the distinction was not made, but rather, up to our time, strumous and scrofulous were used as synonymous with scrofulous and tuberculous. The French seldom used the word struma, except in the same sense as we use the word scrofulous.

As an historical curiosity one may call to mind the term "Morbus regius" (King's evil). Even at the time of Alexander Severus it was stated: "Regius est vero signatus morbus hic,

quoniam celsa curatur in aura" ("Sereni Samon," Poem LIX). In France, and especially in England (from the time of Edward the Confessor), the power to heal scrofula by touch was ascribed to kings and the seventh son in a family, the formula being: "Le roi te touche, le roi te guérit." From the restoration of Charles II till the reign of Queen Anne the number of persons so treated was reckoned at 100,000. White was of opinion that political motives underlay this treatment, and that only such illnesses were submitted to the touch of the King's hand as were so slight that they often disappeared without any treatment at all.

Only in the reign of Louis XIV and with the reigning family in England respectively, this custom came to an end. As the King gave up the practice of medicine, and the idea became prevalent that Scrofula was inherited, the name "Morbus regius" was lost and Scrofula took its place (White, Virchow).

CONCEPTION OF SCROFULOSIS.

As to the conception of the disease to which we give the name of scrofulosis, from the first the importance attached to changes in the lymphatic glands were taken into account, and in the last century changes in other organs, such as the skin, mucous membranes, and joints. Besides the gland enlargements, older physicians associated such diseases as goitre, carcinoma, syphilis, scabies, rickets, &c., with scrofula, so that in the study of these diseases one must always distinguish whether one is really dealing with those diseases which the name indicates. Kortum (1798) made a distinction between scrofula and struma, and a little later Baumès separated glands which were really scrofulous from swollen glands due to cold inflammation or pressure.

THE ACIDITY OF SCROFULOSIS.

Older writers ascribed changes in the lymphatic system to an idiopathic, faulty mixture of the body fluids, and especially, since Cullen's time, the cause was thought to be an acid substance circulating in the blood (acrimonia scrophulosa). Many consider that scrofula is due to a retention of semen, hence it disappears on the outset of puberty, and they advise early marriage as a remedy. Others attribute it to a peculiar venereal poison, others again attribute the glandular enlargement to some specific change in nerve tissue, and especially to a deterioration in the eighth pair. Baumès holds the view that it is due to lymph deterioration; according to him, in scrofulosis the lymph is faulty from the first, although one does not know whether the acid

principle by which the lymph deteriorates is produced in the lymphatic vessels. He traces the acidity to a thickening of the lymph.

Hufeland considers that scrofula is a local affection, scrofulous disease (*Cachesia scrofulosa*) being a general disordered diathesis of the lymphatic system, due to atony and weakness of the vessels, of which scrofula is only a symptom. Allied to restricted idiopathic scrofula there is a false or sympathetic form, symptomatic of the effect of another disease, such as small-pox, measles, syphilis, injuries, and tooth irritation. When, however, such a sympathetic affection lasts long it can produce such an overwhelming disturbance of the affected lymph system that it becomes an independent disease. Writers attribute changes in the skin (eczema, impetigo), in mucous membranes (catarrh, suppuration), and caries of bones and joints, to the acidity circulating in the blood.

When humoral pathology was discarded the doctrine of an idiopathic affection of the lymph glands and some peculiar scrofulous substance lost more and more adherents. Broussais, Velpeau and Piorry recognized that the scrofulous gland affections were secondary and resulted from changes in the organs from which the glands derived their lymph, namely, the skin, periosteum and bones. Virchow supported this view with great emphasis.

SCROFULOSIS AND TUBERCULOSIS.

Originally the expressions scrofulous, strumous and tuberculous were considered identical. Van Swieten called the tubercles of phthisical lungs strumae. Portal speaks of scrofulous phthisis; tubercle is for him a rounded tumour containing scrofulous matter. Bayle (1774-1816) considers tuberculous phthisis a chronic specific disease of a scrofulous nature, and calls mesenteric scrofulosis a mesenteric tuberculosis. Hufeland (1796) describes the "frequent scrofulous consumption of the lung" as phthisis scrophulosa, tuberculosa, or scrophulosis pulmonum, and considers it a metastasis of scrofulous acidity.

Laennec most emphatically supports the identity of both affections, seeing in scrofula nothing more than a localization of tuberculosis in gland structures. This theory of identity found many supporters. Lugol calls any patient scrofulous who suffers from tuberculosis. According to him tubercle is a definite structure having an independent existence (like liver, spleen). The development of the disease, which this constitution attaches to itself, embraces the whole life of the individual and that of

his relations and parents. Rilliet, Barthez and Cruveilbier were also supporters of the complete identity of the scrofulous and tuberculous diathesis; Rokitansky considered tubercle and scrofula the same structures.

The most decided opposition to this view came from Virchow. He emphasized the necessity of considering the nature rather than the structure of the disease. The caseous material from which Laennec argued is not a specific substance which is deposited and which might be styled either scrofulous or tuberculous, but rather decayed tissue material. Pus and typhoid substances, cancer, and other tissues rich in cells can also undergo a similar metamorphosis. There are thus several caseous substances, but it does not follow from their similarity that the processes which produced them are identical. Virchow took the specific character of the caseous material for tuberculosis, and considered the starting-point of tuberculosis to be the tubercle, a cellular, non-vascular, heteroplastic new formation.

Scrofulous new formations, according to him, are not heteroplastic but "irritative changes in tissues which sometimes take on a hyperplastic, and sometimes an inflammatory character."

Under scrofula, in its limited sense, he understands a disease of the lymph glands—there may be ever so large a circle of other organic diseases included—which depends upon a weakness of single parts or regions, or a certain incompleteness in the arrangement of the glands.

This dualistic doctrine of Virchow continually gained more support, in spite of individual opposition by Villemin, but it met with a serious repulse after similar tubercles were described by Koster in the granulations of fungous joint inflammations, by Schueppel in hyperplastic lymph glands, by Friedlaender in scrofulous skin abscesses, and always in lupus. Through Koch's discovery of tubercle bacilli in scrofulous diseases the view of the oneness of the disease appeared to be again quite decided.

INJECTION RESEARCHES.

Long before the discovery of the tubercle bacilli a number of investigators had sought to establish the possibility of injection of scrofulosis, its nature and its connection with tuberculosis.

Kortum (1789) ("materies ex ulceribus scrophulosis benignis effluens"), Hébréard (1802), Salmade (1805), Lepelletier (1816), Goodlad and Deygallières injected scrofulous matter into dogs, guinea-pigs, and a number of healthy children, as well as into their own bodies, without any result.

It is difficult to trace the cause of these negative results on account of the scanty records made of these experiments. The defective technique was partly to blame, partly the unsuitable selection of material and animals chosen for the injections, partly also the unduly short observation of these animals, or their premature death from other diseases.

Villemin only got one positive result by the injection of matter from caseating lymph glands into two guinea-pigs (in another case he had a negative result).

Cohnheim and Salomonsohn reported miliary tuberculosis of the iris after the insertion of caseous particles from the glands of the neck removed from man into the anterior chamber of the eye. Schueller reported tuberculous joint affections after the injection of scrofulous caseating lymph glands; Kiener and Poulet always produced general tuberculosis after the injection of scrofulous tissue substance. Colas and H. Martin had the same experience.

KOCH'S RESEARCHES.

After the discovery of the tubercle bacillus by Koch we became possessed of a sure criterion as to the tuberculous or non-tuberculous nature of scrofulous affections. The importance of these researches demands closer consideration in order that we may comprehend the subject.

Koch found tubercle bacilli in twenty-one glands, which histologically were proved to be tuberculous, often, I admit, only in small numbers and especially in or about the marginal zone, and twice only in the interior of the caseous focus.

He found the same thing constantly in thirteen cases of bone and joint affections, which, both clinically and histologically, were characterized as tuberculous or scrofulous respectively.

Koch could find no tubercle bacilli in the pus of one case of spinal caries, but in this case he could produce tuberculosis by injecting the pus.

In the same way he found tubercle bacilli in four cases diagnosed as undoubted lupus, in an excised portion of skin, only once after the twenty-seventh section, and only once after the forty-seventh section.

More recently, as is well known, it has been possible by the antiformin method in combination with Gram's stain to discover the bacilli much oftener in such structures.

Further, from excised scrofulous neck glands in man, Koch has cultivated tubercle bacilli for many months in an artificial culture medium without being able to detect any difference either

in their growth or virulence from those derived from a tuberculous lung.

Finally he proved the tuberculous character of scrofulous structures by injection experiments. Scrofulous gland substance from three cases injected into ten guinea-pigs resulted in all cases in marked tuberculosis, first in the lymph glands in the neighbourhood of the injection and then in the other organs.

Only it was discovered that the course of the tuberculosis was very slow on account of the small number of bacilli contained in the injection. Gland substance containing bacilli placed in the anterior eye-chamber of four rabbits also gave rise to the following well-known appearance: tuberculosis of the iris, caseation of the bulb and of the neck glands, and tuberculosis of the lungs. Inoculation of particles of tissue from six cases of lupus into eighteen rabbits and eight guinea-pigs gave similar positive results, as did also pus from a tuberculous elbow-joint injected into four guinea-pigs, and from a case of spinal caries injected into five guinea-pigs; finally injections from lupus and a fungous joint also from a scrofulous gland gave pure cultures.

The opinion that Koch constantly found tubercle bacilli in scrofulous glands is generally held. This opinion, which led to quite false conclusions, is erroneous. Koch says as follows: "Altogether twenty-one cases were examined, the glands of which were proved to be tuberculous," and means by this, "the presence of epithelioid cells which were grouped together and enclosed more or less numerous giant cells." "Only in glands which had such a tuberculous structure could any tubercle bacilli be proved to exist. On the contrary in a number of cases in which the glands were enlarged and had partly become soft and filled with pus foci, but in which the epithelioid cells and the giant cells as well as the characteristic tissue necrosis were wanting, no tubercle bacilli could be found."

FURTHER CONFIRMATION OF THE NATURE OF TUBERCULOSIS.

The researches of Koch which formed the basis of his theories were repeated and confirmed by other authors. In fungous bone and joint diseases described as scrofulous Demme found tubercle bacilli (always isolated) in the excised tissues fifteen times in seventeen cases, whilst Schuchardt and Krause found them in twenty-seven cases (including fourteen tuberculo-scrofulous abscesses), but in the cases of abscesses only in the abscess membrane, not in the pus. Müller found them in thirty

to thirty-five cases at most. The latter leaves it an open question whether the negative cases could not turn out to be positive by further search. Further, Kanzler found tubercle bacilli in four cases, each time in the membranes, and eight times in the secretions. Cornil and Babes, Ritter and others in seven cold abscesses with caseous contents every time, in five with watery contents not once.

As regards scrofulous glands, Demme in twenty-one cases of glands undergoing caseous degeneration found bacilli twenty times in the excised tissues, also isolated bacilli in some mesenteric glands which were hardly the size of a pea and were recently swollen and still soft; with serous infiltration (*tabes mesaraica*) Schuchardt and Krause found them each time in three similar glands, also Cornil and Babes, Albrecht and others; Arloing by injection (four times in four cases), Eve three times in five cases. Wyssokowitsch, Pawlowski, &c., had the same experience.

Demme found tubercle bacilli in six cases of lupus, Doutrelepont each time in seven cases of excised tissues, A. Pfeiffer in conjunctival lupus by means of the microscope, and Pagenstecher by injection, Schuchardt and Krause in four cases of lupus and tuberculosis of the skin; Albrecht, &c., also found tubercle bacilli.

Since then many researches have been made into the details of which we need not enter. The fact that bacilli are often found in the tissue and in the surrounding zone, and much less often than in the secretions of pulmonary tuberculosis, explains many negative results. That tubercle bacilli are seldom found in lupus has been explained lately and its tuberculous nature further confirmed through the researches of v. Krueger, who by Uhlenhuth's antiformin method (see p. 247), in combination with Gram's stain, in thirteen cases constantly found the so-called Much's tubercle virus, that is tubercle bacilli and granules of bacilli which stain specially with Gram. As has been already mentioned, this method has now and again apparently proved its utility for detecting the presence of bacilli in other skin diseases. Similarly, Harald Boas and Ditlevsen found bacilli in twenty cases by Gram's method and in only four cases by Ziehl's method. The tuberculous nature of scrofuloderma was proved by Letulla and Leloire by injections.

For further details of the tuberculous nature of lichen, folliculitis, erythema induratum and scrofulous skin eruptions, which have only become better known within the last few decades through the exhaustive researches of Boeck, and which are of more significance for the clinical consideration of scrofulosis, see p. 185, under the heading "Symptoms."

NON-TUBERCULOUS SYMPTOMS OF SCROFULOSIS.

The investigation of peripheral scrofulous diseases, with the exception of lupus, scrofuloderma and lichen, give different results.

In scrofulous eczema, as a rule, neither the histological signs of tuberculosis nor bacilli are present. If Demme found bacilli three times in seven cases peculiar conditions must have contributed to this result.

A nurse-child, aged 3½ years, had eczema of the face, abdomen and thigh. The first three examinations for tubercle bacilli made within three weeks were negative. A few days after the last examination the foster-mother took charge of a girl, aged 7, suffering from pulmonary tuberculosis with cavities and tubercle bacilli in the sputum. Both children lived in the closest intercourse in poor circumstances and in poverty. After about three weeks tubercle bacilli were found in the eczematous discharge from the ear and in the left inguinal region. The cervical and the inguinal glands, up to this point very little swollen, became now markedly larger, and while the eczema had healed three weeks later, one of the inguinal glands on being excised was found to be tuberculous. After two weeks left-sided hip disease came on, soon after which death occurred from meningitis.

Ritter's observations also confirm the above rule. He examined 129 cases of scaly and vesicular eczema both microscopically and by cultures, and in thirty-four of these cases by injections, and found tubercle bacilli only in one child, whose health was not affected by disease inherited from the parents, and then they were only found after many negative examinations; after which the eczema healed. A year and a half later the child, who had meanwhile been brought up by a phthisical aunt, appeared again with eczema in the right auricle and numerous bacilli were then found.

Martin could discover no tubercle bacilli in eczema as the result of injections. Volkmann found them once in an eczema of the arm.

In adenoids, middle-ear discharges and chalazion they were found only in a small number of cases and, as a rule, not at all in scrofulous ozæna. They appeared occasionally under peculiar circumstances, as Demme's case shows.

A boy, aged 8 months, came as a foster-child into a family where the father suffered from acute phthisis; two months later ozæna occurred, in the secretions of which Demme found tubercle bacilli; death occurred soon after from tuberculous meningitis.

Besides this bacilli are occasionally found in the yellow crusts of ozæna which resemble tubercle bacilli, and which are arranged in nests (Karlinski, Alexander). Yet, contrary to earlier statements, the ozæna had nothing to do with the tuberculosis.

According to Ritter, in the secretions of scrofulous catarrh of the nose, ear and eye, in 138 children tubercle bacilli were never found, excepting in otorrhœa of two children suffering from phthisis; neither were they found in twenty-three children with acute multiple subcutaneous abscesses. Further, Ritter examined *post-mortem* microscopically, and injected into guinea-pigs, matter from the cervical, bronchial and mesenteric glands of nineteen children who, during life, had suffered from those "types of scrofulosis most widely disseminated," viz., scrofulous habitus, eczema, otorrhœa, coryza, catarrh of the respiratory tract, and swollen cervical and other glands; only in one child did he find tubercle bacilli.

In those affections in which tubercle bacilli were not found evidence of pyogenous bacteria was mostly present.

That catarrh of the respiratory mucous membrane of the nose, bronchi, eyes, ears and intestines, as far as they did not arise from thermal or chemical irritation, may be traced to bacteria is well known. Of the different forms of eczema the parasitic form is accepted and proved. Bacteria have been proved to be the cause of phlyctenular ulcers by repeated experiments. Burchardt, Duclaux and Bougeron, Leber and Sattler, Straub, have got cultures of bacteria, mostly *Staphylococcus pyogenes aureus* and *albus,* therefore the same as are found in true eczema, and which had a share in producing vesicular eruptions in animals experimented with.

Also in multiple skin abscesses, which so often occur in scrofulous children, Escherich found *Staphylococcus pyogenes aureus* and *albus*. For the tests of virulence of pyogenic bacteria, see p. 22.

To recapitulate: In cases of scrofulosis, when dealing with caseating glands, bone and fungous joints, lupus, and scrofuloderma, and the scrofulides to be discussed later (see p. 185), tubercle bacilli could nearly always be found, thus the tuberculous nature of the affections is assured.

On the contrary, the skin diseases which are reckoned as scrofula, and are characteristic of it, as a rule contain no bacilli except those just named, for example, eczema, impetigo, diffuse catarrh of the mucous membrane, ozæna, &c.; they also produce no tuberculosis by injection and are at the same time not of tuberculous nature, but are caused by pyogenic bacilli.

CHAPTER II.

CONCEPTION AND CLASSIFICATION OF SCROFULOSIS.

THE term "scrofulosis" has met with very various meanings and extensions in the course of time, as we have learned from the historical introduction. Originally associated with a single symptom (the swollen neck glands) its significance has, during the last century, been much extended.

In the sense now accepted scrofulosis comprises a complex of symptoms almost entirely confined to childhood and early youth; such are on the skin and the various mucous membranes: lupus, scrofuloderma, lichen, tuberculides, eczema, impetigo, chronic blepharitis and phlyctenules, middle-ear disease, chronic catarrh of the air passages, rhinitis, pharyngitis, bronchitis, hyperplasia of the tonsils, catarrh of the alimentary canals, and lastly, certain affections of the bones and joints.

These processes are not of themselves specific of scrofulosis, but are distinguished from other non-scrofulous phenomena of the same kind by:—

(1) *Persistency*.—Whilst other affections of the same sort disappear comparatively quickly, a scrofulous affection is distinguished by an extraordinarily chronic course which continues even after the external injury has passed off for a long time.

(2) *Frequent Recurrence*.—When the first attack has subsided, a recurrence will often take place without visible cause, at the same spot or elsewhere, characterized by similar persistence.

(3) *Multiplicity*.—Generally it does not stop at one single affection, but similar or diverse affections appear in the near or remote neighbourhood, or they may alternate with each other.

A.—EXOGENOUS CAUSES—CLASSIFICATION OF SCROFULA.

In the pathological symptoms of scrofula we have been able, as shown in the preceding chapter, to determine two extraneous causes, the tubercle bacillus and, where this is not present, pyogenic organisms, in the general acceptation of the term, viz., staphylococci, streptococci, &c. The well-known pathogenic properties of these bacteria warrants the theory that they are not accidental or irrelevant accompaniments, but clinical manifestations of scrofula; the "scrofulous" character of the disease refutes the notion that they are the actual cause of scrofula; they co-operate rather by setting free and modifying both the purulent bacteria and the tubercle bacilli, and impress upon them the stamp of an idiopathic disease according as one or the other is present. The natural classification of scrofulosis presents a tuberculous and non-tuberculous or purulent form.

Undoubtedly the tuberculous form plays the most important part in the class "tuberculous modifications."

One cannot make much mistake if one reckons as tuberculous all glands which are caseating and which are easily perceptible; also bone fungus; in short, all those severe and mostly widespread pathological processes which form a field of activity, especially for the operating surgeon or for the morbid anatomist on dissection of the bodies of those who have died from tuberculosis. Thus it is that many surgeons and pathologists, as well as noted specialists, Velpeau, Barthez and Rilliet, Neumann, Soltmann, &c., are perfectly agreed on this point, and class scrofulosis and tuberculosis under one heading. Some, by entirely setting aside the idea of scrofulosis, exclude those diseases in which tubercle bacilli are present from the heading scrofula and place them under that of tuberculosis; whilst others, such as Escherich, retain the designation scrofula, but only to denote a certain from of infantile tuberculosis characterized by a lymphatic constitution or a tendency to catarrh.

But even if the severe, clinically most important, cases of scrofula be allied, and numerous scrofulous patients for clearly perceptible reasons (see p. 20) turn out to be tuberculous sooner or later, still the wide field of scrofula is not by any means exhausted.

A second class of complaints comes under this heading which are less severe, seldom need surgical treatment, and still less seldom cause death; they are principally affections of the skin or of the mucous membranes, inflammation of the eyes, catarrh of

the middle ear, nasal cavities, and the deeper seated respiratory tubes, hyperplasia of the tonsils, adenoids, vaginal discharge amongst girls (not of a tuberculous or gonorrhœal nature) and chronic or transitory swelling of the lymph glands; processes which justify no suspicion of tuberculosis either histologically or bacteriologically; in which inoculation causes no tuberculosis, and which, therefore, are not tuberculous, though they have for generations been classed under that head.

But still Escherich acknowledges that even with the constant and characteristic symptoms of scrofula there are no tuberculous changes to be detected. These depend mostly on infection, as a rule by pus organisms, but they are not simple pus infections like the adenitis which appears and disappears without any other accompanying symptoms in consequence of dental caries, for example; but these here mentioned produce the typical scrofulous glands which the triad of obstinacy, multiplicity and frequent relapses proves to be of scrofulous nature (see Ritter in der Diskuss., *Berl. klin. Woch.*, 1907, p. 261).

On the other hand, it is not permissible to remove such formations as are demonstrably tuberculous from the heading Scrofula and simply to place them under that of Tuberculosis, for they differ essentially, as the clinical symptoms characteristic of scrofula and the course, prognosis, and therapeutics of tuberculous affections prove. But it is just as unjustifiable when other authors leave the non-tuberculous forms entirely out of the scrofulous class, as Neumann does, for example, in chronic catarrhal and purulent rhinitis, all inflammations of the middle ear, all eczemas, ulceration of the skin, all the numerous abscesses in the subcutaneous tissues of infants, and the blennorrhagic affections of the vaginal mucous membranes in older girls, when he denies them to be of scrofulous character unless tubercle bacilli are present.

This separation is not justifiable when all these characteristic features of scrofula—which is generally the case—are present and their combination points to intimate connection with it. Also the attempt to consider the pyogenic form as a preliminary condition of tuberculosis is essentially without foundation.

Kanzler showed that tuberculosis and scrofula are as intimately related to each other as the soil on which a plant grows by preference is to it. But even Neumann calls attention to the fact that "that which Kanzler and others call soil on closer inspection represents a part of the plant itself." Besides this, every indication is wanting that tubercle bacilli thrive better with those who have a tendency to scrofula or are manifestly scrofulous; on the contrary, from a clinical point of view it appears that the

tubercle bacillus does not thrive with scrofulous patients, and is generally of a mild character with them,[1] in contradistinction to tuberculous patients, and this is a point generally emphasized. How can these contradictory statements be reconciled?

It is obviously a one-sided view to put down the differences in the development of the disease as due to better or worse foster ground, endogenous factors, of which we know little, instead of studying the cause of the disease, the exogenous factor. Thus the individual tendency was first made responsible for the rare infection from tuberculous milk till Koch showed the difference in the virulence of the exogenous factors of bovine and human bacilli.

The theory which is very much advocated, that simple hyperplasia of the lymph glands must prepare the ground for the tubercle bacillus, can only rest on the fact that hyperplasial or tuberculous processes are found together in the glands. This state of things can be easily explained; in consequence of peripheral lesions, doors are opened by which all kinds of bacilli can enter the glands, and that pus cocci enter sooner and oftener than tubercle bacilli.

What will happen then to the non-tuberculous cases if the name scrofula disappear, or if it be restricted to non-tuberculous phenomena? The pyogenic form of the disease is a clinical entity, and cannot be separated from scrofulosis without destroying the clinical picture to which we have become accustomed. It is only a different branch, which connects the tuberculous form with the same stem and root as the scrofulous tendency.

I should like to put the question to those investigators who deny the pyogenic form in an inverted manner.

(1) Is it not laid down as a rule that virulent pyogenic organisms are immensely numerous and are very widely distributed, infinitely more so than the tubercle bacilli, that they are frequently found in the dust of our rooms and even on the human skin, and where an open wound exists immediately give proof of their colonization and their pathogenic nature?

(2) When scrofulous children with a tender skin or mucous membranes, or, as I take it, have open paths of entry and broad lymph channels (see p. 60), how can one logically deny that they absorb with extraordinary frequency these pus organisms, with the pathological consequences of increased local irritation and secondary glandular swelling, on account of increased susceptibility, more frequently than normal children, and that, in consequence of these increased opportunities for infection, they repeatedly experience such invasions, and so at last show manifestly

[1] Of the cause of this benignity we shall speak later (see p. 45).

scrofulous symptoms, in which case it is immaterial whether we seek the scrofulous tendency in the increased receptibility to bacilli, or in increased vulnerability, or in both?

But if the pus organisms contribute as considerably as an inciting factor in cases where a scrofulous tendency is present, as tubercle bacilli in parallel cases, then it is no more than just and reasonable to recognize their relationship by name, and to use the term "pyogenic scrofulosis." The understanding of scrofulosis can only be advanced by this designation.

Lately the supporters of the identity of the diseases defend von Pirquet's theory of cutaneous reaction, in contradiction to the dualistic idea favoured by myself and also entertained by Biedert and others. It appeared at first as if the question might be easily solved by the simple and easy tuberculin test. Thus Escherich, who was unfortunately so early cut off, based his theory on the fact that he, with Neumann, Salga, Heubner and others, obtained cutaneous reaction in all cases of typical scrofulosis. He considers that as a proof that, in all children with scrofulous symptoms, tuberculosis has already been established by means of the toxin allergie.

But (1) these results of von Pirquet's tests received no general confirmation, therefore are not conclusive. Thus Moro points out that negative results have been obtained in a number of cases in spite of pronounced scrofulosis, in spite of a scrofulous constitution, in spite of dermatitis in the form of chronic eczema of the face and ear, impetigo, lichenous eruptions, inflammation of the eyelids and connective tissue, of swelling of the lymph glands, in spite of external symptoms which exactly resemble tuberculous scrofula, and although the patient was of an age when positive reaction appears and had repeatedly submitted to the tuberculin test both by friction and injection.

Although negative reaction generally occurs amongst such children in their first year, yet the number of older children of 5 to 7 and 11 years who do not react, and who have all the signs of scrofulosis, impetigo, eczema, vesicular eruptions, and swollen neck glands (Moro), confirms the old experience that not all scrofulous patients are tuberculous, and that scrofulosis cannot be identified with tuberculosis.

The phenomenon that negative tuberculin reaction among tuberculous patients in later childhood becomes positive is easily explained. It is the exact parallel of a similar observation among the non-scrofulous; that is to say, it is explicable by the fact that many, and perhaps most, scrofulous patients, especially among the poorer classes, have plenty of opportunities in the course of

years of taking up tubercle bacilli of the human and bovine type and become tuberculous either decidedly or in a modified form, and exhibit allergie and positive tuberculin reaction.

Such infection by tubercle bacilli, as well as by pus cocci, amongst those with a predisposition to scrofulosis is all the more probable and all the more frequent because they appear anatomically to be especially predisposed to it because of the ready means of access and the easier dispersal of the bacteria (see pp. 63 and 70), but this is particularly the case amongst those suffering from scrofulosis in which impetigo, eczema, &c., have left open paths for the entry of bacteria.

If such children exhibit a positive tuberculin reaction, still it is not because their scrofulosis (which had made its appearance much earlier) (see Moro above) was from the beginning of a tuberculous nature; on the contrary, the counter evidence lies in the former negative reaction.

(2) In the exposition of von Pirquet's reaction there is, as unfortunately often happens, an undercurrent of error which has hitherto not received attention, and which has led to quite false notions on other questions. Positive reaction was put down to clinically evident scrofulous phenomena which, though so apparently conclusive and seductive, were, *a priori,* baseless; positive cutaneous reaction proves nothing more than that a tuberculous centre is or was in the body which caused allergie; as to where this centre lies it leaves us completely in the dark, unless a distinct local reaction take place in the very centre of the disease.

Now it is indisputable that, amongst those who react positively quite independently of their scrofulous symptoms, their eczema, their impetigo, their vesicular eruptions, and later swelling of the neck glands, there are some who have tuberculous, bronchial, or mesenteric glands and thus react, so the tuberculous character of their evident scrofulosis was only deceptive; such are not isolated cases to which no importance need be attached, and which do not enter into the calculation, but they are, and must be, tolerably frequent and form a considerable percentage. It may be presented statistically.

(1) Persons suffering from scrofulosis (*i.e.*, the pyogenic form) are exposed to the same sources of infection as the non-scrofulous, such as infection by particles of sputum, or by milk containing tubercle bacilli, which, notwithstanding their slight virulence, are frequently sufficient to create a small centre which then causes allergie.

(2) They will thus develop with at least the same frequency as the non-scrofulous, bronchial and mesenteric glands (as to

whether slightly or highly virulent we will speak hereafter) which have not the slightest causative connection with the scrofulous symptoms visibly present on the skin and in the neck glands and perhaps also never appear in connection with them. But Heubner himself acknowledges that he has never dissected a child suffering from genuine scrofula which was without tuberculous bronchial glands. Such children would evidently react positively during life on account of their tuberculous bronchial glands, and would then, according to the above view, in spite of their genuine tuberculous condition, if they have external scrofulous symptoms, be wrongly classed as tuberculo-scrofulous.

(3) Those suffering from pyogenic scrofulosis would, on account of their increased susceptibility to bacterial infection, exhibit tuberculous bronchial and mesenteric glands much more frequently than persons normally developed. I will not insist further on this point, but base my proofs on facts which are universally acknowledged.

Thus, as the non-scrofulous act positively to von Pirquet's test, simply on account of their bronchial and mesenteric glands without having any other tuberculous centre, sufferers from pyogenic scrofulosis must react positively with at least equal frequency and with an equal percentage from the same cause without the presence of other tuberculous centres, that is to say, without the symptoms on their skin and in their neck glands being in any way connected with their latent tuberculosis, and without the manifestly scrofulous symptoms being tuberculous.

Thus if Moro, for example, had found amongst 300 cases of scrofulosis 13 (4·3 per cent.) with decided scrofulosis but negative reaction, the result would be considerably changed if it were possible to strike out of the remaining 287 all those who have solely tuberculous, bronchial and mesenteric glands independently of their scrofulosis, and who exhibited allergie only on that account. Weber (Heft 42) found, for example, that the inoculation of a caseating mesenteric gland caused tuberculosis in a scrofulous child, but that inoculation of swollen neck glands did not prove tuberculosis. Thus tuberculin cannot decide whether the scrofulosis is of a tuberculous nature unless there be at least decided local reaction.

The latent bronchial and mesenteric glands may indeed have been caused through the influence of the scrofulous predisposition, but who can prove in a single case that this is so? In any case not those, as numerous observations prove, who exhibit no trace of scrofulosis, though latent centres may exist.

The results obtained by cutaneous reaction, the importance

of which rests on other grounds, are in no way applicable, and can under no circumstances destroy the theory that pyogenic scrofulosis is a division of general scrofulosis, and it is quite unauthorized when Moro, Escherich, &c., lay stress on the collaboration of a diathesis with the tuberculous infection as the cause of scrofulosis, while they ignore or place in the background other branches.

That, besides bacteria, other exogenous evils can, where predisposition is present, excite not only single symptoms, but clinically prove scrofulosis, is a supposition that must appear doubtful. Amongst such evils are cold in the respiratory mucous membrane, toxic and alimentary troubles, excess of metabolism in the digestive canal, mechanical and chemical irritation (but these come under the head of bacteria in the broader sense of the term). Pfaundler goes so far as to consider every non-physiological irritation of the cells as a possible exciting cause. But up to the present, at least, there are no proofs on which to base this theory.

Such irritation may, perhaps, amongst sensitive children, cause temporary reaction, which of itself is sufficient to facilitate the entry of the bacteria and even promote it and thus forms a favouring medium, but this irritation is certainly not sufficient to produce typical and classical scrofulosis with all its characteristics; which leaves plenty of scope to subjective opinion in fixing its limits; for this presupposes microbes which, when they have forced an entrance, become active agents through their multiplication, and are capable of maintaining the process (obstinacy, recurrence).

We find a confirmation of our opinion in the proof given by pus organisms, which, as a rule, easily enter the scrofulous foci. Also observation of the diseases of the lymphatic glands, when there is apparently no disease of the tributary area, or a temporary advance beyond it, does not contradict this opinion, as a very satisfactory explanation may be found (see pp. 63, 64, 67 and 81).

We have, therefore, to distinguish the following forms of scrofulosis:—

(1) The tuberculous form due to the tubercle bacillus.

(2) A non-tuberculous form caused by other bacteria. According to our present knowledge they are mostly the staphylococcus (aureus and albus) or the streptococcus. To simplify the matter, I should like to propose the term "pyogenous form," but we must always remember that it does not always go so far as the formation of pus, but the process is often arrested in the first stage of inflammatory swelling, and the pus, which is to a

certain extent properly a final product, engenders the bacteria which cause it. This term may be used in the same sense as when we class caseating pneumonia as tuberculous, although there are often no typical tuberculous formations. To these we may add:—

(3) A combination of both processes, the tuberculous and the pyogenous, the mixed form of scrofulosis, the effects of which differ according as the tubercle bacillus or other germs come into play first or simultaneously.

How frequently the tubercle bacillus and other bacilli are concerned in scrofulous modifications, in the glands for instance, is shown by the researches of v. Brunn, who could prove that in thirty-nine cases of tuberculous neck glands there were streptococci in twenty-eight of them.

Therefore scrofulosis is a pyogenous or mixed tuberculous infection arising from a special diathesis (predisposition)—*vide* next chapter.

VIRULENCE OF BACTERIA GENERALLY.

Having acknowledged that bacteria, as outward factors, play a considerable part in the genesis of scrofulosis, we must recognize the necessity of knowing more of their pathogenic qualities and virulence.

VIRULENCE OF PUS BACTERIA.

It has long been known that the virulence of bacteria fluctuates within very wide limits; from the trifling almost saprophytic activity and medium virulence, which is most widely disseminated to the highly virulent forms which induce a speedy breaking down of the tissues. This is corroborated by the extremely slow course of the maladies which, even in the pyogenous form of scrofulosis (apart from the different power of resistance of the organism), frequently does not go so far as the formation of abscess, but spontaneous retrogression occurs; from time to time, however, a more or less speedy suppuration in the tissues is induced.

One considerable difficulty in the investigation of the scrofulous processes lies in the fact that the test of virulence of the staphylococci in the animals experimented on does not always lead to reliable results, as we know from experience that man is more susceptible to these bacteria than animals, therefore no certain conclusions can be drawn. The most suitable animal for such experiments is the rabbit, and the best method is the intravenous injection of bouillon cultures, so as to combine the action

of the toxins already formed with the action of the living bacteria. A rather virulent strain of a bouillon culture of one day's growth in an intravenous injection will kill a medium-sized rabbit in from four to eight days; many animals have great powers of resistance; many are even refractory. The eye of the rabbit exhibits a high degree of sensitiveness; a tiny scratch with a needle which has been infected with staphylococci produces opacity of the cornea (Leber). Subcutaneous, and, better still, intramuscular, injections lead to positive results with rabbits, whilst cutaneous injections fail entirely.

The virulence appears to increase with its passage through the animals. The ferment and poison production do not run parallel with the widely varying limits of the virulence, the formation of the poison can entirely disappear without any appreciable diminution of the virulence (see Neisser and Lipstein, "Handb. f. Path. Mikr.," third edition, p. 124).

For the influence of injury to the primary tissues, see below.

To draw conclusions for man from the pathogenicity of animals is also unreliable in the case of streptococci. A test of virulence is made with fresh bouillon cultures (alkaline meat bouillon with 1 per cent. peptone Witte), but without the addition of grape sugar, because this increases the growth; but it has an adverse effect on the virulence (see Lingelsheim).

Naturally, only fresh cultures can be employed because their virulence decreases rapidly; it is best retained in a mixture of serum bouillon and in gelatine puncture. It increases in its passage through animals. Rabbits injected cutaneously near the root of the ear, and mice injected in the skin at the root of the tail, are specially adapted for these experiments, whilst guinea-pigs are unsuitable. Should doubt still exist as to the virulence, peritoneal injections are employed, when it will be found that still virulent cultures will lead to death in eight days in the case of mice with a dose of 0·5 to 1·0 c.c., and in the case of rabbits a dose of from 5·9 to 10·9 c.c. (see Lingelsheim).

VIRULENCE OF TUBERCLE BACILLI.

(a) Attenuated Virus.

After we have been able to prove in a number of scrofulous foci that tubercle bacilli have been the cause, we must be struck with the generally slow course of such diseases in the skin, the glands, and the joints, in contrast to the relatively speedy destruction of tuberculous processes in other places, especially pulmonary tuberculosis in persons of the same age.

This was endeavoured to be explained by the supposition that among scrofulous persons there was a weakened virus. But no exact proof has been forthcoming. Arloing indeed stated that when he inoculated scrofulous glands into rabbits he could only obtain local foci at the place where he had injected, but no tuberculosis, whilst inoculated guinea-pigs suffered from general tuberculosis. On the other hand, Koch and others successfully inoculated rabbits with matter from scrofulous glands and lupus, and do not mention such failures. Eve also succeeded in producing general tuberculosis three times out of five by inoculating rabbits with scrofulous glands.

I have also repeatedly inoculated guinea-pigs with lupus matter or lymph glands dependent on lupus, and transferred the resulting tubercles into other guinea-pigs in the most widely different organs, without being able to distinguish the least difference in these results and those obtained from sputum.

As I have already remarked in my first edition, I can state from my own experience that animals inoculated with scrofulous organs exhibit in general—but not always—a longer course of disease than those inoculated with sputum or cultures. But we must not necessarily seek the cause for this in the weakening of the bacilli, but it may rather be explained by the fact that the inoculated particles of tissue may have contained a trifling number of bacilli, for it is clear that the quantity of germs must have an influence on the sort of infection and its course, especially with bacilli of such slow growth as the tubercle bacillus. This relative dependence of the success of the inoculation on the quantity of bacilli has been much too highly rated by many, especially by Bollinger and his school, on the ground of so-called attenuation experiments which have been completely insufficient.

These attenuation experiments of Gebhardt, Bollinger's pupil, formerly so much quoted, were in no way capable of settling the question. For the result, that animals which had been inoculated with highly diluted milk (1 : 1,000) from tuberculous cows remained healthy, whilst the milk was pure or contained only 1 : 50 attenuated tubercles, is no proof that such diluted milk is innocuous, for milk from healthy udders (as in Gebhardt's case) will as a rule rarely contain bacilli, and if it does there will be but few, so the presence of living bacilli in the selected attenuation of 1 : 1,000 is questionable.

It is the same with Gebhardt's further experiments. Experiments on animals with attenuated sputum up to 1 : 100,000 infected subcutaneously, interperitoneally, or by inhalation had, without exception, no positive success. It was the same with

attenuated cultures of 1 :400,000; but because one single animal which had been inoculated with a culture of 1 :200,000 did not become tuberculous, must this be taken as a proof of the innocuousness of attenuated tubercle toxin and at the same time throw light on the question of the importance of individual disposition (*vide* below, experiments of Fraenkel and Baumann), whilst one leaves out of account the manifest possibility that bacilli which adhere closely cannot so readily disperse, and in the one case of attenuation of 1 :200,000 there was perhaps not one living specimen present? Further, the freshness and virulence of the culture seems questionable, so that Gebhardt himself had doubts of its virulence; besides, the time in which the animals were under observation (four weeks) was too short. Thus, at any rate, the conclusions drawn by Gebhardt and Bollinger that virulent milk from tuberculous cows loses its virulent properties by a certain attenuation is completely unwarranted, if only based on the ground of these experiments, and is serious in its practical consequences, because the tuberculous mixed milk described by Bollinger as being to a certain degree innocuous might possibly spread the danger of belief among many persons.[1]

It may be incidentally remarked that the expression "dilution of milk," which we so often hear, is very unfortunately chosen; for only soluble or fluid matters, such as poison, can be diluted, but a bacillus is not a soluble body. We can just as little talk of a bacillus in dilution as we might talk of a crocodile in a certain dilution (as if it were in a large river) being innocuous!

Just as inexact is the computation of Bollinger and others made on the basis of Gebhardt's experiments, and which we hear so often quoted, that 820 tubercle bacilli are sufficient to produce infection, especially with the interpretation which is mostly implied that about that number are necessary to cause infection; for, in spite of the difficulty of dispersal of such adhesive bacteria, such calculations are completely worthless when we do not know whether among those 820 one, or 100, or 800 are living or dead. The same may be said of the experiments of Wyssokowitsch. Preyss already discovered that in inhalation experiments 40 tubercle bacilli were more than sufficient to cause infection. Finde even found 20 ample (how many were living he was not able to ascertain), and Reichenbach found 3 × 3 enough. C. Fraenkel and Baumann could cause disease in guinea-pigs with a massive culture of 1 :100,000 millions, and rightly supposed

[1] Thus, for example, Liebe refers to Gebhardt's experiments, which show that milk even with a dilution of 1 in 50 loses its power of infection.

that with many bacillus cultures the transplanting of one single germ (naturally a living one) sufficed, which confirms my statement made in my first issue, and which agrees with the opinion of Oehlecker.

But if we have no lowest limit under which tubercle bacilli are incapable of producing infection, still there is no doubt that the number of bacilli influences the type and the course of the infection, as is proved by numerous experiments, many of which have been made by myself.

If from the first a large number of bacilli enter into the tissues they will be dispersed over a large area through the lymph channels, and will immediately form numerous foci. Their propagation is therefore more abundant, and the effect which with one bacillus it would have taken months to attain is in this case obtained in weeks. Thus it is that inoculation of animals with scrofulo-tuberculous matter from glands, bones, or lupus of the skin containing few bacilli has a much more tardy course than an inoculation with sputum, cultures, or pieces of tuberculous lungs containing many bacilli. Besides which, in the case of these inoculated particles of tissue, which are poor in bacilli, the bacilli are often covered or encapsuled, as one might say, by layers containing no germs. I will only mention lupus, in which Koch found no tubercle bacilli till after the 43rd section. The bacilli can only come into action when this dead layer is absorbed; it is on this account that the process is retarded. On dead soil these particles fail to grow unless they are well rubbed in. If before inoculation such particles are carefully reduced in size, rubbed to powder and flushed with some fluid, the bacilli which have been set free develop a much more virulent character, and cause, as I have been able to prove, much more speedy and intensive tuberculosis in the same time than if the piece had been inoculated whole. This difference in the nature and preparation of the material for inoculation may have contributed largely to the divergent results obtained by different investigators.

It has, therefore, been required lately that when making tests for virulence only such particles of tissue shall be employed as have been made uniform by culture (see p. 33). Recently a means has been found of simplifying these experiments in inoculation and of placing them on a surer basis by the antiformin method (see p. 247).

Further, in the material for inoculation from such chronic processes as scrofulosis and tuberculosis which, intra corpus, do not appear to have nearly that length of life which the imagination of many authors has assigned to them, a considerable part have

died off, and at the same time as the few living bacilli are inoculated there will be the *débris* of decaying bacteria—toxins—which will be inoculated in the same place. This causes great irritation of the tissues. We have in them one of Nature's principal remedies, and reaction at once takes place, a sort of healing process, or encysting, which hinders more or less the dispersal and multiplication of the bacilli inoculated at the same time.

The slower progress of tuberculosis which Baumgarten, Gosselin, and Wesener obtained by inoculating tubercle bacilli, which had been attenuated by iodoform or other chemicals or putrefaction, may be explained in the same way. It is clear that the greater part of these must have been dead or decayed, and so have anticipated the conditions of nature healing. We leave the question of how far the processes of immunity can be imitated by them out of the question.

For all these reasons scrofulous materials when inoculated into other bodies may, now and again, show a slower and less active effect than that which has been obtained by acute or even virulent processes. So, although the statement has been so often made that there is reduced virulence in the bacilli from scrofulous foci, no proof has ever been forthcoming that is entirely conclusive; and even the work of Vagades, who was the first to make tests to discover the difference in the virulence of tubercle bacilli, did not completely succeed in removing the doubts entertained about it.

(b) Bacilli of Human and Bovine Tuberculosis.

The question of the virulence of the tubercle bacilli in scrofulosis has appeared in quite a new light since Koch (1901) demonstrated that the exciting causative agent in human tuberculosis and of bovine in cattle is not identical, which had been the accepted theory up till then, but that they represent different types, if not different species, which act in a different manner on men than on animals, both in their biological and in their pathological behaviour. This gives us a clearer understanding of the etiology of scrofulosis and throws light on many a dark question; but it seems strange to us that this point has been so little insisted on in the recent literature on scrofulosis.

In Villemin's time (1865) human and bovine tuberculosis were considered different, and were only identified after the great sensation caused by the discovery of the tubercle bacillus and the authoritative explanation of Koch in 1882. The merit of again drawing attention to certain differences in the morphology, the cultural and animal pathology of tubercle bacilli of human

or bovine origin, is due to Theobald Smith. It was he who set the ball rolling; but who knows what would have been the fate of the communication if Koch had not been induced to test the circumstances more closely?

The remarkable circumstance, that for twenty years after the discovery of the tubercle bacillus, the human and bovine types were considered identical and were acknowledged, or rather, rediscovered so late, in spite of the discoveries of Villemin, Langhans, Orth, von Baumgarten, which point to it, may be explained by the almost exclusive use of the guinea-pig as animal for experiment on tuberculosis, not only because these animals are cheapest and easy to obtain, but also because they react most exactly and most speedily on both types of tuberculosis.

Rabbits were less often employed, excepting for intraocular experiments, on account of their susceptibility to other infectious diseases, which often had a disturbing effect on the experiments. Its lower susceptibility to human tuberculosis had been long remarked, and I remember the time when I was assistant at Goebersdorf (1885) making many fruitless experiments with Petri to infect rabbits with sputum, which finally made us doubt both our skill and the accuracy of the information imparted by others, and to support the incipient scepticism of Brehmer with regard to tubercle bacilli.

The striking statements of many authors who relied on experiments on rabbits, which statements contradicted my practical experience, can now be satisfactorily explained. I will only mention the numerous therapeutic successes claimed by French investigators, who were deceived because they inoculated rabbits with human tuberculosis, to which they are almost insusceptible, whilst my after tests (see *Zeitschr. f. Hyg.*, vol. vii) on guinea-pigs, which are decidedly tuberculous animals, were one and all without result. A revisal of the experiments in this direction is advisable.

One great mistake was that they only took into account (as did Koch), when endeavouring to explain the individual disposition of animals, the inconstant results obtained by inoculating rabbits with bacteria of different origin, which are always one-sided on account of the endogenous factor, instead of studying more closely the exogenous factor which certain schools, more especially in recent times, seek, again so one-sidedly, to press into the background, *vestigia terrent.*

It is not the place here to discuss this much-contested question more closely. Reference must be made to the voluminous literature on the subject, especially to the works of Kossel, Weber

and Heuss, Taute, Titze, Oehlecker, as laying the foundation, and to the reports of the English Commission for Investigating Human and Animal Tuberculosis, to the debates of the Congress on Tuberculosis at Washington, 1908, and the works of Fibiger and Jensen, Lydia Rabinowitsch, Beitzke, Eber, Burckhardt, &c., &c. The statements of Koch, as conclusive after tests, have been confirmed, that is to say, with some modifications.

The results, which are of the highest importance, especially for the etiology of scrofulosis, may be thus summed up :—

Tubercle bacilli obtained from tuberculous human or bovine structures cause immense tumours, from the size of the fist to that of a child's head, when subcutaneously injected into cattle; these tumours appear either at the place of inoculation or the nearest prescapular gland and the neck glands, and lead almost without exception to progressive, and at last to general tuberculosis, with fatal ending. In apparent exceptions, as in the case of Kossel, where the process was confined to the prescapular gland, an intravenous injection revealed the same complete and high pathogenicity as in other cases.

The tubercle bacilli obtained from tuberculosis in human beings are divided into two groups: the one, which comprises the great majority, when subcutaneously injected into cattle, causes no progressive tuberculosis; the animals continue to live, unless they succumb to some intercurrent malady.

Considerable swellings, the size of the palm of the hand, appear at the place of injection, which often suppurate and break through the skin; further lumps the size of a walnut, a hen's or a goose's egg are formed at the nearest prescapular gland, sometimes beyond it, at the middle and lower neck glands; in the course of time these reduce in size, or even disappear completely.

If the animal be slaughtered after four to six months, either there are no modifications to be discovered, or, which is most frequently the case, swelling filled with caseous or creamy pus at the place of injection is noticed; but in many cases a partial or even considerable swelling is discovered in the nearest prescapular gland containing caseous or chalky masses; and cysts of connective tissue are formed as a protection against the environment (see p. 117). The longer the animal lives the smaller are these processes, and the less often are they found. We are dealing here with processes which remain localized on the place of injection or deposit, and with the glands which lie nearest; and where caseation sets in a spontaneous retrogression takes place after a longer or shorter period, or they become covered with chalk or lime. In a smaller group, the tubercle bacilli obtained from man

coincide exactly with the bovine bacilli and cause general progressive tuberculosis in cattle.

The counter test, the inoculation of bovine bacilli in man, is illustrated by some experiments. Baumgarten informs us that considerable quantities of bovine bacilli had been subcutaneously injected into more than half a dozen persons suffering from malignant tumours, and there was no resulting malady in consequence, with the exception of small abscesses. Spengler and Klemperer inoculated bovine bacilli into their own bodies unsuccessfully. Small as is the number of these experiments, they go to prove that, as a rule, bovine bacilli possess no perceptible virulence, at least for adults. The different pathological behaviour of human and bovine bacilli corresponds clearly to morphological and cultural differences, which are emphasized on certain cultural media (serum) and on others are lost.

The bovine bacilli are shorter, thicker, and more elongated, many are wedge-shaped and thickened out to a knob at the end, and more highly coloured. Human bacilli, on the contrary, are slimmer, somewhat curved, the ends of the same thickness, and are uniformly coloured; the former are more difficult to cultivate, of slower growth, and have a tender covering, which later becomes nodular, whilst the latter develop in culture an eminently thick covering and swollen folds. These differences in pathogenic and biological behaviour undergo no rapid change, but are stationary characteristics, which remain in the bacteria in later generations, whether they are further propagated in culture or in animals. It is clear, then, that we have to do with two different types: that which is as a rule found in cattle, the bovine type (bovine tubercle bacillus), which for cattle is highly pathogenic, but, judging from its rare occurrence amongst men, is of less virulence or avirulent for them; and that which principally occurs in man, the human type (human tubercle bacillus), which is highly virulent for man, but for cattle is less pathogenic or non-pathogenic and causes no general and progressive tuberculosis.

The method of their differentiation is fully discussed in the chapter on Diagnosis (p. 266).

On account of the importance of the bovine type in the genesis and course of scrofulosis we must examine the question of the results of experiments above mentioned a little more closely.

It may be presumed that the results brought forward are established facts; where they are contested it is with reference partly to unimportant matters, or when they are supported by single observations which are subject to the chance accidents,

or by experiments which do not conform to the demands of exact experiments which Koch so precisely defined at the Washington Congress (see p. 267), and therefore cannot claim to be of value.

Thus it has been much disputed whether the two groups represent one species or not. Arloing, von Behring, Fibiger and Jensen, de Jong, Goggia, Maragliano and his school defend the unitary idea by designating the morphological, cultural, and pathogenic characters as inconstant and insufficient for the separation into different species.

The question whether there are two species is only scientifically interesting; in practice it is quite secondary. We best avoid deciding it by using the term introduced by Koch and saying two types, which binds to no distinctive characters.

Differences in Virulence.—Some few authors do not dispute distinct differences in type in the sense that bovine bacilli represent higher virulence, but this is contradicted by the simple fact that the species of bacilli which are highly virulent in cattle are non-virulent in man (von Baumgarten, Klemperer, Spengler), or exhibit only a trifling amount of virulence, with the exception of a few cases where the issue has been fatal (see p. 39), and yet when re-inoculated in cattle develop their former complete virulence.

Koch, Kossel, Oehlecker, Burckhardt, &c., think that a division into two types is justified, basing their theory on the results of exact experiments. Others state, on the contrary, that the cultural qualities peculiar to both types are not always clearly perceptible and do not always coincide with the conclusive pathogenic characteristics. Thus Lydia Rabinowitsch introduces a third form, the atypical species, as an intermediate form between the human and the bovine type, which answers to what the English Commission termed the intermediate group. Beitzke, Theobald Smith, &c., think we cannot manage without such an intermediate form.

As to **cultural differences,** these only appear clearly, as Weber, Oehlecker and Koch have repeatedly and emphatically insisted on, in the above-mentioned culture (see p. 268), and only then when they are freshly taken from man and animals.

Even differences which are hardly perceptible in the preparation of the culture medium as well as changes in temperature modify the cultural characters. Differentiation will also be caused by the choice of the material subject to experiment, whether we take the quite fresh, thin, peripheral portion of the culture film or the more central thicker part. This fact has been

emphasized by Fibiger and Jensen. It is possible to produce from the same strain cultures of completely different appearance. If several influences combine which are unfavourable to differentiation, the characteristic marks tend to disappear. The preliminary conditions of culture to obtain an exact differentiation are very delicate, and it may be readily understood that if they are not sufficiently observed it may lead to the appearance of atypical forms.

These researches, made with the object of masking and effacing these cultural differences in artificial culture media and to prove the relationship of the two types (a thesis which no one has doubted), in no way comply with these conditions. It is just as if we endeavoured to study the racial differences between a white man and a negro in pitch darkness. Our task should rather be to seek to make these differences more discernible than to do the contrary.

If we chose for comparison from a series of parallel cultures the finest grown, as we naturally should, we should succeed without difficulty in introducing intermediate forms between the two types. The special character of these apparently atypical forms is also questionable from the fact that these deviations from type, caused by unknown influences, mostly disappear on further culture (Burckhardt).

Experiments in animals, too, will only lead to a clear comprehension of these differences under certain sharply defined and subtle hypotheses. For example, if we subject an animal which is only slightly susceptible to an intravenous injection with human bacilli a pathological appearance will ensue which will differ but slightly from virulent bovine infection.

Now an exactly uniform arrangement of the experiment leads to a comparison against which there can be no objection, for besides the influence of the type, unintentional accessory circumstances often exercise an influence, such as the quantity and the freshness of the culture, the fineness of the trituration, also the age and weight of the animal, the manner of inoculation, the unintentional piercing of a small vein; added to this, stocks of the same type exhibit certain variations as to the amount of poisons contained and their activity; also animals vary much in their susceptibility, especially rabbits. If one of these agents which are favourable or unfavourable to infection be present during the experiment, there would naturally be deviations from the average true pathological effect, even when the same type is employed, which may lead even skilled investigators to false conclusions unless repeated experiments correct the error.

The introduction of idiopathic tuberculous infection, and mistaking tuberculous changes for the symptoms of intercurrent maladies—as mistaking coccidian processes in rabbits for the septicæmic processes (see p. 273)—frequently give rise to faulty results, the more easily the fewer the experiments.

It cannot be too often insisted on that experiments on animals can only be considered as decisive after numerous repetitions and after accidental circumstances which might affect them have been carefully eliminated; for the decision of important questions only such experiments can be taken into account as are made in the mass, and in which, from their number and a certain continuity in the work, even in small and comparatively unimportant details, a continuity in the material and sufficient personal experience guarantee correctness. Therefore when such a series of investigators as Koch, Kossel, Weber, &c., assert a constancy of type in form, culture, and pathogenicity, based on a long series of experiments, and confirmed by Jatta and Cosco, Nathan Raw, much more weight attaches to the assertion, especially when they are partly able to discover the sources of errors by mutual observation.

Thus it is not free from objection to take bouillon containing organisms in which the quantity of bacilli cannot be ascertained and with which organic substances may be introduced, which induces conditions quite distinct from natural infection, instead of taking a quantity of culture which has been accurately selected for its exact pathogenic reaction. Thus bouillon containing organisms is not suitable for ascertaining the variation of the types, but is more likely to conceal them.

Just as little is it admissible to inundate the body with bacilli by a simultaneous subcutaneous and intraperitoneal injection. So Eber's experiments with bouillon containing organisms and his double injections with the opposition based on them to a division of types are rightly rejected. Equally right is Weber when he criticizes Schottelin's experiments, where he omitted the preliminary tuberculin tests in the case of cattle, remarking that even in tuberculin tests, and not taking into account animals which react, we may count on 9 per cent. of faiiures in cattle.

Again, in other experiments the accounts are frequently incomplete, and so the possibility of being entirely trustworthy is lost, or else the experiments on cattle, which is a necessary complement in doubtful cases, is wanting, as with Rabinowitsch's experiments. Apparently non-typical cases, on a repetition of the experiment and on further inoculation, exhibit a completely typical behaviour, as the cases of Kossel and Burckhardt prove.

Mixed infection of human and bovine bacilli, which have often been studied, may at times give rise to sources of error by causing apparently non-typical forms (Oehlecker, Weber). If both types are combined in the original material, both will thrive in guinea-pigs, whereas in culture the bovine type will be suppressed by the human, but when further transplanted in a suitable species of animal—rabbit or cow—the bovine bacilli may, although there was no trace of them in the culture, gain the ascendancy over their non-virulent competitors. We know from the experiments of C. Fraenkel and Baumann that infective material, even in the proportion of 1 : 100,000 millions, is capable of producing disease. Stocks of the same type may show among themselves only slight fluctuations in growth and virulence which, especially under certain conditions, brings them apparently nearer to the other type; evidences based on a series of exact experiments and free from all objections which would make the introduction of an intermediate type needful are at present lacking.

Change of Type.—Many authors, especially those who oppose the separation of the types, think that both types represent only one variety adapted to the species of animal (Dammann and Muessemeier, &c.), that they may be cultivated one on the other, and that it is also possible that the changes can take place in the human body. The relative frequency of bovine tuberculosis amongst children and its rarity among adults was even endeavoured to be explained by this transformation of bovine into human bacilli. This question is also of the greatest importance on account of the possibility of bovine scrofulous infection resulting in pulmonary tuberculosis.

According to the accounts of von Behring, de Jong, Dammann and Muessemeier, the virulence of the human type may be increased by passing through the goat. I prefer not to enter more closely into these accounts and will refer to the criticisms on them by Kossel, Weber and Burckhardt. I will only remark that in the experiments of von Behring, Roemer and Ruppel, besides three negative successes, in one case an increase of virulence was apparently obtained, but according to the condition of things the cause of the delusion may have been the introduction of bovine bacilli (Kossel).

In the experiments of Dammann and Muessemeier, who observed an increase of virulence after passing three times through rabbits, and in another experiment five times through goats, the bovine bacillus appears to have been the unbidden agent in producing spontaneous infection, as the sudden increase of virulence seems to intimate, besides which infection was partly

induced by organic material, which experiments, according to the above analysis, are not conclusive.

The English Commission on Tuberculosis is also alleged to have succeeded in obtaining increased virulence in the human type in three cases of passage through the body of the cow, but only when tuberculous organs were inoculated, whilst experiments with cultures were unsuccessful.

De Jong believed he had enhanced the virulence of the human type over that of the bovine by passage through the goat, but no clear proof is adduced, because the animal was used at the same time for testing different kinds of tuberculin (see also Kossel). Eber believed that he had succeeded in bringing about a sort of change; he, too, used bouillon besides subcutaneous and intraperitoneal inoculation, a method which has been criticized above (see Kossel, Weber and Burckhardt).

In the case of Fibiger and Jensen it is just as difficult to draw a definite conclusion as to the change of type. A dealer in hides suffered for five to six years from skin tuberculosis in the arm from bovine bacilli. He fell ill with pulmonary tuberculosis; on *post-mortem* examination the human type was bred from the lungs. But who would call this a metamorphosis or even think it proved anything? To the unprejudiced observer what is clearer than to take for granted that in this case we have to do with one of the many thousand infections of the lungs, quite independent of tuberculosis of the skin?

As we have above mentioned (p. 34), in these experiments spontaneous and mixed infections give rise to misconstructions. As Burckhardt has rightly remarked, in the cases which have up till now come before us, either the increase of virulence is so trifling that it may be placed in the catalogue of accidental variations, or it is so great and sudden that spontaneous bovine infection may be concluded.

The communication of Lydia Rabinowitsch that she has isolated tuberculous stocks which were similar in character to the human type from milk is also interesting. Also the observations of Dammann and Lydia Rabinowitsch, according to which, in the case of a slaughterer who had wounded his hand when sorting refuse meat, tuberculosis of the bones and in the region of the glands developed from the wound, which culture proved to be non-typical; naturally this is not a proof of variation.

The experiments of Weber, Kossel and Heuss, according to which human stocks after repeated passage through goats retain the type, refute the theory of variation in passage through

animals. Weber's further experiments gave only negative results. Thus:—

A human stock after passing	5	times	through	goats	during	284	days
"	"	"	"	8	"	"	"	"	516	"
"	"	"	"	4	"	"	cattle	"	586	"

showed no perceptible change either in virulence or growth; the same was observed in a human stock after remaining about 300 days in the body of a pig.

According to Weber, Titze and Jorn, human bacilli in the bodies of cattle were in three cases unchanged after a period of two years and one month, and two years and six months, respectively. Similar experiments by Gratias had also negative results.

Further, clinical and bacterial observations refute the theory of variation. Hoelzinger mentions the case of a young man aged 24 with primary abdominal tuberculosis ending fatally, the origin of which went back to childhood. On examination there was found, besides general tuberculous peritonitis, tubercular nodules caused by bovine bacilli, which, therefore, had not changed in countless generations nor adapted themselves to their human host.

Oehlecker cultivated tubercle bacilli with all the characters of the bovine type from the tuberculous metacarpal bones of the hand in a boy aged 8, the genesis of which, according to the history, must have dated back six and three-quarter years. Burckhardt obtained bovine bacilli from the tuberculous knee-joint of a girl, aged 19, which had been apparently of thirteen years duration. Koch informs us that he has repeatedly cultivated bovine bacilli from old, healed, partly calcined, glands of slaughterers after many years. Hess also mentions two such cases. Zwick did not succeed in changing tubercle bacilli of the avian type.

The fact that up till now the bovine type is found in man, almost exclusively in places connected with the organs of digestion, points to direct infection by tuberculous food and contradicts the theory of change of type.

Taken altogether, the facts before us have not even proved the possibility of a change of type, to say nothing of proving them in a manner that is free from all objections; and even if this possibility were proved by complex experiments in the laboratory which are not found in nature, it is quite irrelevant to the practical side of the question, to the spread of human tuberculosis, to the transition of bovine scrofulosis into pul-

monary tuberculosis. For, as Koch pertinently remarks, "men do not first take the trouble to make experiments on animals or to prepare cultures, but enjoy them in their fresh and unchanged condition." See also p. 105.

SIGNIFICANCE OF BOVINE INFECTION.

THE OCCURRENCE OF THE BOVINE TYPE IN MAN.

In consequence of the difficulties connected with the exact proof of the two types (see chapter on Diagnosis, p. 266) we have a relatively small number of experiments at our disposal—at present hardly a hundred discoveries of the bovine type in man—which naturally cannot give us even an approximate picture of the relative frequency of the two types in man.

In the 150 cases examined by Kossel, Weber, Heuss, Titze, Tante and Oehlecker, for the purpose of the discovery of the human (H.T.) and the bovine (B.T.) type, tuberculosis is thus distributed:—

	Cases H.T.	Cases B.T.
54* adults had in	53	—
Of these—		
22 pulmonary tuberculosis	22	—
6 primary intestinal and mesenteric tuberculosis	6	—
2 tuberculosis of the neck glands	2	—
11 tuberculosis of the bones and joints	11	—
And—		
86 children	63	12
Of these—		
20 primary and mesenteric tuberculosis	7	13
16 neck glands operated	10	6
27 bone and joint tuberculosis operated	26	1
1 lupus	1	—
Further—		
1 case of double infection (bovine and human type) amongst adults.		
2 cases ,, ,, ,, ,, ,, children.		

* On the other hand thirteen cattle had exclusively bovine type.

In the last two cases the bovine type was found in the mesenteric glands and once in the spleen; in the second case the human bacilli were found in the meninges.

Taking the 20 cases of primary mesenteric and intestinal tuberculosis in children, of the 13 cases due to bovine tuberculosis 4 were fatal (no fewer than one-third). Of the 7 cases

of human tuberculosis 3 were fatal; the rest were secondary discoveries.

The third report of the English Commission includes 108 cases of human tuberculosis, which are distributed thus :—

Cases.	Times H.T.	Times B.T.	Times mixed H.T. & B.T.
14 of pulmonary tuberculosis	14	—	—
28 of tuberculous sputum	26	2	—
3 of miliary tuberculosis	3	—	—
3 of tuberculous meningitis	3	—	—
5 of tuberculosis of the bronchial glands ...	3	—	2
9 of tuberculosis of the cervical glands ...	6	3	—
29 of primary abdominal tuberculosis	13	14	2
14 of tuberculosis of bones and joints ...	13	—	1
3 of urogenital tuberculosis	3	—	—
108	84	19	5

Burckhardt had 5 cases of bovine tuberculosis amongst 49 cases (10 per cent.) of surgical tuberculosis which were not specially selected, and included tuberculosis of bones, joints and neck glands. Retzke found human tuberculosis twenty-two times and once an atypical form in 25 cases of children who had died of tuberculosis. Amongst children Spronk found that 20 per cent. were suffering from bovine tuberculosis.

Smith, Ravenal, de Schweinitz, Dorset and Schroeder, Fibiger and Jensen, Westenhoefer, Eber, Fife and Ravenal, Rabinowitsch, Duval, Mohler, Parodi, Karliski, &c., have communicated other cases.

General conclusions cannot be drawn from these cases, because these researches were made for the special purpose of watching the bovine bacilli. But we may conclude with certainty from them that bovine infection occurs only rarely in adults and principally in childhood, and apparently the younger the child the oftener it is found.

In the cases of Kossel, Weber and Heuss, Oehlecker and Burckhardt, amongst 57 cases above the age of 15 no case of bovine affection was found, whilst among 71 cases of children under 15 years 13 such cases were noted.

Counting the primary abdominal cases of Weber, of the English Commission and 14 cases quoted by Weber of 56 children suffering from bovine tuberculosis, 20 occurred before the 6th year, 2 between the 6th and 10th years, 4 between the 10th and 15th years.

The bovine type occurs also in infancy, as a case of Fibiger and Jensen shows, but apparently only exceptionally.

BOVINE TYPE IN ADULTS.

That bovine infection very rarely occurs in the internal organs of adults may be accepted as an established fact. If we except the cases in which the mixed types have appeared, Dammann and Müssemeier have found the bovine type in the case of a young man aged 25 suffering from peritonitis, which ran a favourable course, and Hoelzinger in a fatal case of primary abdominal tuberculosis in a young man aged 24, but in both cases it is questionable whether the infection, as such, did not go back to the time of their youth. L. Rabinowitsch has cultivated bacilli from the calcined mesenteric gland of a woman, aged 30, who died of another disease. Weber's researches prove the possibility of infection in later years; according to him, a woman who had drunk raw milk for two years from a tuberculous cow developed a tuberculous ulceration of the mucous membrane of the cheek which was of bovine character.

Hoelzinger's case proves that bovine infection can lead to fatal results even in adults, whilst that of Fibiger and Jensen is not conclusive (see p. 35), for it is obvious that pulmonary tuberculosis is independent of the bovine infection; the older cases of L. Pfeiffer, Ravenal and Hartzell are not free from objection in this respect.

Older observation of skin tuberculosis after injury or after handling bovine tuberculous matter point to bovine infection of the skin in adults, as in the cases of Tscherning, Jadassohn, Braquehaye, Johne, Jong, Mueller, Leloir, Grothan, Troje, &c. (see G. Cornet, "Die Tuberculose," second edition, pp. 74-75).

The bovine bacillus was proved in such cases by von Spronk and Hofnagel by its virulence in calves, in tuberculosis of the skin, and glands caused by a wound when dissecting a tuberculous cow, and again by Kleine by cultures in the case of five slaughterers suffering from tuberculosis verrucosa cutis (see chapter on Infection, p. 76).

Here the disease was confined to the place of inoculation and the nearest gland. Niché's case must also be mentioned—the infection of a dairyman through an injury caused by abscesses in the armpit of the bovine type.

BOVINE TYPE IN PULMONARY TUBERCULOSIS.

The fact that the bovine type is hardly ever found in tuberculosis of the lungs is of the greatest importance. Arloing professes to have found it several times in a cavity. Eber mentions bovine bacilli which he proved by inoculation to exist in the lung substance; but this experiment of Eber cannot be

taken into consideration on the above-mentioned grounds (see p. 33). A second case in which he inoculated the brain tubercle of a person suffering from phthisis naturally proves nothing as to the lungs (Weber).

De Jong and Stuurmann cultivated the bovine type from the sputum of a country girl, aged 27, who was constantly occupied with tuberculous cattle. Mohler and Washburn together describe a similar case, and the English Commission on Tuberculosis cultivated the bovine bacilli from the bronchial glands of a cow which had been fed with tuberculous sputum. In these cases, however, it is not impossible that the bovine bacillus was introduced into the sputum by means of butter or milk beforehand, and in the latter case independent spontaneous infection may also be suspected. Beitzke's discovery of bovine bacilli in the caseous bronchial gland of a phthisical child is of more importance, but it is not fully proved that the tuberculosis of the lung was induced by the bovine type or whether it was only an accompaniment of the human type. In the one case of Mietzsch the sputum of a person suffering from phthisis was highly virulent in a rabbit, but a calf remained free from tuberculosis; again a proof of how necessary experiments on cattle are in arbitrary or questionable cases.

The discovery of the bovine type in miliary tuberculosis of the lungs and general tuberculosis of the bronchial glands proves nothing as to the part it plays in the etiology of progressive pulmonary tuberculosis. C. Spengler's statement that the bovine type is symbiotic with the human bacillus in most cases of phthisis has not been confirmed either by the after-tests of G. Schroeder or from any other quarter. Mueller found human bacilli in the sputum of 51 persons suffering from phthisis; so, according to his account, 632 cases of human bacilli cultivated from sputum are known.

At present completely reliable cases of the genesis of tuberculosis of the lungs caused by the bovine type are not known, therefore the bovine type (and with it infection through milk) plays only a secondary part in human tuberculosis, as it is only phthisis which lends to tuberculosis its dangerous social and economical character and causes eleven-twelfths of the deaths.

It is interesting in this instance to remember the calculations of Speck against von Behring, according to which of 8,010 persons suffering from phthisis, 73 per cent. were infants nourished by mother's milk and not cow's milk; according to Sabotta's account, more than 176 persons, 18·4 per cent. of children at the breast, 35·1 per cent. of those which had mixed food, and 41 per cent.

of those artificially nourished, were tuberculous; a contradiction which may be put down to Sabotta's too small number of cases.

BOVINE TYPE IN MESENTERIC AND CERVICAL TUBERCULOSIS.

It may be clearly gathered from the material before us that bovine bacilli are present almost without exception in youth, especially in childhood, that the bovine infection attacks as a rule in the first place the digestive canal and the organs connected with it, especially the mesenteric and neck glands. It is clear from this that the bovine bacilli enter the body by swallowing; thus the source of the infection is clearly indicated, namely, milk and milk products derived from tuberculous cows, which, especially in the case of young children, are the chief articles of diet.

On the other hand, scrofulosis is almost entirely a child's disease; tuberculous mesenteric and neck glands are its chief pathological symptoms, therefore there can be no question of the frequently close relationship between bovine infection and scrofulosis; the supposition, which has often been expressed, that scrofulous infection is for the most part to be put down to the consumption of tuberculous milk, is thus completely confirmed.

Among the small number of examinations hitherto made there were in Weber's 20 cases of primary mesenteric and intestinal tuberculosis amongst children, 13 caused by the bovine type; in the 29 cases of abdominal tuberculosis in childhood, of the English Commission, 14 were bovine; so in 49 cases, 27 (*i.e.*, more than the half) were caused by the bovine bacillus, besides which, in 4 cases—a relatively large number—there was mixed infection (bovine and human) present.

Further, Oehlecker found that in 28 neck glands which had been operatively removed, 14 belonged to pyogenous scrofulosis and 14 were tuberculous; of this number 12 were amongst children, and of these 12·4 (*i.e.*, one-third) were tuberculous cases in which the tubercle bacillus was the creating agent of the disease. These 4 cases occurred between the ages of $1\frac{1}{2}$ and 5 years. Altogether amongst 16 cases of tuberculosis of the neck glands, operated by Weber and his colleagues, 6 were of bovine type, 10 were of human type, and 2 (in adults) were of human type.

Amongst the 9 cases of tuberculosis of the cervical glands examined by the English Commission 3 were of bovine character; in 9 cases communicated by Goodale with tuberculosis of the tonsils, neck glands and adenoid growths between the ages of 2 and 6 years, the operative matter of which was examined by

Smith, in 4 cases the bovine bacillus was cultivated; of Burckhardt's 9 cases of tuberculosis of the neck glands, only one exhibited the bovine type, 8 the human type. These remarkably small results in comparison with those of other authors may be explained by the greater age of the cases, for in Burckhardt's 9 cases, 7 were already over 15 to 28 years, and the only case which was under 10 years was the bovine case in a child of 5 years.

Naturally these figures do not give us a proper impression of the importance of bovine infection in mesenteric tuberculosis of the glands, for hitherto the examinations have been made principally on specially chosen cases. Most of the cases dealt with have been fatal and advanced processes of abdominal tuberculosis, and seldom accidental discoveries in the case of death from other causes, so that a great number of cases of pure tuberculosis of the mesenteric glands, abdominal scrofulosis, which seldom cause death, swellings with small caseating foci, which anatomists themselves pass over without remarking, or even do not see because they heal spontaneously, await closer investigation. It is hardly doubtful that it is just amongst these that the bovine bacillus will be most frequently discovered to be the cause.

Also the tubercles of the neck glands which have hitherto been examined have been mostly derived from severe cases which burst spontaneously and challenged operation; the larger field of chronic tuberculous swelling of the neck glands extending over a long period without any considerable changes, and which disappear at last clinically, have been almost entirely passed over. One may take for granted that these two are probably caused in the first place by the bovine bacillus.

The examination of **tuberculosis of the bones and joints** in children, which we are accustomed to consider as scrofulous, had results which were remarkable in many ways.

In 25 cases of tuberculosis of the bones and joints in children under 15, Oehlecker only once found the bovine type and twenty-four times the human type.

In 19 cases of bone and joint tuberculosis in children, Burckhardt found the bovine type only twice and the human type seventeen times.

The ages of the three bovine cases were 8, 11 and 14 years, respectively.

In 11 persons over 15 Oehlecker found the human type only twice; in 10 cases, Burckhardt found one of bovine type in a person aged 19; with this exception all were of human type.

The English Commission noted 14 cases of tuberculosis of

bones and joints; in one case there was mixed infection, *i.e.*, tubercle bacillus and pyogenic organisms, the other 13 were of human type.

We must take this opportunity of recalling the fact that Krompecher and Zimmermann considered it a mistake to attribute the chronic and more favourable form of tuberculosis of the bone and joint to the lesser virulence of the bacillus; but Gruner, on the other hand, found spontaneous reaction in tuberculosis of the bone similar to that found in scrofulosis, therefore higher than that of tuberculosis.

The English Commission gives observations on 20 cases of lupus; in 8 cases the tubercle bacilli cultivated from it had the cultural signs of bovine tuberculosis, but in the case of calves and rabbits they proved themselves in part less virulent. Besides these, isolated cases of Weber, Burckhardt (one case of 17 years) were of human type.

Rosenberg, who observed that primary nasal and pharyngeal **lupus** was often found amongst women and girls in the country, raises the question whether the bovine type does not come into play here.

The importance of bovine infection for tuberculosis in man is therefore in general very inconsiderable; on the contrary, in tuberculosis of children, especially in tuberculosis of the mesenteric and neck glands, it plays an important part. Amongst the cases mostly regarded as scrofulous, according to observations hitherto made, it is the cause of more than a third of all the most severe cases, in an examination of the lighter ones the proportion in favour of bovine infection would be considerably increased. There is no basis for Abramowski's distinction, according to which torpid scrofulosis is of bovine, but irritant scrofulosis of human nature.

A complete separation, such as Caw and Raw tried, by stating that tuberculosis caused by inhalation was of human origin—that intestinal tuberculosis, tuberculous peritonitis, tuberculosis of the bone and joints, lupus, miliary tuberculosis, urogenital tuberculosis, and tuberculosis of the middle-ear, were caused by the bovine type—is contrary to the fact that in intestinal, and especially bone tuberculosis, human bacilli are frequently found. By the demonstration that bovine bacilli are frequently the cause of scrofulous tuberculosis, the knowledge of this disease has been much advanced, and many striking symptoms are explained by it.

Thus it is a well-known fact that scrofulosis appears, as a rule, towards the end of the first and second years. Bovine

infection appears almost without exception after the first year; primary tuberculosis of the mesenteric glands with the bovine characteristics is rare in infancy. Fibiger and Jensen have described two such cases (11, 12) in which the consumption of milk from a partly tuberculous cow was proved.

As Edens and others have remarked, the reason of this lies clearly in the fact that in infancy, even amongst the poorer classes, the milk is generally boiled, whilst in later years, besides frequently consuming milk in the raw state, butter and other milk products increase the opportunities for infection. Contradictions which have hitherto been found in treatises on scrofulosis and tuberculosis now find a satisfactory explanation.

The relation of scrofulosis to tuberculosis, including consumption, has been described in many ways in the course of time. For centuries it was a clinical axiom that scrofulosis predisposed to tuberculosis. Former clinical experience had taught that most of those who suffered from scrofulosis died later of tuberculosis of the lungs, and found in this fact support for the etiological identity of the two diseases.

According to a recent statement, which is as yet unproved, those who are predisposed to scrofulosis possess a certain amount of protection against tuberculosis on account of their violent reaction to unaccustomed irritation, which, according to Moro, is an act of self-preservation, and the mild course of scrofulous tuberculosis is owing to this. But they forget in this instance that morbid over reaction has not the same effect as the reaction of healthy tissue, just as little as the flabby granulations of the weak, in the healing of a wound, have not the same effect as robust granulation.

In strict antithesis to this, Czerny states that just by combating this exudative agent he has changed such weaklings "into blooming children with tuberculosis." One sees how easy it is for clinical experience to be influenced by preconceived subjective opinions, which give rise to false conclusions unless based on temperate figures.

When speaking of the tuberculosis of childhood, *κατ' ἔξοχήν* (human infection), its great danger is universally emphasized. In the period of infancy it is considered to be, almost without exception, fatal; but also in later years it has a decided tendency to spread and attack other organs, as the experience of all pathologists and physicians for children's diseases concur in proving.

On the contrary, in all treatises on scrofulosis, which is even attempted to be merged into tuberculosis, it is especially noted how favourable is the course it takes in the largest number of cases,

that no one dies of scrofulosis, also other remarks which hardly agree with the above sad pictures.

Escherich calls the pure scrofulosis caused by tuberculo-toxic changes in the integuments the most harmless of infantile tuberculosis, which even offers a sort of protection against later tuberculous infection; and also scrofulous tuberculosis occurring with manifest foci appears to Escherich to take a more favourable course than the tuberculous form which is tuberculous from the beginning.

The numerical occurrence of tuberculosis of the neck and mesenteric glands points to the fact that other sources of infection besides the usual ones collaborate at least in a considerable degree; besides which, the mild course of the infections, just at an age when tuberculosis proves itself so harmful, shows that these other sources of infection are different in their characteristics from the usual tuberculous virus.

There can be no question about referring all tuberculo-scrofulous affections, especially affections of the glands, to bovine infection. But if a part of scrofulosis depends (as I take it, it does) on pyogenic infection, and so has nothing to do with tuberculosis (as in Oehlecker's eighteen cases it had not); if, as it seems, a further considerable portion of the remaining scrofulo-tuberculous cases were not caused by true human bacilli but by the bovine type (as bacteriological differential diagnosis has already proved to be the case), then it is plain that the gloomy colours in which we are wont to paint the tuberculosis of childhood are here considerably brightened, for the bovine type is without exception less pathological for the child than human bacilli.

It is true the bovine infection can cause in many cases, and especially in very young children (exceptionally in adults), progressive tuberculosis or general miliary tuberculosis, a tuberculosis which cannot be distinguished by its proportions and changes from virulent infection of the human type in persons of the same age.

It is much more frequent for the bovine infection to act at the point of entry or in the nearest gland, as is the case with the human bacilli when inoculated in the calf, and to give rise to foci which remain localized. After some months, and perhaps dragging on for many years, swellings of various sizes ensue with caseation and suppuration often complicated by mixed infection, but showing unmistakable tendency to heal, and healing eventually. The bovine type, especially when introduced in small quantities, appears to be much more mild and almost, if not entirely, non-virulent.

We must not judge of the course from the material we have hitherto obtained; for those cases which were chosen for examination were, as has been stated above, mostly fatal, and but seldom accidental discoveries. All those numerous small neck and mesenteric glands showing little changes, but which may here and there cause clinical symptoms which retrograde and are for the most part attributed to the bovine type, have been little examined. In spite of the immense amount of work already done we are only at the beginning of these researches, and must, therefore, take care not to draw too far-reaching conclusions from the small amount of material at present to hand.

A further contradiction of the experience hitherto obtained is explained by the recognition of bovine infection as one of the causes of scrofulosis.

I have before drawn attention to the fact ("Tuberculose," second edition, p. 401) that among clinically tuberculous children the source of infection may and must be found as a rule in their nearest surroundings, in parents, sisters ("pseudo heredity"), or in servants; for the important part played by infection from comrades later cannot then have come into force.

Among scrofulous children this source of infection is, as a rule, absent. As has been remarked, such children are born in many cases of non-tuberculous parents. Heredity (pseudo-heredity) here plays a very minor part, naturally, for the infection arises in many cases from bovine bacilli in butter and milk.

Amongst children reacting to the cutaneous test—the cutaneous reaction being of special importance when dealing with the class of tubercle bacilli—Hillenburg found tuberculosis in the family in 15 per cent., so that in 85 per cent. the source of infection for the reaction probably lay elsewhere. Rightly interpreted, does not this speak volumes? especially when one finds further that in 120 families whose children reacted positively, in twenty-two families the relations showed no reaction. Mendelsohn also found in twenty-five cases of primary intestinal tuberculosis that in eighteen there was no tuberculosis in the family.

In recent researches this difference is thrown into bolder relief. Weber calls special attention to the fact that amongst children with human tuberculosis the opportunity for human infection could, as a rule, be established. Out of nine cases, in eight either the parents or the relations were tuberculous, but in thirteen bovine cases twelve of the parents and relations were free from tuberculosis; one case was undecided. It was the same in the other cases reported by nine other authors.

It is, naturally, only the history of children who have little

intercourse with the outside world which can give us a sure indication of the etiological differentiation of type. On account of the relative frequency of double infection, human type and bovine type, I do not attach too much importance to it.

B.—THE ENDOGENOUS FACTOR—PREDISPOSITION TO SCROFULOSIS.

GENERAL DIATHESIS.

Historical.

The genesis of this peculiar complexus of diseases is not sufficiently accounted for only by the intrusion bacilli. For no age is entirely free from contact with tubercle bacilli and pus cocci, as is proved by the frequency of pure tuberculous and suppurative processes at all ages. Scrofulosis, on the contrary, appears almost without exception in the years of growth, and almost never later, even when the individual is exposed to the same outward conditions.

It is clear, then, that the preliminary condition must lie in man himself, and in a condition of the whole body or certain parts of it peculiar to youth, which in later years disappears of itself.

The nature of this peculiar condition of body which induces a predisposition to scrofulosis has been at different times variously explained according to the notions of physical science which governed the spirit of the age.

In the first place the whole body was included in the predisposition to scrofulosis, an opinion which finds certain support in the dispersal of scrofulosis over the most various organs.

In the time of humoral pathology one would naturally seek the causes in the humours themselves by supposing an acrid substance to be circulating with them. This "acrimonia," or "dyscrasia acris," is, according to Hufeland, a specifically changed or corrupted lymph, the causticity of which attacks the skin, mucous membrane and bones. The exogenous factor of the disease was at that time only slightly hinted at.

We owe decided progress to Virchow, who, in accordance with his belief in the importance of the cell, considered the pathological constitution which leads to scrofulosis to be a weakness of certain parts or regions, such as a certain incompleteness in the structure of the glands, generally connected with an incompleteness in other tissues (skin, mucous membrane, &c.). The

growing glands of children which are still incomplete offer, according to him, many points of attack. On this account scrofulosis is especially a disease of childhood.

Virchow described the condition as inflammatory diathesis, which accords with the diathesis inflammatoria already advanced by Thomas White (1788).

Sylvius had already supposed a peculiar constitution of the lymphatic system.

Later the conception of the term lymphatic diathesis, "lymphatism," came into favour, especially amongst the French, to denote the tendency to scrofulosis, and at the same time its supposed character of increased (hereditary) tendency to swelling and change of the lymphatic tissues.

Influenced probably by the external appearances, which show hyperplasia as the most constant and most reliable symptom of scrofulosis, they saw in lymphatism the primary and inflammatory diathesis induced by the disturbed functions of the lymph, and an increased inclination to the exudative processes of the skin and mucous membrane as a consequence of it.

Others took the clinical observation more into account that, as a rule, skin and mucous affections prevail with younger children, and changes in the glands amongst older ones, and they came to the conclusion that the former were primary processes and that the latter were to be considered as secondary processes dependent on infection, which, etiologically, is the more exact conception.

Later both expressions came to be equally employed, and the mistake crept in of speaking directly of dyscrasia as a blood infection instead of diathesis and disposition in the same sense, whilst only a predisposition was intended to be expressed.

The expression used by Hiss, Pfaundler, &c., "increased readiness for disease," to denote diathesis or disposition, seems to me to be well chosen, and its adoption might tend to allay disputes which have raged in the last decades over the tuberculous disposition, and to cool the animus heated by them; for it would always bring to those fanatics of the theory of disposition—who were inclined to divide mankind into two classes, the disposed and the non-disposed, in which favoured class of non-disposed all precautions were unnecessary, and for the disposed were useless—the knowledge that we are all predisposed to tuberculosis. The difference is a gradual one, and consists only in the more or less increased readiness of many individuals, the existence of which readiness is not denied by anyone (see Schlueter's excellent treatise).

Billroth and Birch-Hirschfeld are of the same opinion as Virchow. The latter described scrofulosis as a constitutional anomaly, meaning that the tissues are excited on very small provocation to changes of partly inflammatory, partly hyperplastic nature, and that they have faint powers of adjustment, so that retrogressive metamorphoses easily take place, and, in connection with these, local tuberculosis.

Baginsky thinks it is not proved, though it may be possible, that the predisposition is constitutional, *i.e.*, anatomical, in the sense of Beneke's hyperplasia, in which the reduced relative size of the single organs and the reduced power of work consequent upon this of the whole organism plays a great part. He looks upon scrofulosis as a peculiar condition of the body to which certain micro-organisms, chiefly the tubercle bacillus, give the possibility of the power of adhering and of speedy progressive development. I cannot give my support to this theory, because the predisposition to scrofulosis is already described as scrofulosis.

Henoch has deviated from the concise and local point of view of Virchow. He leaves it undecided whether the cause of the disease is an anomaly of the blood or of the elements of the tissues, or whether it may be sought in both together.

Ponfick (1900) looks upon scrofulosis as an inclination to more vigorous exudative and proliferative reaction which has no limit as to age and is qualitatively variable, and which may be traced to an innate defect in the morphological and chemical composition of the child's organism. He produces no proofs to support his theory.

Scrofulous diathesis has been sought in the cell, in the humours of the body, everywhere. It appears best when stating a hypothesis to include all possible agents, for then later, whichever proves right, one can always say, " I said the same before."

Lately, the theory of diathesis has again come prominently into view. Old wine has been put into new bottles; what was formerly termed inflammatory diathesis has now been named exudative diathesis by Czerny. This is more precise, but it is questionable if it be more exact.

Modern Hypotheses—Exudative Diathesis.

For a long time unsuitable and too plentiful nourishment has been connected with the genesis of scrofulosis, partly by attributing irritation of the mucous membrane of the intestine and secondary swellings of the mesenteric lymph glands to this cause. Deranged nutrition was spoken of amongst the Arabs, especially

Rhazeus, as the basis of scrofulosis (v. Preisich). At the same time bad or insufficient nourishment was not considered harmful, but they attached great weight to over-nutrition (probably led to it by the external view of the exudative process). Rabben said (1817): "*Si pauperrimos exceperis, hoc malum* (scrofulosis) *ex abundantia potius quam ex inopia alimentorum derivandum censeo,*" and Rau (1832): "With young children the cure often succeeds most easily by simple change of diet" (by which it is not said that the illness was caused in the first place by unsuitable nourishment).

It is generally agreed that the nourishment in the first year has a great influence on the genesis of scrofulosis.

According to some authors scrofulosis is attributed to the lack of albumin in the nourishment; according to others (Monti, &c.), the preponderance of carbohydrates was determinative. But the most frequent cause of scrofulosis is attributed to the premature introduction of amylaceous products with human milk in the infantile stage, stuffing the children with spoon-food from the first month; the pernicious influence of feeding children in the first year with bread, dry crusts, and farinaceous foods instead of milk; or later, the preponderance of bread, potatoes, vegetables and pulse forming an excess of vegetable food, encourages this (Monti).

Czerny has deduced that there is a special predisposition to scrofulosis which he terms exudative diathesis from improper nourishment and over-feeding. This exudative diathesis depends, according to Czerny (1909), on an innate and clinically latent defect in the composition of the body, that is, on chemical processes. This is mostly in consequence of exogenous mischief, and becomes manifest early, even in the first weeks or months, by abnormal results of nourishment either by loss of weight, in spite of plentiful milk, without this loss being explained by disturbances in the digestive tract, or else by a remarkable increase of adipose tissue, even when the food is poor in milk. Outwardly the exudative diathesis shows itself by a mapped tongue, by seborrhœa, milk-scurvy, strofulus, and the ready formation of sores, &c., &c.

Czerny sees the cause of this remarkable behaviour in faulty endogenous nutrition which he supposes to lie in a peculiar disturbance of the adipose changes, as children who can only digest milk-fat in very slight quantities always have the signs of exudative diathesis in which every sort of fattening is harmful. According to this, the essential, and, at the same time, the standard of the predisposition of infants to exudative diathesis is

an innately low condition of the inception of assimilation for the fat of animal-milk, and as many children do not thrive even at the breast, partly also of the mother's-milk. The axiom that has up till now been accepted that mother's-milk is the best food for infants needs to be accepted with some reservation.

The reduced absorption of fat in exudative diathesis has been confirmed by two of Czerny's colleagues, Steinitz and Weigert, in the case of two children, and has also been supported by the success of change of diet.

Food that is poor in fat, without milk and eggs, the fat being replaced by carbohydrates, or in the case of infants by small quantities of milk, frequently produces a series of the undermentioned phenomena of exudative diathesis, and even causes a return of the scrofulous habitus; whilst, on the other hand, they may be provoked in children with a tendency to it by diet containing fat and by feeding up (Czerny). On the other hand, a favourable influence on pallor of the skin, lichen urticatus, &c., is conferred; but milk-scurvy and eczema are less influenced and require local treatment.

According to Pfaundler, certain vasomoter, vasotonic, and neuropathic, as well as lymphatic symptoms, put down to exudative diathesis, have very little, if any effect.

The result of such food is most clearly perceived by a speedy and progressive reduction in weight.

Czerny's statement that by means of food containing little fat the scrofulosis disappears and scrofulous children are transformed into "fine children with tuberculosis" meets with well-founded scepticism; for, as Pfaundler rightly remarks, something more than just the deprivation of milk, eggs, and sugar are necessary for this. Supposing Czerny's theory were right, should we not expect in the last decades, when so much has been expected from nourishment with milk and eggs, butter and meat, and all fatty foods, that scrofulosis must have enormously increased? Yet this has not been observed or even stated. The opinion of P. Heims that the periodicity of our views is caused by periodical variations in the organisms of different generations will find few followers.

That defects of nourishment cannot be the only cause of the symptoms of exudative diathesis, of the scrofulous habitus, and of scrofulous symptoms, if only for the reason that from observations made in other quarters, all these symptoms, phlyctenæ, blepharitis, eczema, &c., may be traced to tuberculin treatment without change of food, and now and again with astonishing rapidity, and even the facies scrofulosa, give place to a natural appearance (Epstein, Ganghofer, Escherich).

The prejudicial effects of the reduction of absorption of fat in exudative diathesis is also disputed by others (Birks, L. and F. Meyer, Freund).

According to Aschenheim, the power of assimilation of carbohydrates is reduced (see also Nothmann, Huessy), and acetonuria and mellituria, and, according to Cobliner, glycosuria are frequently present (see Vogt, Simon).

Finkelstein and L. F. Meyer impute it to changes in the salts; several cases of eczema and asthma which were treated by Langstein by Finkelstein's method with food containing little salt (only the fifth part of the quantity of salt contained in one litre of whey) lost their eczema in a few weeks (p. 382).

If Czerny's demonstrations were binding in former cases they must be accepted here, then Czerny's theories would lose their exclusive significance.

W. Freund considers variations in the changes of mineral material with continued increase of excretion of ammonia through the urine as the consequence of an excessive supply of fat.

Here we must also mention the theory of A. Robin (demineralization), according to which tuberculous persons excrete more of the components of the urine than healthy persons, so that their organism becomes poor in certain constituents, and this poverty of mineral matter precedes the onset of this disease. This theory, too, lacks exact proof, and many other questions on this subject still await further study (Senator, Ott, Steinitz, and Weigert, also G. Cornet, "Die Tuberculose," second edition, pp. 513-514).

Besides improper nourishment and the injury caused by it to those predisposed, Czerny mentions as later causative agents of the exudative diathesis, intercurrent infections, teething, vaccination, measles, and tuberculin, in which he regards the assumption of a specific reaction of the tissues as arbitrary.

Czerny (1908) has assumed the close connection (not the causative agent) of exudative diathesis with neuropathic and psychopathic conditions, inasmuch as the parents and relations of children with exudative diathesis are always neuropathic or psychopathic, and children of highly nervous parents are seldom free from exudative diathesis, even if only in a small degree. The connection of exudative diathesis with the irritation of certain regions is shown by the fact that children who have been treated for eczema for months and years will sometimes lose it rapidly by going with the parents, or, better still, alone to a seaside home or health resort; or by change of air only; with play and occupation to divert them, these children not infrequently lose their

susceptibility to asthma by a thorough change in their conditions of life (food, education, &c.), by wearing woollen under-clothing, and by a diet containing eggs, while among such children strofulus may be arbitrarily evoked.

Pallor, without anæmia, the extraordinary secretion of perspiration after the least physical exertion, difficulty of breathing through the nose, and after exertion, as well as the intense irritation of the skin in many children with milk-scurvy and strofulus may be referred to nervous influences.

Czerny even attributes catarrh of the upper air passages, when it is not dependent on infection or cold, and therefore is not to be avoided by precautions directed against a psychic and neuropathic constitution.

The vasomotor over excitability and neuropathic constitution of children of an exudative diathesis, and the angioneuropathic nature of the symptoms which make it evident (such as inflammatory reaction, eczema, often in symmetrical arrangement, urticaria, mapped tongue, asthma, &c.) is brought into prominence by other authors, especially Moro.

Other Signs of Exudative Diathesis.

It is not unusual to find in the lymphatic children of exudative diathesis, even in the latent stage, more or less pronounced, hyper-eosinophilia, which is specially pronounced in the case of eczema.

But the data vary even amongst healthy children, whilst in adults the proportions of eosinophil cells to the leucocytes is with tolerable conformity about 2 to 4 per cent. and 0·5 to 4 per cent.; we often find among healthy children higher computations (Ehrlich, Lazarus, Karl, Meyer, Jacksch), even to 10 per cent.; among infants, 2·5 to 3·9 per cent.; Rosenstern found 2 to 3 per cent. of eosinophils among children at the breast, and 0·7 to 4 per cent. in those artificially fed.

Much higher rates were obtained in the examinations of Langstein (up to 33 per cent.), Helmholtz, Benjamin, and Rosenstern in exudative diathesis, and especially in eczema, over 10 per cent., even 20 per cent. and 30 per cent.

Stäubeli even speaks of eosinophile diathesis. Langstein leaves it uncertain whether this phasis is a symptom of exudative diathesis or the local skin affection of eczema; but Helmholtz found in two cases the number of the eosinophilia considerably reduced, and L. F. Meyer observed here and there a reduction of the eosinophilia with the healing of eczema, but mostly the

proportion remains stationary, so that he considered them as one of the earliest constant symptoms of asthma.

Ventura mentions hypertrophy of the liver as one of the symptoms he has found with tolerable frequency in the exudative diathesis.

It would lead us too far to go more closely into the relation of the exudative diathesis to the status lymphaticus of Paltauf-Escherich, with which are included a series of symptoms; or the subordination of both, the diathesis and the status lymphaticus, by Eppinger and Hess in the infantile form to the condition of tone in the vagus; or the connection with Comby's rheumatism in children, and similar questions which still need further discussion.

Reference must be made to the interesting anatomical studies of Bartel and Stein, according to which, in the status lymphaticus of Paltauf-Escherich, a disturbance takes place in the development of the lymphatic gland system, and in the connective tissue; whether such a disturbance can be taken into account for the exudative diathesis, whether it rests on congenital inferiority, irritability, and ready deterioration of the meso-chyme and its derivatives (Pfaundler) are suppositions, the proof of which covers a wide ground.

As an external sign of the exudative diathesis Czerny includes a mapped condition of tongue (not always a reliable sign), seborrhœa, milk-scurvy, prurigo or strofulus, intertrigo, soreness behind the auricle, in the folds of the neck and armpits, pronounced hairiness between the shoulder-blades, in the region of the elbows and on the thighs (Friedjung describes a similar condition as a sign of the tuberculous habitus). Freund also mentions stiff tufts of hair which Pfaundler describes elsewhere.

Further indications are eczema, impetigo, vesicular eruptions, caries of the teeth, diffuse bronchitis and bronchiolitis, sometimes combined with asthma; further, catarrh of the nose and pharynx—symptoms which are not characteristic of themselves, but become so by frequent repetition; further, an increase of the lymphoid tissues of the gums, tonsils, and pharynx—blepharitis, vulvitis, balanitis—paleness of the skin beginning in infancy without hæmatological indications of anæmia and not caused by improper nourishment or preceding illness; loss of appetite at times, sometimes fever lasting several days, and coated tongue, with or without disturbance of the general health, but without the stomach being affected.

In the case of the intestinal canal, Czerny at first only acknowledged the mapped tongue (1905), and later hyperplasia

of the intestinal follicles as signs of the exudative diathesis, but Langstein and Goeppert established slimy stools containing pus to be an external indication of the diathesis (see also Sehlbach).

Of the symptoms of exudative diathesis here brought forward some do not belong to scrofulosis in our sense, but they (such as milk-scurvy) are the acknowledged indications of disturbances in nutrition, and are sometimes the precursors of scrofulosis by favouring infectious processes.

In this connection Czerny (who purposely avoids the expression "scrofulous"), to avoid controversy over the identity of scrofulosis with tuberculosis, comprises in his conception of the diathesis phenomena, such as vesicular eruptions, dental caries, blepharitis, with which there can be no question of diathesis, and readiness for illness, but which rightly and by general consent belong to fully developed scrofulosis, and are consequently phenomena of diathesis plus the infectious processes which have been facilitated and maintained by it.

This is just as little justifiable as if we classed florid phthisis under our notion of the term tuberculous disposition.

The exudative lymphatic diathesis with its manifestations can only be taken into account as a preliminary stage of real scrofulosis, as a favourable field for the development of further morbid reaction, which itself is induced by external irritation, and almost without exception by bacteria; it is true many symptoms that stand on the boundary between diathesis and scrofulosis can be adduced, *e.g.*, eczema amongst skin phenomena, amongst affections of the mucous membrane, catarrh and hypertrophy of the tonsils, now and again perhaps induced by alimentary irritation, overfeeding, or errors of nutrition. In such cases bacteria play only a secondary part by keeping up the process, but it is a confirmed fact that for the real scrofulous phenomena, and especially for the pathognomonic indication of scrofulosis, the exceptional pathological processes must be made answerable, and such processes are induced by bacteria and their toxins (see also previous chapter).

When Pfaundler raises the question, whether exudative diathesis alone in concert with tuberculous infection is enough to induce the typical phenomena of scrofulosis—when he at the same time emphasizes the universal experience that there are plenty of children, especially amongst the better classes, who, in spite of exudative diathesis, in spite of superabundant nourishment and overfeeding, and in spite of tuberculous infection and active disease, relatively seldom exhibit the pronounced signs of scrofulosis—there is, in fact, an unintentional and unwilling

acknowledgment of the important part played by the badly treated pyogenous scrofulosis, the infection by dirt, which is naturally more rare with the better classes, whereby the "pronounced cases," when it is not a question of tuberculous glands, are avoided.

It will hardly be contested that much of the diathesis theory is completely unproved and lacks exact foundation, that much remains to be explained before the path from Czerny's "innate defect" to the complete phenomenon of classical scrofulosis can be considered free from doubt.

One thing that speaks in favour of this theory is the fact that preceding the development of scrofulosis there have been, almost without exception even in the infantile stage, certain indications of lymphatism, of mapped tongue, seborrhœa, and milk-scurvy conversely, that at the same time, especially in the first year and frequently later, no tuberculous infection existed, as is proved by the negative result of the tuberculin test, even with these children who are so highly sensitive to reaction.

Unfortunately, at present we possess no means similar to the tuberculin test to prove the presence or absence of pyogenous infection.[1]

We do not deny a certain exudative predisposition, a coincident increased readiness for disease—recognized by an increased tendency to react to irritation, especially bacterial irritation in children causing an obstinate and protracted reaction—but we must bear in mind that the facts which have up till now been obtained give us no insight into its nature; whether we have to do with a chemical defect, or if it be really a disturbance of metabolism of the fatty matters, which is the gist of Czerny's theory, for it is especially in this direction that an exact basis is lacking.

Thus, the older notion, still retained by the French, of a lymphatic constitution, lymphatism, has found new followers in Escherich, Moro, &c., but with the interpretation that it is a constitutional anomaly which distinguishes itself by a "great tendency of the organism to inflammatory reaction of obstinate and recurrent nature (with exudation of lymph) in which the lymphatic tissues take a decided primary and secondary part," a conception somewhat divergent from that of the older physicians—Hufeland, Bandeloque—who find in the lymphatic temperament of the lymphatic constitution the only conclusive

[1] When therefore Pfaundler thinks it is possible, by excluding such cases as react to tuberculin, to study the character of genuine diathesis without complicating infections, this is not to the point, as we cannot exclude pyogenous infection.

reason for scrofulosis, and define scrofulosis as the highest degree of the status lymphaticus.

Rightly understood, the combination of the expression lymphatism with the etiology of scrofulosis is debatable; even as a designation of the collective scrofulous tendency I consider it inappropriate, because by drawing attention to the lymphatic system only, it is only a part of the tendency, a part of the readiness that is denoted; while it is recognized, as Virchow has emphasized in his definition, that a certain abnormal preliminary state of the skin and the mucous membrane exists in a prominent degree, let the cause be what it may.

But even if we accept the supposition, which is completely unproved, that lymphatic symptoms are really caused by the scrofulosis, that they are its cardinal point and essence and not symptoms, where can the boundary line between lymphatism and scrofulosis be drawn?

The designation "exudative diathesis" would be more suitable, inasmuch as it includes the symptoms of the disease and yet does not bind us as to the etiology; it at least comprises the cycle of changes in the skin, mucous membranes and lymphatic glands, unless a strictly etiological term be preferred.

The adherents of lymphatism, Escherich, Moro, as well as Czerny in his exudative diathesis theory, go beyond the mark when they, without due grounds, designate a part of the scrofulous phenomena simply as lymphatism, the greater part of which the the faculty have for centuries termed typical scrofulosis. Escheric and Moro remove the whole boundary line; for them, lymphatism is no diathesis, no readiness for lymphatic processes, but the process itself; thus they exclude the greater part of what every one understands by scrofulosis, with the exception of those affections induced by tubercle bacilli. Scrofulosis is only lymphatism combined with tuberculosis; the lymphatic constitution is the ground in which an accidental tuberculous infection will develop scrofulosis.

Does Moro believe that all the cases of non-tuberculous scrofulosis (he uses this expression once) arise without bacteria, and if not, why does he not state it? To what serious consequences, or rather inconsequences, may this not lead us? Does not the clinical aversion to bacteria go too far, and is not a too important part ascribed to the exogenous factor?

Moro says it is frequently tuberculin reaction alone which enables us to discover the non-scrofulous cases in this class, for the external complex of symptoms which such children exhibit can, under certain circumstances, be so deceptively similar to those

which characterize scrofulosis, that at present no other means of distinction by clinical examination can be used. This is especially the case when children exhibit the dermatose habitus already described, in the form of chronic eczema on the face and ears, impetigo, or an eruption resembling lichen on the trunk, or when inflammation of the lymph glands, the eyelids, and the conjunctiva are present at the same time.

Moro terms children with, as he himself admits, all the decided external symptoms of scrofulosis (with scrofulous habitus) not scrofulous but lymphatic, for the single reason that they do not react positively to the tuberculin test; therefore, according to Moro, all the old classical cases of typical scrofulosis (one has only to read the history of his cases and their progress) (see above) are not scrofulous because no tubercle bacilli have come into contact with the organism is question; but these individuals (he describes two cases) belong to the scrofulous class from the moment when the reaction becomes positive. It is all the same even if the positive reaction (see my cases, pp. 18-21) is induced by some latent focus, a small, completely inactive and already healed bronchial gland, caused perhaps by bovine bacilli, the allergie of which perhaps remains, and so by an accident that has nothing whatever to do with the phenomena of scrofulosis. Yet the behaviour of such glands in scrofulous children (according to Moro, lymphatic children) follows the same statistical law of frequency as in normal children.

Is it not turning logic upside down to pull to pieces what clinical observation has taken centuries to build up, in response to what are, at least in many cases, irrelevant accidental circumstances?

Moro supports his opinion by two cases[1] affected with all the signs of scrofulosis which reacted positively after a previous negative reaction; but in such cases, of which there are doubtless thousands, the infection which has taken place in the meanwhile, if it had been caused by bovine bacilli, remains strictly localized in the primary focus, and after a while disappears without leaving a trace; but when virulent bacilli enter the lungs, phthisis or miliary tuberculosis may ensue, but whether the bacilli act upon the scrofulous phenomena already present and change them no one can say. In what way have the signs of scrofulosis which are now present—the eczema, the impetigo, and vesicular eruptions—changed, that one must now call them by another name?

[1] Moro says after discussing the two cases, "Such observations lead us to think that there must be some genetic connection between lymphatism and tuberculosis."

To my mind the acceptation of Moro's point of view would only bring more confusion into this already obscure question instead of making it more clear.

Soltmann brings forward a completely different opinion. He considers scrofulosis an hereditary, non-bacillary toxic tuberculosis; according to his view the normal placenta forms a filter for corpuscular elements, which it retains, and allows of no return when it is diseased, injured or eroded; but to matter in solution the intact placenta allows free passage. Soltmann thinks that in tuberculous persons the products of the changes of the tissues and the *débris* of bacilli which are in solution —the tuberculous toxins—pass over from the tuberculous mother in the fœtal stage, and by their chemotactic effects induce lasting toxic symptoms. According to which, that which one designates hereditary disposition to tuberculosis is hereditary diathesis, and the time of its appearance, and the way the consequences will manifest themselves, depends on how much material for defence there is at the time of birth.

Soltmann's idea has at first view something fascinatingly simple in it, for it is known that toxins can produce changes similar in many respects to scrofulosis. A plausible explanation was found for the sluggish course, different from that of the usual bacillary infections, for the appearance of tuberculides and a series of phenomena which present difficulties, also for the not rare fact of scrofulous children being descended from tuberculous parents and the fact of scrofulosis running in families. At the same time important considerations tell against it; in the first place, scrofulosis does not appear immediately after birth, but mostly at the end of the second half-year and in the second year, and also tuberculin reaction (a fact which is of great importance) appears very seldom in the first year when the toxin must be most operative, more frequently from the second year, when an elimination of the toxin may be expected; further, though truly scrofulous children often descend from tuberculous mothers, but very frequently from non-tuberculous also and judging from the total, relatively seldom from tuberculous mothers,[1] so that the *conditio sine quâ non* of Soltmann's representation of the matter does not agree with the generally accepted idea of the defensive action of the toxin against fresh infection on the one hand, and the not infrequent later appearance of tuberculosis of the lungs in the scrofulous on the other hand; also the frequent proof of bacilli in the scrofulous changes contradicts a pure toxic genesis;

[1] Mothers who are tuberculous at the time of the birth.

a series of reasons which forces us to reject the hypothesis of Soltmann.

A further hypothesis, based on the doctrine of Behring, may be mentioned. He looks upon scrofulosis as the clinical expression of the tuberculous diathesis induced by a special method of infection either by repeated hyperinfection or by a very long latent stage.

ENDOGENOUS FACTOR—LOCALIZED DIATHESIS.

For the present no conclusive proofs are to hand to cause us to accept diathesis affecting the whole body as a preparation for an attack of scrofulosis, but at the same time, as there is no proof to the contrary, I have no reason to deny it.

But, then, must the endogenous agent be dispersed over the whole organism? Is it not more reasonable to seek, like Virchow, this anomaly in the nearest organ affected, and so, in the first place, in the lymph glands?

The erroneous opinion that the receptivity for the disease and the constitutional anomalies must always be universal in their nature is a legacy from the humoural pathology, and is caused by the fact that diathesis and dyscrasia are mistaken for one another. I have already mentioned in my former treatises on tuberculosis that—in opposition to the general disposition to tuberculosis mostly accepted, for which till now there are no proofs—for the local disposition a series of positive bases are to hand. Martius has recently, in his large treatise, laid special stress on these strictly localized constitutional anomalies.

In scrofulosis the whole of the lymphatic system, and even the lymph glands of one region of the body, are not attacked at the same time but by degrees, and the process always occurs at the outer or inner surface of the body which lie nearest. This observation leads us to further consider whether, because the noxious material intrudes itself from the periphery, the state of predisposition to scrofulosis is not to be placed at the periphery of the body, at the origin of the lymphatics, which is also often much earlier attacked than the glands. As a fact, the lymph glands are nothing more than passive reservoirs for the tributary area and their behaviour and reaction is entirely dependent on that which is conducted to them by the vasa afferentia. It depends in the first place upon their anatomical position and their communication with the place of inoculation whether they take part sooner or later in the infection. Do we ascribe a special long pre-existing tendency to glands which become syphilitic

or cancerous, or do we not rather see in it a completely natural and necessary consequence of the immigrant toxin?

Therefore we can speak of an increased tendency of a certain group of glands to tuberculous poison, just as little as we can attribute to a lake a tendency to receive its tributary streams and the materials which they contain.

The first thing we have to settle is how far a different constitution of the skin, mucous membrane, and the lymph vessels leading to them, is capable of explaining the scrofulous tendency.

Anatomical Explanation of the Tendency of Scrofulosis.

Skin and mucous membrane form the protective covering of the inner organs through which bacteria must force themselves to enter the body. As we can judge by the size and quantity of the solid substances passed through a filter of its width or narrowness, of its openings and canals, and its permeability, so we can just as rightly draw conclusions as to how often or how seldom germs enter the body by the more or less permeability of the skin and mucous membrane.

Hueter (1872), at the time when the theory of bacteria lay in darkness, touched upon the incomplete and defective formation of the protecting epidermis and epithelial layers in different persons as a part of the scrofulous tendency—it is true only as a supposition and without experimental confirmation. He refers to the microscopic phenomenon that, besides the sweat and fat glands of the epidermis, and the mucous glands and the follicles of the mucous membrane, fine pore channels are visible between the epithelial and epidermal cells; the different sizes of these channels in different persons afford as a natural corollary a greater or less possibility of the intrusion of micro-organisms.

So the tendency to a repetition of inflammatory processes, which has been attributed to scrofulosis, the increased vulnerability and irritability, as well as the recrudescence, would be accounted for by an easier intrusion of bacilli. Just so we have the cause for the easier dispersal of the exciting agent, *i.e.*, the tendency of the inflammation which has arisen, to expand itself both as to space and time, the chronicity—which is also a sign of scrofulous individuals—in the extended channels of the lymphatic system and of the ducts of the blood circulation, if we may suppose the abnormal volume of these pores to indicate an equal expansion of the lymphatic system which is in connection with them. At present we have no reliable anatomical proofs

for the greater permeability of the skin and mucous membrane in many individuals being one of the real factors of the tendency to scrofulosis, but to deny it off-hand on account of this is just as unjustifiable, because the particulars on which the theory is based, the permeability of the skin and mucous membrane, the individual variations of this permeability according to age and sex are based partly on hundreds of experiments on animals, partly on well-known facts, anatomical examinations, clinical reports, and find acceptation with Virchow, Hueter, &c. In any case, it is better confirmed than the chemical defect of exudative diathesis, which has many times been willingly accepted without other chemical proofs being adduced than the authoritative assurances of its originator.

Monti accounts for scrofulosis as a faulty histological structure with defective metabolism. Virchow believes that tissues which are rich in lymph are more easily accessible to infection. Ponfick agrees with me that there is a pyogenous tuberculous mixed infection, and he attributes the easier deluging of the infantile tissue with bacterial germs to the more plentiful presence of lymph, the greater power of extension of the lymph glands and the greater power of rapid growth. Preisich mentions hyperplasia of the lymph glands as the foundation of scrofulosis, which readily leads to expansion of the lymph spaces and vessels, the consequence of which is Virchow's vulnerability; whilst I put infection (which is simply its introduction), instead of vulnerability. Moro and Czerny, on the contrary, exclude the interpretation of diathesis in the sense of a slighter infection, but unfortunately they withhold their reasons against it.

Is it not a fact that has long been confirmed, that constitutional disturbances of any sort on the surface are the forerunners of scrofulosis and favour infection, and to these disturbances seborrhœa, eczema and lichen urticatus belong?

Do not many clinical professors go too far when they put in the background everything connected with infection and show their partiality to the endogenous factor by placing it in the foreground?

(1) PERMEABILITY OF THE SKIN AND MUCOUS MEMBRANES.

The protection afforded to the internal organs by the skin and mucous membranes is not always absolute nor the same even under normal circumstances.

There are two things which we must keep apart: (1) The intrusion of organisms into the intact surface; (2) the permeability of the skin, that is the property of allowing bacteria to penetrate through the covering into the tissues lying beneath it.

The permeability has been much questioned, in cases of necessity it has been allowed that bacteria may insert themselves through small wounds in the epidermic and epithelial covering, also that under certain circumstances an invasion of bacteria may take place through the intact surface. But "for the genesis of scrofulous glands a previous lesion of the surface of the body" was a fundamental condition. Velpeau was the first to teach that every swelling of the lymphatic glands was the consequence of inflammation in the area of their source; and Baginsky and others said "there is no swelling of a gland with a primary scrofulous affection of that organ from which the lymph-stream flows to the affected part of the gland."

The penetrability of macroscopically uninjured mucous membrane was first proved by me after hundreds of experiments on animals (see G. Cornet, "Die Tuberculose," first edition, p. 58; second edition, pp. 131-139). I note this especially, as it is customary to refer to authors, who a decade later have confirmed my proofs by a few experiments (see also *Berliner klin. Wochenschrift,* 1904, p. 153, and discussion).

When I have placed tuberculous sputum or pure culture on the mucous membrane of the conjunctiva, the nose, in the vagina, or on the penis, as a rule infection of the animal followed, especially if the infectious material was rubbed in. Many times, after further observation, the mucous membrane itself remained intact till the death of the animal without any changes; the process of the disease first showed itself in the lymphatic gland nearest to the part of the mucous membrane affected, and thence spread over the body if the animal lived long enough.

In the same way I was able in inhalation experiments with fluid or dried sputum to prove tuberculous disease in the bronchial glands of animals without the lungs exhibiting any change whatever. Dobroklonsky has proved histologically the permeability of the intestinal mucous membrane (see G. Cornet, "Die Tuberculose," second edition, p. 236). In feeding experiments tuberculosis of the mesenteric gland was the consequence; the mucous membrane of the intestine remained intact.

Orth's experiments lead to the same results.

Tangl, influenced by v. Baumgarten, repeated my experiments, and admitted the possibility of the introduction of tubercle bacilli into the body without causing tuberculous changes at the place of entry, though he qualifies the admission by adding that, as a rule, it is not so.

Later a treatise was issued from Flügge's Institution in which the infection of the bronchial glands by inhalation, without tuberculosis of the lungs, was specially noted.

Under the influence of v. Behring's doctrine of ingestion tuberculosis, the permeability of the mucous membrane was re-tested by Uffenheimer, Bartel, Nebelthau, Ficker, Klemenko, H. Reichenbach and Bock, Courmont and Lesieur, Vansteenberghe and almost without exception confirmed. I lay the greater stress on this, as my statement of the permeability of the skin was questioned by Bollinger, Schmidt, v. Baumgarten, Flügge, &c.; even the macroscopically uninjured cutis appears mostly, though not always, to be absolutely impermeable. For in many experiments I have succeeded in obtaining tuberculosis of the neck glands by cutaneous rubbing of the head with tuberculous material, whilst the place where it was rubbed in showed no change, with the exception of a little scale on the nose.

For similar experiments with other bacteria by Roth see p. 76.

It is also proved that under certain circumstances by friction, and now and again by contact, bacteria can force themselves into the uninjured skin and mucous membrane, and even through it, and can get to the nearest gland without leaving any changes at the place of entry due to the tubercle bacilli. This permeability has been confirmed by observations in man, but the best proof would be on an actual case of scrofulosis; but I will not base my theories on it here, to avoid falling into that fault in logic, a proof "*ex petitis principiis.*" But I will mention the well-known observations of the penetration of far larger particles of carbon into the bronchial glands when the mucous membrane of the lungs is intact.

(2) VARIATION IN THE PERMEABILITY OF SKIN ACCORDING TO AGE.

The skin and mucous membrane is with different individuals not of the same nature anatomically, and in the same individual is macroscopically very different according to age. As the difference in the skin of a child from that of an adult is one of the bases of our theories on the nature of scrofulosis, which appears almost without exception in youth, we must devote more careful attention to it.

A.—ANATOMICAL DIFFERENCES.

(1) Skin.

In the child the skin is thin and tender, the blood-vessels are seen through it, and, on account of the peripheral growth of the tissues lying beneath it, it is in a state of continual tension. As the years go on it becomes thicker and coarser, and in old age

shrivelled and puckered on account of the disappearance of the fat. This difference becomes accentuated at the end of the period of growth, at the time when scrofulosis rarely develops for the first time.

Also histologically many differences, according to age and the part of the body, are known in the skin, especially since Tanzer's staining by orcein, recommended by Unna, has made the study of the elastic fibres more easy.

Blaschko's researches have confirmed the fact that the development of the epithelial structures increases with age, a condition which is attributable to formative stimulation dependent on outward conditions, such as working with the hands or pressure on the soles of the feet in walking.

Blaschko and others have proved that the epithelial cones represent transverse sections of layers which grow luxuriantly from the epidermis towards the cutis; a system of ridges laid crosswise and lengthwise which may be likened to a honeycomb with different sized cells, and he thinks it very probable that the network of the epithelial ridges is stretched in the same direction as the pull of the muscle, therefore is in a state of continual motion backwards and forwards. This circumstance may possibly not be without significance for the admission of substances into the skin.

According to Löwy, preparations of the skin of new-born infants exhibit a system of ridges mostly arranged according to the growth of the hair; after a few years a considerable change may be noticed. In the neighbourhood of the mouth, on the cheeks, the chin, and the forehead this network can no longer be perceived, and only slight indications of remains of the ridges exist as evidences of their former presence. In all the preparations from children a few months old well developed ridges are to be seen as a network almost completely closed.

In old age, on the contrary, a connected network is no longer found; with advancing age the papillæ disappear, and later the atrophy of age asserts itself. But, as Löwy remarks, there are great differences in individuals.

Without speculating upon the relation of these histological differences to the tendency to scrofulosis, I will here only mention the existence of such differences according to age and individuals.

As far as I know, no histological proofs have been adduced to show the relation of individual differences in the size of the stomata and the pores and the width of the lymphatic vessels to the predisposition to scrofulosis. But in this direction an extremely slight difference can play a very important part, especially

with regard to a predisposition to scrofulosis and facilitating infection. For example, the tubercle bacilli measure 0·0015 mm. in length, therefore a transverse section measures hardly 0·0003 mm., and a stoma or a lymph canal, which is 0·00001 mm. narrower or wider than another normal one, offers considerably either less or more favourable conditions for their entry and conveyance. But this difference (which is of the highest importance) escapes our eye, even when furnished with the latest optical resources, it being accustomed to entirely different conditions of measurement.

(2) Mucous Membranes.

The same differences according to age are to be noted in the mucous membranes. As extremes, I would refer to the mucous lining of the stomach of an infant and that of a drunkard, of the vaginal mucous membrane of a little girl, and that of an aged multipara and the infinite intermediate stages.

Ficker has proved experimentally the difference in the permeability of the mucous membrane in youth and age. With young sucking rabbits, after inhalation of *Bacillus prodigiosus*, germs were without exception proved to be in the blood. With full-grown rabbits they reached the periphery of the lungs, but did not enter the blood. Also after feeding, germs were found in the blood and the organs of the young rabbits, but only in a few of the older ones, and not in full-grown dogs and cats. Ficker makes a mistake when he thinks that it is only Weigert who has mentioned these differences according to age as being probable; it is, rather, I, who have stated them most emphatically in the first editions of my "Tuberculosis" and of my "Scrofulosis."

B.—CLINICAL PROOFS OF THE GREATER PERMEABILITY OF THE SKIN IN THE YOUNG.

In young children it is known that the particles of carbon inhaled are stored up, not in the mucous membrane of the lungs, but principally in the bronchial glands; but in later years more particles of carbon remain in the mucous membrane itself and in the passages to the glands and the interstitial tissues. It is clear that in adults the conducting lymph vessels are more or less choked up and closed, partly perhaps by the former deposits and the irritation caused by them.

There is no difference between the particles of carbon and bacteria. We take the tubercle bacillus as our principal example, not only on account of its particular relation to scrofulosis, but

also because of its minuteness, and because its conditions have been best investigated both clinically and experimentally.

In childhood the tubercle bacilli, when they penetrate by inhalation, enter into the deep recesses of the lungs in very minute quantities, but they enter completely into the glands, and these set up tuberculosis of the bronchial glands, also designated scrofulosis; the lung remains intact, or is only infected later by the rupture of the glands. On this account it is frequently localized in children in the middle lobe in contradistinction to tuberculosis of the apices of the lungs in adults. With adults, on the other hand, the germs are retained in the mucous membrane itself, and in the lymph canals; they induce there primary tuberculosis of the lungs and cause tuberculosis of the bronchial glands as a secondary consequence, sometimes even with fully developed tuberculosis of the lungs; in older persons the bronchial glands are attacked very slightly or not at all. Exceptions to this rule are rare. Nowack mentions the case of a woman aged 61 with primary tuberculosis of the bronchial glands.

The infection of other parts of the body follows the same rule. In youth, for example, we find tuberculous neck glands without meeting with other tubercular changes in the region that caused it, as far as the mucous membrane is concerned. The bacilli have all wandered through the mucous membrane. Usually it is only in small quantities (for the influence of quantity see below), and they only find a hindrance to their progress in the narrower filtering tissues of the glands. Local tuberculous affections of the mucous membrane—of the tongue, mouth, pharynx, and nose—affect, as a rule, older persons, or at least adults. With them the glands generally only become affected by advanced processes, that is, by the greater increase of the bacilli.

In the same way it is well known that in tuberculosis of the mesenteric glands in children, which we must attribute to infection of the intestinal mucous membrane, frequently the intestinal mucosa itself is not affected; in adults ulcers of the intestine preponderate. Tuberculosis of the lymph vessels is also more frequent with them than with children, but then the lymph glands belonging to them are relatively smaller and show secondary changes.

Thus everywhere we find it clinically confirmed that in childhood there is an easier passage of the tubercle bacilli through the mucous membranes to the glands. In later life, on the other hand, a more difficult passage through the mucous membranes and a retention of the bacilli in them.

The conditions in the skin are somewhat different, as may be

readily conceived from its anatomical constitution. The intact skin, in adults and children, is much less permeable than the mucous membrane, and that of adults and older persons is the least permeable. Clinical proofs: whilst the particles of carbon which have intruded themselves into the mucous membrane of the lungs partly arrive as far as the glands, we do not find deposits of carbon worth mentioning in the ulnar and axillary glands, even of persons who are handling coal all day.

If the skin of a child come into contact with tubercle bacilli, *e.g.*, with tubercular sputum, it offers, as a rule, sufficient protection when there is no disturbance of the continuity, but should there be slight epidermal injuries, or if a quantity of the material of injection comes into intimate contact with the skin, one or another bacillus can insinuate itself and cause lupus, which, according to experience, mostly happens in youth, and, we add at once, more in the female than the male sex, when it declares itself in later years. The beginning can mostly be traced back to youth.

The epidermis of adults, which is much less permeable, only very rarely allows of the intrusion of the tubercle bacilli, in an uninjured condition, even when large quantities are present, else all anatomists, nurses of tuberculous cases, and slaughterers would have their hands full of tubercles.

But should one small lesion exceptionally occur, as is often the case with persons whose occupation constantly brings them in contact with parts of corpses which are tuberculous (anatomists), no lupoid focus would be formed extending itself peripherally, but a *post-mortem* tubercle which generally remains strictly localized, and seldom includes the glands in the processes of the disease.

These are not to be compared with tuberculous processes which form in the mouth and rectum of phthisical persons when in constant contact with infectious material, and aided by the erosion produced by their chemical irritation.

Besides the lesser permeability of the skin in later years, its denser tissue hinders a dispersal of the germs in the vicinity. Where tuberculosis of the glands, and even death, follows in consequence of infection from a dead subject—cases such as we have mentioned in a former volume—it is connected mostly with some simultaneous defect and wound, some unusual favouring circumstances, mostly in young students or young doctors, or from some tuberculosis from inhalation which has arisen through a completely independent local affection.

The tuberculosis verrucosa cutis described by Riehl and

Paltauf, which can also be traced to the repeated handling of tuberculous animals or other materials, distinguishes itself by its local character. The glands are seldom affected, and still more seldom does it lead to generalization of the tuberculosis, because it generally appears in persons who have passed their childhood, and besides this, because the bovine bacillus is much less virulent.

Riehl's and Paltauf's fourteen cases were between the ages of 19 and 45 years; the cases of Heyse and others were of similar ages.

Extensive tuberculous ulceration would hardly ensue with older persons without a previous superficial wound.

The considerable differences which the skin of a child and of an adult exhibit with regard to their permeability to carbon particles or tubercle bacilli are the same also for other bacteria; it would lead us too far to analyse the clinical proofs for this.

This different behaviour of the skin and mucous membrane of a child and that of an adult is, apart from the consideration of immunity, possibly also one of the reasons why measles and scarlet fever, as well as some of the other infectious diseases, are more easily communicated to children than to adults, a belief which is deeply rooted among the lower classes.

It appears as if these differences obtain also in the lymph system as well as in the skin and mucous membrane, and specially in the lymph passages, in such a way that these are in childhood more easily penetrated and broader than in later years. Also the thoracic duct, the reservoir, is considered to be wider in proportion in childhood (Benda). On this point strictly anatomical proofs are wanting on account of the difficulty of such researches (see above), but it is generally accepted that the lymph-vessels in childhood are broader. Our adoption of this opinion is based on the fact that the nutrition of the tissues is specially abundant in the child on account of the continued growth during the years of development.

It was Hueter who claimed that this greater width had to do with the genesis of scrofulosis. He emphasized the difference between the dry connective tissue, poor in cells, of the adult, and the moist connective tissue, rich in cells, of the child, and attributed to childhood a more complete plasmatic circulation, a richer lymphatic system furnished with larger passages. The pasty, spongy appearance of scrofulous patients shows a repletion of the connective tissue with nutritive fluid, and "such a body is not unlike a sponge filled with nutritive fluid."

Aviraguet characterizes scrofulosis as an unusual expansion of the lymphatic system (glands and vessels) in which this greater

extension is normal in early years, and only becomes pathological when it is long continued or increases.

Most, to whom we are obliged for thorough researches respecting the lymphatic apparatus in children, says, "The lymph channels themselves are relatively wider and more branched in the child, also the glandular elements are more numerous and lie nearer together than in the adult."

A greater development of the lymph apparatus has also been shown experimentally by Ritter to depend upon the larger quantity of lymph in younger persons.

That wider channels and lymph passages facilitate the transport of the germs from the surface into the glands, and from there farther on still, is a matter of course.

One might object that the lymph channels which are large enough to give passage to the lymph corpuscles would never present difficulties to the smaller tubercle bacilli.

But it is not only the size which is decisive. The tubercle bacillus is specifically heavier than the lymph corpuscle, as the more speedy sinking of pus proves, a factor which is as important in the microcosmos as in the large world. All the bacilli are not absorbed by the lymph cells; they are long, and easily catch against the walls of the passages, like the trunk of a tree against the banks of a river, whilst the round, smooth lymph cells slip over them. The bacillus has a firm, unchangeable shape, whilst the active polymorphous protoplasm of the lymph cells winds itself through the narrow channels, adapting itself to their lumen. Small differences in the width of the lymph spaces are thus not without influence with regard to the path the bacilli take.

The different course of tuberculous disease in the same organ of a child or an adult is to be explained in the same way by the greater width of the lymph passages, and an easier power of conveyance in tuberculosis of the lungs in children, the marked tendency to speedy dispersal over the whole body till a general miliary tuberculosis is attained, whilst with older persons the lung process only spreads very slowly (for more on this subject see G. Cornet, "Die Tuberculose," second edition, vol. ii, p. 683). This tendency to a relatively more speedy course in the child is marked in chronic tuberculosis of the glands by the fact that whole groups of glands are attacked, the bones suffer at the same time, and even miliary tuberculosis is the final result.

In this direction children behave exactly in the same manner as the young animals used in our experiments, which also exhibit the same great effort to propagate the tuberculous process in the lymph passages.

Amongst other things, the circumstance that in advanced

phthisis we very often find foci in the tonsils, but in adults the glands belonging to them are seldom attacked in a manner worth mentioning, whilst in children this is regularly the case, proves the difficulty of the conveyance of the bacilli from the path of entry through the lymph channels in later life.

Also the quick swelling and reduction of the glands from other causes in childhood may be connected in causative relation with the breadth of the lymph channels and the force of the lymph-stream, and must not the irritation, which universally accompanies it, be put down to this cause?

In youth we meet with swellings of the lymphatic glands of the neck and with caries of the teeth in an extraordinary number of cases; in later life these rarely occur.

In other tissues this same difference according to age is established. Körner emphasizes the tendency to inflammation of the dental periosteum, in caries of the teeth, and more especially in the milk teeth, because these have "a very wide pulp cavity and a relatively thin coating of dentine, so carious processes very soon affect the pulp sympathetically," and after destroying it the dental periosteum is, as a rule, attacked by the inflammation.

But, it may be rejoined, all these differences lie in the predisposition, and the power of reaction of the glands; but the single reference to the homogeneous and passive deposit of the carbon particles suffices to invalidate this objection.

We find a satisfactory explanation of the predominance of scrofulosis in youth (and its appearance almost without exception in youth) in diathesis or readiness for illness, in the skin, the mucous membrane, and the lymph system, dependent on anatomical circumstances, that is to say, on a further enhancing of the normal increased permeability in childhood, of the skin, mucous membrane, and lymph passages, a condition which may be designated as enhanced infantilism, or, better still, "embryonalism."

(3) DIFFERENT PERMEABILITY OF SKIN ACCORDING TO SEX.

The difference of the frequency of scrofulosis in the male and female sex is obvious. We have noted before (see p. 3) that the female sex is attacked more frequently; girls bring a far larger contingent than boys, especially to the ranks of external diseases. Among the 116 cases of Lebert combined with skin diseases 44 were males and 72 females; in Rabl's cases of scrofulous diseases of the eyes the number of girls was double that of the boys, and the relative percentage was 23 girls to 15 boys (3 : 2). Satller and Guttman state that the frequency of scrofulosis of

the eyes is doubly as great in the female as in the male sex. Scrofulous catarrh of the mucous membranes preponderates remarkably in the female sex. The only exception, the severe bone and joint affections which for special reasons are more frequent in the male sex (49 per cent. boys to 31 per cent. girls) does not make any considerable change in the total proportion of the diseases, which, according to our former calculations, amounts to 5 :6.

In opposition to this more frequent scrofulosis of bones and joints in boys, in youth tuberculosis is in general more usual in the female sex, and, as an explanation of this, the fact has been advanced that girls are at home much more than boys, and therefore more exposed to opportunities of infection (see Cornet, "Die Tuberculose," second edition, p. 426).

A very natural explanation may be also found for this according to our conception of predisposition to scrofulosis.

The cause of the preponderance of scrofulosis in females, and especially of external diseases, lies for the most part in the manifestly more tender skin and mucous membrane, a sort of infantilism, as is shown by the more frequent prevalence of lupus, even after the age of puberty, and continuing even till later years.

The fact mentioned by Körner, and also well known, that the female sex has worse teeth than the male sex, may also be brought forward as an example of the more tender structure of the superficial tissues in the female, as we have before remarked.

The female skin, even after puberty, more resembles that of a child than that of a man, and stands between the two.

In practical life the leather industry has long known such differences in the sexes in the skins of animals and makes its choice from this knowledge according to the technical purpose for which they are required. The same experience of the human skin was gained at the time of the French Revolution, when it was worked up in the Meudon factory; female skin could only be used, as Hyrtl informs us, for belts and braces.

(4) INDIVIDUAL DIFFERENCES.

The difference of permeability which skin and mucous membranes exhibit in the same individual (on the sole of the foot and palm of the hand, for example, the skin is different from that of the inner side of the thigh) show us without doubt that these qualities vary even in individuals of the same age. We shall speak later of the conditions of this difference as to sex, parentage, nourishment, external agents, &c.

Adults are only attacked by scrofulosis exceptionally; in

them individual variations in permeability—the width of the stomata and lymph channels—never recede so far from the normal that the protection against the dangers of daily life, as far as scrofulosis is concerned, is insufficient.

Even the permeability of the covering in childhood suffices to a certain degree in individuals for the ordinary demands of life, and gives ample protection against dangers threatened from without, but it is often not sufficient when the agents of infection are numerous or the attacks too frequent.

With many children the more the increased permeability of the skin and width of the lymph glands is abnormally increased, the less are they capable of withstanding the ordinary dangers of infection; and so much the more certainly, as a natural consequence, do they suffer from local skin or gland diseases caused by tubercle or other bacteria. In this we may see one of the principal causes of "predisposition to scrofulosis." The force of the lymph currents varies in exact proportion to the width of the openings of the lymph channels.

The permeability of the skin and the mucous membrane, as well as the width of the lymph passages, do not always run parallel in their abnormality, but one may preponderate at one time and one at another, and so stamp the disease with its special mark.

Virchow has called attention to the great individual variations due to the size and number of the lymphatics, variations which have no parallel in other systems. The number of the solitary glands of the intestine, and the mesenteric and bronchial glands, the size of Peyer's patches, the tonsillar glands, neck and inguinal glands vary immensely. As he remarks, it is clear that here we have to do with congenital circumstances, and in this sense we also speak of a lymphatic constitution. The individual variations in number and structure of the lymph passages naturally cause a difference in the propagation of the causative agent of the disease.

The view of scrofulous diathesis here developed as a local readiness for disease confined to the skin, mucous membranes, and lymph systems, has been forced upon me by the results of numerous experiments on animals, and is, as we see, confirmed by abundant clinical facts and observations, which can only be explained by it.

All these conceptions are only relative, and it would be a mistake to draw a hard and fast line and to say in one case it is not possible to fall ill with scrofulosis and in another that it is unavoidable.

An individual, were he ever so much predisposed to scrofulosis, when the conditions for infection—the intimate contact with

bacteria—are wanting, will never become scrofulous; such a person remains latently disposed. On the other hand, a child with almost no predisposition will so much the more readily become scrofulous the more he is exposed to opportunities for infection. In this respect a certain difference is brought to bear according to the nature of the cause of infection.

We must strictly individualize not only in the case of the person attacked, but also as to the causative agent of the disease.

The tubercle bacilli gain an entrance into the body much more easily than other bacteria on account of their minuteness. But by reason of their comparatively slight dissemination outside the body (Cornet, "Die Tuberculose," second edition, p. 99) this entrance is not so often repeated, therefore recurrences are more rare. But the disease caused by the bacillus has another symptom which is much more especially marked than in other bacteria, namely, persistency. As one single infection is sufficient, by being carried to the glands and from there to other organs, especially the bones, to produce the whole series of scrofulous symptoms, so the tendency does not play so important a part in producing the clinical phenomena of scrofulosis.

Other bacteria, however, demand wider paths of entry on account of their size, and are therefore more dependent on predisposition; the symptoms, especially in cases of reduced virulence, are not so obstinate but disappear more easily, and have not so great a tendency to disperse over the nearest glands in such a high degree, or, in other words, the glands appear to have greater powers of resisting them. One infection will probably not suffice to produce the phenomena of scrofulosis. Only after repeated intrusion (which will be facilitated by their greater dispersal, but, on the other hand, which presupposes a greater predisposition) will the phenomena of scrofulosis with the repeated recurrence and the multiple external foci appear, which, owing to the fully developed lymph system, also attain to a high degree of persistency. Here also predisposition has great weight.

If the tendency is not there, in spite of this, one *tuberculous* infection can cause the whole complexus of symptoms of scrofulosis; but the picture of ordinary non-tuberculous scrofulosis, which betrays its connection less by its pertinacity than by its frequent recurrences and its sphere of action will hardly ensue from one single *pyogenic* injection.

We differ here from Hueter, who attributes to every scrofulous person an increased disposition; this conclusion could only have been attained *post hoc*.

CHAPTER III.

GENESIS OF SCROFULOSIS.

SCROFULOSIS arises from the combined effect of the scrofulous tendency with bacteria. Whence come the different bacteria which we find in the scrofulous changes? Under what circumstances do they reach the body? How does the infection begin?

I.—CAUSATIVE AGENT OF PUS.

(a) Appearance.

The origin of the germs of infection which we have under consideration is different according to their species.

The ordinary pus cocci and streptococci are almost ubiquitous in closed dwelling rooms. Wherever we leave saucers of gelatine about some pyogenous colonies will be sure to be found developing in them.

The *Bacillus pyogenes aureus* has frequently been demonstrated on the human skin, in the cavity of the mouth, in the saliva, in the nose, in the vaginal secretion, and in the normal contents of the intestine; pus cocci have also been found in the dust from factories and schools.

It is more rare to find streptococci, at least in virulent condition, outside the body.

Probably, infection depends upon living in closed rooms, but more especially when the opportunity is given of contact with persons with suppurating processes of any sort and when such persons do not sufficiently guard against the spread of the virulent pus cocci.

But these pus cocci generally possess unequal and weak virulence, so that the danger is much less than *a priori* appears, and is often represented to be.

Many of the pus bacteria lose their virulence, in part or completely, as compared with tubercle bacilli.

(b) Mode of Infection.

The manner of infection by pus cocci, their localization, the spreading of the process to the next lymph glands, is the same in the case of the tubercle bacillus, and I must refer my readers to the next page for further particulars on the subject.

Numerous experiments prove that these pus bacteria not only introduce themselves into the skin through small wounds, but even the uninjured cutis of adults does not afford sufficient protection against them when well rubbed in; much less protection is afforded by the skin and mucous membrane of a child, which is much more tender, and still less with that of a child who, with a morbid predisposition to scrofulosis, would be much more disposed to become infected.

Garré rubbed cultures of pus cocci into the intact skin of his forearm, and produced a good-sized ulceration at the place of friction, accompanied by swelling of the lymphatic glands. Larré and Bockhardt produced typical carbuncle, boils, and pustules of impetigo by friction with cultures of staphylococcus. Schimmelbusch also produced, by rubbing in staphylococcus, pustules in skin that was proved by microscopical examination to be completely uninjured.

By friction with *Staphylococcus pyogenes aureus* and *S. albus* on the uninjured skin of the forearm, Wasmuth produced flat red patches, and by more vigorous friction blisters containing pus. He also infected guinea-pigs on the carefully shaven skin by friction with anthrax, and confirmed the facts that the uninjured human skin (N.B.—In this case his own) is more permeable than that of animals. This permeability of the skin exists also for other bacteria.

The permeability of the mucous membrane of the lungs for the anthrax bacillus was also demonstrated by Buchner; Roth succeeded in introducing Ribbert's bacillus into the bodies of animals by brushing them with a soft brush on to the uninjured mucous membrane of the nose. Infection was also obtained by rubbing in the anthrax bacilli on the bare skin behind the ears of guinea-pigs; but simply placing them on the same spot without friction produced no result; he found that fairly strong friction was necessary.

Machnoff infected animals by rubbing anthrax cultures into the shaven skin of the back, using only light pressure. On examination afterwards no injury or defect of the skin could be discovered.

Garré considered that in the case of staphylococci the point

of entry was the ducts leading from the sebaceous and sweat glands. Roth and Wasmuth considered that the anthrax bacillus entered by the same route.

All these experiments made on men were on adults, which explains the fact, the cause of which was shown above, that there was no superficial spread from the point of entry, and that the propagation was towards the glands.

The frequency of swollen glands (*e.g.*, in the neck), without being able to detect the place of entry of the bacillus which gave rise to the infection, is explained by the greater permeability of the skin in childhood. For clinical examples see p. 85.

According to Bender, Bockhardt, and Gerlach, eczema can be induced, on the arm being irritated, by germ-free filtrates of staphylococci. Neisser and Lipstein do not confirm this toxic result, as the same effect may be obtained with alkaline bouillon ("Handb. für Path. Mikr.," iii, p. 130).

II.—TUBERCLE BACILLI.

A.—HUMAN TYPE.

Occurrence.

It appears that shut-up rooms in a great measure account for the infection by tubercle bacilli of the human type.

Formerly the tubercle bacillus was supposed to be everywhere (ubiquitous), but could not be discovered. By my researches it has been established that, as a rule, it is only found in numbers worth mentioning in shut-up rooms, which tuberculous persons either inhabit constantly or occupy for a time, and who incautiously disperse the bacteria contained in their secretions. At the head of these are those suffering from phthisis, but still patients with other open tuberculous foci can also afford opportunities for infection.

My experiments have been confirmed both positively and negatively by Rembold, especially Schliephake, v. Krüger, v. Kastner, Bollinger, Kustermann, Enderlen, Prausnitz, Petri, Martin Kirchner, Gotschlich, Dudley (see also Wagner, Belli, Cacace, Kunz).

From the convincing fact that tubercle bacilli are not ubiquitous, but are only found regularly in the immediate surroundings of persons suffering from phthisis who are careless in their habits, it would perhaps be well not always to speak in general terms of the "infinite dispersal of the bacilli from which no one can escape."

Tubercle bacilli are a source of danger to children threatened with scrofulosis, either through the respiratory passages (infecting the bronchial glands), or by entering the mouth and digestive organs (infecting the neck and mesenteric glands), either mixed with food, or by dirty fingers and such means; external contact also may infect the neck glands, or other glands in the vicinity of the point of entry.

Infection may be caused by material in liquid or dry state.

I still think that for introduction into the deeper respiratory passages the dried excreta are far more important than the particles dispersed by coughing, for a person suffering from phthisis excretes in the sputum a million times more than he, in most cases, ejects by coughing; besides, dried sputum has much greater vitality than finely dispersed spray, and so forms a reserve of infectious material during a longer period.

To go further into this question would take up too much time. (I refer to the second edition of my "Tuberculose," p. 111.)

Sputum or other excreta containing tubercle bacilli, when in fluid state, appear to be less dangerous for the spread of scrofulosis, as well as for the spread of tuberculosis of the lungs, as the soiling of fingers and other objects is more easily avoided.

When dry the bacilli often pulverize, and settle here and there on all sorts of objects, and on food, without betraying their presence to the eye, and when not inspired are deposited on uncovered parts of the body, such as the nose and mouth, and pass on to the regional glands.

As scrofulosis appears at an early age infection principally takes place at home, and occurs in young children, most frequently, from the parents, sisters and brothers, grandparents, and relations who dwell with them or frequently visit them, or to whom the children are sent ("pseudo-heredity"); in better class families from the servants, especially nurses and wet nurses; in poorer classes, perhaps from boarders or lodgers.

In later childhood infection may arise from schoolfellows, playfellows, and teachers. And when they visit each other, from the homes of their friends or parents and relations. Those not biased by the ideas of heredity may see daily in their practice clinical proofs of such infection.

Disease germs may be carried by the soles of the shoes, also by flies, but such causes are nothing in the total of infections.

Just as opportunities for infection are numerous, so are also manner and place of infection. With a view to ascertaining the genesis of tuberculosis and scrofulosis, I endeavoured to study more closely these conditions and the path of the infection by

experiments. My own experiments, which were also partly made for another purpose, go back for the greater part to the years 1887-1892, and cover about 4,000 animals.

Exact records of the *post-mortem* examinations were made in about 2,000 of these; later, as the facts discovered repeated themselves in all important points, such as the site and path of the infection, these records were replaced by short notes.

EXPERIMENTAL.

My Experiments on Animals.[1]

I have been enabled to graduate the experiments, and so to imitate and follow, step by step, the endless variety of natural possibilities for infection in human life with their various effects; by the large number of my experiments made with every variation and combination, with changed amount of material for infection down to the very smallest dose, with different kind of contact from hardest friction to simple touching, with the most varied localization on all parts of the skin and mucous membranes, from the quite uninjured covering to that in which the continuity was almost entirely destroyed, and with the most varied time of observation.

(1) SUBCUTANEOUS INFECTION.

In subcutaneous infection on one side of the hypogastrium (as shown by autopsy on 240 animals) the place of inoculation closes at first; after a few days it breaks open and forms a caseous suppurating ulcer; as a rule, during the first two or three weeks, only the inguinal glands on the inoculated side become infiltrated, then caseated and softened; later the opposite side becomes attacked. Generally a long chain of glands, gradually becoming smaller, spreads itself from the place of inoculation upwards. The peritoneum remains normal usually, or is slightly injected; the portal glands, and especially the retroperitoneal glands, are caseated. From about the thirtieth to the fortieth day the spleen is attacked by tuberculous processes, and the liver from about the fortieth day. Only about the fortieth to fiftieth day there appear in the lungs and bronchial glands isolated tubercles which later become numerous.

In animals which had been inoculated between the toes of the hind foot a small scab appeared at the place of inoculation;

[1] I take this method of procedure from my book on Tuberculosis, on account of the importance of these experiments in connection with scrofulosis and tuberculosis.

after a fortnight a swollen gland in the knee-joint of the same side; after three to four weeks there occurred swelling of the inguinal glands, and from about the seventh week miliary tubercles in the spleen and liver, while the lungs remained intact.

In six animals inoculated between the toes of a fore limb after three weeks the ulnar glands, and later the axillary and bronchial glands, were found caseated, and the lungs had become permeated here and there with isolated tubercles; the abdominal organs were only attacked in the case of animals which were killed later.

If the tip of the ear were inoculated (as was done in four cases) after two months, a chain of caseated and softened glands ran down from the ear of the inoculated side to the organs of the chest; later the lungs were found to be highly tuberculous, but the abdominal organs were only affected to a slight degree.

A similar result was obtained, as far as the glands and other organs were concerned, by inoculation (in two animals) in the inner part of the ear.

(2) CUTANEOUS INOCULATION.[1]

Rubbing with sputum, pure cultures, &c. (eighteen autopsies) on the skin of the cheek, nose, and forehead were followed in the places inoculated partly by ulcerations, partly by lupoid changes, in many places by a scaliness which was hardly noticeable, according as the injuries which had preceded the inoculation were more or less superficial, *e.g.*, by scratching with the finger nail. But first swelling and caseation of the neck and bronchial glands regularly appeared first on the same side and then on the opposite side; later the process spread to the lungs, spleen, and liver. Rubbing the shaven and superficially eroded skin of the bend of shoulder or the inner side of the thigh had, as a first effect, swelling of the axillary or inguinal glands. But simply placing the sputum or culture on the uninjured skin or using only slight friction had no further consequence.

Recent years have brought numerous confirmations of my results.

Cutaneous injections, mostly by rubbing the shaven skin with tuberculous material or cultures, were tried by Cozzolino, Manfredi, Frisco, Courmont and Lesieur, Babès and Nouri, C. Frankel, Lewandowski; sometimes skin tumours or verrucose tubercles were formed, sometimes the skin appeared to remain intact; but

[1] I only mention here such animals as were thoroughly examined and recorded; the greater number of others, in which results already obtained were only confirmed, remain unmentioned.

in guinea-pigs and cattle, as a rule, swelling of the neighbouring glands occurred, and, following this, general tuberculosis. Babès and C. Frankel have proved by means of a microscope the presence of tubercle bacilli in the hair follicles after one or two days.

In the experiments of Takeya and Dold, and of Julius Meyer (who used sputum), there was always tuberculosis at the place of injection.

As already mentioned, the success appears to depend mostly on the greater or less intensity of the friction.

Sometimes the scales formed thick layers and crusts, and even grew to considerable excrescences and horns; after being removed by operation considerable loss of substance resulted. As a rule, animals cutaneously injected succumb much later than those subcutaneously injected; many lived for a year. Changes similar to the tuberculosis verrucosa cutis appeared in rabbits.

J. Meyer infers the great importance of mixed infection for the genesis of tuberculosis of the skin from the fact that by rubbing the shaven skin of the abdomen with sputum containing mixed infections he obtained a much more extensive development of tuberculous nodules than from pure material (caseated mesenteric glands). But this reasoning is not conclusive, for in the first place he rubbed in many more bacilli than would be contained in glands, which ordinarily contain but few.

If French investigators especially got negative results from their friction experiments, it may be asked if these authors did not experiment with tuberculosis of fowls, which was formerly much employed in French laboratories. Recently Babès succeeded in inducing infection with no affection of the skin by rubbing tubercle bacilli into the uninjured skin. (Breslauer Naturf.-Vers. u. Tub.-Kongr., 1905, Paris.)

(3) INFECTION OF THE MUCOUS MEMBRANES.

Mucous Membrane of the Mouth.—In other animals (of which we have seven autopsies) sputum was introduced into the gums with a blunt or a sharp instrument. After several weeks an ulcer formed on the spot, but sometimes, after eight weeks, there were no changes whatever to be noticed at the place of injection. But caseation of the sub-mental, sub-lingual, and neck glands in regular sequence set in, especially on the injected side; later, some nodules were noticeable in the lungs, and finally in the spleen, &c.; the bronchial glands were hardly at all caseated. I obtained similar results by rubbing the gums (in two cases) and the back of the pharynx (two cases) and of the tongue (six cases).

In these cases it was principally the glands of the neck and

the trachea which were attacked, and showed diffuse caseation before the bronchial glands were implicated. These, in the further course of the disease, never showed such extensive changes as resulted from inhalation. From six to ten weeks after the infection the neck glands formed large softened swellings, and then, as a rule, the lungs were affected sympathetically.

Conjunctiva.—If we introduce tubercle bacilli into the conjunctival sac (as was done in twenty-four cases), with or without slight friction, after two to four weeks small ulcers form if the friction has been preceded by slight injury, otherwise only injection and thickening of the conjunctiva occur, later caseation of the neck glands, first on the same side then on the other side, and caseation of the bronchial glands, followed by tuberculosis of the lung and of the abdominal organs. If the conjunctiva through the exercise of great care remained uninjured, in many cases it exhibited no change, and then the nearest glands showed the first tuberculous stages. Once no infection whatever was obtained, perhaps because the infective material did not come into close enough contact with the mucous membrane. In six cases of corneal inoculation ulcers appeared on the cornea; the state of the glands was the same as in conjunctival infection.

Ear.—Inoculation in the inner ear (two cases) produced after two months a string of caseated and softened glands on the injected side of the ear down to the organs of the chest.

Genitals.—If the penis (twenty-one cases) were rubbed with sputum or pure cultures, provided a slight wound had preceded the friction, an extensive ulceration took place at the infected place. On rubbing, with no visible wound, sometimes the penis itself showed no change, or a slight ulcer was formed after about two to three weeks; as in the other cases, a swelling occurred on the infected side and later on both sides, with caseation of the inguinal and the retroperitoneal glands; after a further two to three weeks the spleen and liver became tuberculous, and it was only after a few months in most cases that tubercles were found in the lungs. One animal lived 6½ months.

Injections in the urethra (three records) gave similar results. v. Baumgarten caused diffuse tuberculosis of the urethra, followed by general tuberculosis, by injecting tubercle bacilli into the uninjured urethra of a male rabbit, which he had kept for several days previously without food or water.

By rubbing sputum or pure culture into the vagina (in thirteen cases) by means of a smooth or grooved glass rod—therefore without preceding injury, or only slight injury—a strong milky discharge was caused, also a typical tuberculous development in

the vagina and uterus, which once occurred in the bladder also. But in many cases the vagina remained unaltered. After a short time swelling and caseation of the inguinal glands appeared in all the animals; later caseation of the peri-uterine glands and of the glands lying near the vertebral column, then tuberculosis of the spleen and liver occurred. Injection of pure culture into the vagina (of which I have three records) produced similar results.

Infection of the Intestinal Canal.—In feeding experiments, some of which were made before my own, tubercle bacilli introduce themselves through the completely intact epithelium of the intestine into the walls of the intestinal canal, as proved by Wesener, v. Baumgarten, Fischer, Dobroklonski, Bollinger, G. Cornet, v. Behring, F. Arloing (in dogs), Uffenheimer, Macfadyean (in monkeys), Bartel, &c. Either they develop further here and form tubercles in the lymphatic follicles, especially in the ileum, cæcum or colon, or they produce ulcers on further absorption, which have a very great similarity in their changes to those of human intestinal phthisis (Fischer), or they can pass without alteration from the walls of the intestine to the mesenteric glands and there develop further. Later we find tubercles in the liver, whilst the lungs and bronchial glands remain unchanged, or are only attacked later and in a slight degree (see also the interesting experiments of Nebelthaus).

By feeding with large quantities of infectious matter, especially when it is of firm consistence, *e.g.*, mixed with bread, now and again the neck glands became affected, clearly by the taking up of bacilli from the mucous membrane of the tonsils. But I have never found this when very small quantities of tubercle bacilli were mixed with the food, and never in animals (twenty-five in number) in which I cautiously introduced the infective material directly into the stomach with the stomach tube (after careful lavage) so as to exclude contact with the upper digestive organs.

Infection of the Respiratory Organs.—With slight rubbing of the tubercle bacilli into the mucous membrane of the nose (twelve cases) the mucosa remains unchanged, if great care be taken to avoid injury; in other cases inflammation takes place, and after a time redness and ulceration.

With harder friction or preceding injury ulceration generally follows. A few weeks later the neck glands on the inoculated side, and then those of the other side, become swollen and caseated; after a further two to three weeks the bronchial glands become tuberculous, then the lungs, and only at a later stage the spleen and liver.

If the animals (of which we have over 700 records) inhale,

no matter whether sputum or culture, whether moist, sprayed, or naturally dried and pulverized, in two to three weeks very small greyish white spots become visible in the lungs, and about the same time the bronchial glands become enlarged and are found to be infiltrated with a medullary substance. The tubercles in the lungs enlarge, and should the animal live long enough, now and again cavities are formed, the bronchial glands develop into widespread masses to a degree attained by no other method of infection, and later caseate. From the third to the fifth week the spleen and liver exhibit signs of commencing tuberculosis, the peritoneum and omentum remain as a rule unchanged, the neck glands are affected sometimes, but mostly only at a later stage; intratracheal injections caused large caseous foci analogous to those of caseous pneumonia in the lungs. The rest of the progress was the same as with inhalation. For the differences in the arrangement of the experiment with sputum, used dry or wet, as well as other details which are less interesting for scrofulosis (see Cornet, "Die Tuberculose," second edition, p. 135).

If we use extremely small quantities of sputum for inhalation the lung may remain free, as it is well known that only a part enters the lungs, and after from four to six weeks only slightly developed tuberculosis of the bronchial gland is exhibited. It appeared to me this was specially the case with young animals, but on this point my records do not always give exact information, as this point was at first not considered.

(4) INTRAPERITONEAL INFECTION.

After injecting tuberculous material into the peritoneal cavity at times swelling of the inguinal glands occurs on the side inoculated, but this is clearly when the material for infection enters between the abdominal skin at the introduction or withdrawal of the syringe. In the peritoneum on the parietal and visceral layer, especially with a fine emulsion of tubercle bacilli, numerous small tubercles develop, and at times a few larger tubercles, but the great omentum absorbs the bacilli with special regularity and to a great extent, and the tubercles develop in the form of a row of beads, or when a large quantity of tubercle bacilli are absorbed the omentum becomes distended in the form of a large sausage filled with a caseous mass. A serous or sanguineous discharge is present from time to time, but not always. The retroperitoneal glands are affected at an early stage, then the spleen and liver. At times the advance of the processes can be well observed from the peritoneal side of the diaphragm to the pleura by way of the lymph vessels which permeate them.

Tubercles are formed on the diaphragmatic pleura, in the bronchial glands, and finally in the lungs.

The reports of most other authors agree with the above-mentioned description, when more exact details are given, and the human tubercle bacilli and not those of fowls are employed (see "Pariser Kultur," "Die Tuberculose," second edition, p. 31) (for results which do not agree, see p. 100).

(5) INTRAVASCULAR INFECTION.

Infection can be obtained most speedily by intravenous injection, *e.g.*, into the jugular vein or a vein in the ear. Corresponding to the uniform dispersal of the material for infection in the blood-stream we find tubercles in the organs of the chest and abdomen, in the lungs, spleen, and liver at about the same stage of development; a greater number is often found in the lungs, as this organ forms the first filter in intravenous injection.

From these experiments we learn this most important fact concerning scrofulosis, that it is always those glands which are attacked first, and perhaps only those which lie in the immediate vicinity of the part which has come into actual contact with the tubercle bacilli; it is indifferent whether an injury has been caused there or a local lesion existed previously. Infection with tubercle bacilli is a direct means of studying the anatomical connection of the glands with their tributary areas. I must lay special stress on the point that we never find a gland tuberculous when it is at a distance from the place of infection (although perhaps highly predisposed) without finding the intermediate part infected with tubercle. We may draw from this the corollary that for the primary or exclusive disease of a certain gland we must select the tributary areas of that gland as the place of infection (see also p. 88, Law of Localization).

CLINICAL OBSERVATIONS.

Are we justified in applying the same chain of reasoning to man? Doubtless we are. For this intimate and regular connection between place of inoculation and disease of the nearest gland has been completely established by a series of clinical observations.

v. Bergmann as early as 1887 emphasized the fact that the successive advance of the infection from one gland to the next, from one group to another in the direction of the lymph current is most clearly marked in those affections of the glands which are connected with tuberculous processes, but at that time he held

that it was not conclusively proved that the group of glands which lay nearest to the inflammation of the skin was always the first to be attacked.

Other clinical observations on the most widely different regions of the body accord with my opinions upon this.

Scalp.—In connection with a tuberculous infection of the scalp by tuberculous ulcers, after a few weeks there was a collection of glands in the neck (Dencke). With eczema of the head, caseation of the retromaxillary glands and miliary tuberculosis occurs (Demme).

Eye.—In tuberculosis of the conjunctiva, cornea, and of the iris (Haab), it is generally the pre-auricular, the jaw and neck glands which are tuberculously affected, and only, or for the most part, on the side affected. Thus the left neck glands were much swollen in the case of tuberculous ulceration of the tarsal conjunctiva, which had partly run its course, in the left eye of a boy aged 14 (Sattler). In tuberculosis of the right conjunctiva the pre-auricular glands were only swollen on the right side, although it was evident that the whole of the lymph gland system of the neck on both sides was diseased and had partly suppurated from some other infection (Stolting). Further, swelling of auricular and submaxillary lymph glands on the side which was diseased was noted by Walb, Haab, &c. (in six cases).

Mouth and Pharynx.—According to the researches of Krückmann and Schlenker, with a tuberculous infection of the tonsils tuberculosis of the neck glands will follow as a secondary consequence. Sacaze notes that in tuberculous inflammation of the tonsils there will be at the same time severe swelling of the neck glands. Grawitz notes in connection with inflammation of the tonsils with diphtheritic membrane, a tuberculous infection of the neck glands. Uckermann found in tuberculosis of the left velum palati a swollen and very sensitive gland (in a woman aged 35) under the left angle of the jaw on the hinder edge of the sternomastoid, and under the tip of the mastoid process. Wroblewski often found in fourteen cases of tuberculosis of the pharynx (in persons from 22 to 59 years of age) considerable affection of the lymph glands, the cervical as well as the axillary, ulnar and inguinal glands. In tuberculosis of the tongue (median region), Poncet and Graser found swelling of the submaxillary glands.

In a child which previously had been quite healthy, Steigenberger noted that after it had been suckled four weeks by a nurse who was phthisical, it developed at the end of two months a hard tuberculous swelling, the size of a hen's egg, in the neck glands of the right side (containing tubercle bacilli). Doutrele-

pont found in tuberculosis of the skin and mucous membrane of the right cheek that the right submaxillary glands were also swollen, the glands on the left side were hardly enlarged; later tuberculosis of the lungs occurred.

Teeth.—Odenthal found in 346 children swelling of the submaxillary glands consequent upon dental caries. Berten established a complete coincidence not only between the position of the caries, but also between the intensity of the glandular swelling and the caries which caused it. Hoppe also established swelling of the maxillary lymph glands as an extremely frequent consequent symptom of caries of the teeth; Starck noticed the same strictly local dependence of the glandular swelling upon the situation of the carious tooth with which it corresponds, not only on the side of the body, but also that with caries of the hinder molars the glands in the vicinity of the angle of the jaw are swollen; with caries of the canine teeth the glands farther forward or those of the other side are swollen. Körner proved in 1,646 children the correspondence of the glandular swelling with the affected tooth, both as to position and degree of affection. Grawitz remarked tubercular swelling and caseation of the neck glands on the same side in consequence of caries of a molar, and tuberculosis of the lungs showing itself months after the first appearance of the swelling.

Nose and Ear.—In affections of the nose and ear we see the same involvement of the glands on that particular side. A. Jacobi refers to the frequent cure of scrofulous inflammation of the cervical glands simply by treatment of the nose. Hang found in perichondritis of the auricle in four tuberculous persons that the lymph glands of that part were tuberculously infiltrated, and that in a chronic middle ear catarrh with tuberculosis of the mastoid process a small gland on the mastoid process was similarly affected; in primary central tuberculosis he regards the affection of these glands as one of the very earliest symptoms. According to Ferreri, the salivary glands, the cervical lymph glands, and the joint of the lower jaw are, especially in childhood, seldom sympathetically affected in diseased processes of the ears.

In tuberculosis of the breast the axillary glands are, as a rule, affected at the same time (Volkmann).

Holst observed tuberculous swelling of the axillary glands consequent upon indolent ulcers of the finger in the case of a sick nurse; Tcherning, after an injury to the hand with a spittoon; Colling and Murray observed in three cases pustular formations with consecutive swelling of the ulnar and axillary glands after tattooing on the arm by a person suffering from phthisis; Gerber, tuberculosis of the axillary glands four months after tuberculous

infection in a finger; Leloir noticed in connection with lymph-angiectatic lupus tuberculo-scrofulous swellings in the course of the thickened lymphatic vessels, with swellings of the ulnar and axillary glands, and later, affection of the lungs; Koch, caseation of the ulnar glands after spina bifida; Schuchardt, tuberculosis of the inguinal glands on both sides consequent upon soft chancre, tuberculosis of the inguinal and pelvic glands after ulcers in the vagina; Lindemann (in two cases), and Lehmann (in ten cases), tuberculous ulceration of the penis, and swelling and caseation with suppuration of the inguinal glands after circumcision by a person suffering from phthisis; Hamilton, tuberculosis of the inguinal glands consequent upon tuberculosis of the testicle. Severe swelling of the femoral glands is not infrequently found with affections of the foot and knee-joints, and enlargement of the inguinal glands in caseating processes about the hip-joint and the acetabulum (v. Bergmann).

For further details I refer to the chapter on "Infection of the Glands," Cornet, "Die Tuberculose," second edition, p. 353.

These clinical experiences in man, which could be easily multiplied, justify us in assuming that the results of our experiments on animals would be the same in man, and wherever we come across a primary affection of the glands we may invariably seek for the point of entry of the toxin in the peripheral region of the gland.

In practice we have an apparent exception to this rule. Thus, for example, a pre-auricular gland was swollen as the result of an affection of the eye, and at the same time the bronchial glands swelled, without the cervical glands lying between showing any changes. But in such cases we may always suspect a second independent infection in the lungs, the opportunity for which infection was given at the same time and under the same conditions as that of the eye.

LAW OF LOCALIZATION.

The law of localization has been drawn up by Cornet as the result of experiments on animals, and confirmed by clinical experience in man.

Tubercle bacilli which have entered the body develop, as a rule, in the organ which is susceptible for that special virus, immediately at the point of entry, or at least in the lymph glands situated nearest (law of localization). The glands act as a filter, and retain the bacillus at first. Cohnheim called attention to the connection between the point of entry and the localization of the tubercles.

The further spread in the body does not take place by leaps and bounds, but step by step, therefore the path of entry may almost always be concluded with certainty from the pathological condition as indicated in that organ in which the disease is further developed (for Bartel's objections, see p. 97). This guide only becomes unreliable when the processes are relatively old, when several organs are attacked and in a high state of tuberculous development, the paths of the disease being thereby obliterated. Tubercle bacilli can penetrate into a macroscopically uninjured mucous membrane, in more rare instances even into the skin, especially when it is brought into intimate contact by friction, as proved by my experiments on the conjunctiva, vagina, mucous membrane of the mouth, nose, and intestines, on the penis, and cutis.

It does not necessarily follow that the tubercle bacilli must begin to develop at the point of entry; they can penetrate the mucous membrane, and in exceptional cases even the skin, without leaving a trace behind; as a rule, the nearest gland is never passed over without typical changes taking place, be they ever so slight.

The permeability of the skin and mucous membrane for the tubercle bacilli, first confirmed by my experiments, is to be understood in a double sense.

The bacilli penetrate and establish themselves locally, or they may penetrate and be located in the nearest glands by way of the lymph passages.

This permeability of the skin and mucous membrane varies greatly according to age and sex and the individual, as we have explained on p. 63.

This enables us to understand that after infected food the mesenteric glands may become tuberculous, after inhalation the bronchial glands, and after infection of the mouth the neck glands may become tuberculous without the lungs, intestines, or mucous membrane exhibiting any changes.

This law of localization is of the most far-reaching and fundamental importance for our conception of the genesis of tuberculosis, its mode and path of infection, and its prophylaxis, which is our justification for its thorough discussion in this place.

OBJECTIONS TO THE LAW OF LOCALIZATION.

Influenced by the theories of v. Behring on the enterogenous genesis of tuberculosis, the law of localization was subjected for a time to repeated attacks.

With respect to the permeability of the mucous membrane, v. Baumgarten and his pupils, Takeya and Dold, disputed that

tubercle bacilli would migrate through the intact mucous membrane, and maintained there were always microscopic changes; de Vechi also believes the normal mucous membrane to be impermeable; Klimenko maintains the same, but adds that frequently slight injuries are present which allow of the passage.

Apart from older experiments (see Cornet, "Die Tuberculose," first edition), Hilgermann, Uffenheimer and Plate have proved microscopically the penetration of the bacilli through the intact mucous membrane (see also pp. 81-84).

The frequent pathological condition of tuberculosis of the bronchial and mesenteric glands, without any evidence of the slightest injury or tuberculous developments in the mucous membrane of the lung or intestine respectively, is in favour of the permeability of the mucous membrane.

The objection that perhaps the tuberculosis of such glands may have arisen in the blood passages is met by the experiment on completely healthy animals in which we can induce tuberculosis of isolated glands where we will, in any gland system, in the bronchial or mesenteric glands, without injury to any part of the mucous membrane either by inhalation or feeding. As such results have been regularly attained by myself and other investigators in hundreds of cases, the objection that the animals may have been diseased and the mucous membrane not intact (Hornemann) is unsound. I refer further to the extensive experiments of Uffenheimer, the discoveries of Max Wolff, of Orth, and L. Rabinowitsch.

I have proved (p. 82) the permeability of the mucous membrane of the eye, nose, vagina, and Galbo has confirmed the same in the vaginal mucous membrane of guinea-pigs.

Further, in the above-mentioned feeding experiments, tubercle bacilli were proved (Bartel, Kovács, Plate, Hermann, &c.) to be in the mesenteric glands even after a few hours or days, therefore before the tubercle bacilli which had been swallowed could have produced changes in the lining of the intestine.

It was not necessary for v. Behring to base his theories of the entry of bacteria on Disse's incontinuity of the mucous membrane in the new-born and in children a few weeks old, as long before the permeability had been experimentally proved to hold good in later life and in full grown animals.

Even the theory of the genesis of tuberculosis of the lung by inhalation advanced by Tappeiner, Koch, and others, and confirmed by me on more than 1,000 animals (in over 700 official records), further extended and considered assured by the law of

localization, was again disputed and again re-tested on all sides. That which appeared to the unprejudiced so clear, that the bacilli floating in the air would be inspired with the air and so be drawn down the free and open air passages into the lower part of the lungs, and so arrive in the minutest air passages, appeared to be doubtful, though without any evident reason; it was maintained that the bacilli which were swallowed in inhalation entered the stomach and intestines and the mesenteric glands, and from there, without leaving a trace behind, into the thoracic duct, and thence into the blood and the right side of the heart and so into the lungs, and only then caused the primary changes.

There were even some, such as Calmette, who denied that the formation of anthracosis of the lungs was aerogenic and arose from direct inspiration, which up till now had been universally acknowledged, and revived the assumption which had been disproved some years before by Arnold, that the carbon particles which were inspired were first swallowed, and then migrated through the intestine and mesenteric glands in the way already described, leaving no trace behind, and only by an indirect route through the thoracic duct and blood, arrived at their definite place of deposit in the lungs.

But the experiments of Calmette's pupils, Vansteenburghe and Grysez, which were to have demonstrated the truth of his theory, by no means confirmed it, even after numerous tests, and were completely disproved by renewed experiments by Schultze, Aschoff, Passet, Cohn, Kuss and Lobstein, Mironescu, Remlinger, Tendeloo, Beitzke, and Charles Montgomery, who experimented with carbon, soot, carmine, prussian blue, &c. Tendeloo refers specially to the fact that dust-pigment has never been found in the human mesenteric glands, either in adults or children, but that in the bronchial glands of nearly every person dust-pigment is to be found. Why should the bronchial glands retain the dust and the mesenteric glands not? (See also Cobbet.)

The inhalation experiments instituted by Frosch (Gaffky) with sulphate of silver or ultramarine and emery powder showed that even with animals which were immediately killed (one to two hours after inhalation) the inspired substances had already penetrated deeply into the lungs.

It is the same with tubercle bacilli. They, too, enter directly into the lungs, and not by the indirect way of ingestion, already described. The recent experiments of Bartel and Neumann, as well as Heymann, prove this. They killed the animals experimented on immediately, or very soon (five to ten minutes) after the inhalation of tubercle bacilli which had already penetrated

into the minutest bronchial tubes; Heymann also demonstrated them by excision in alveolar and epithelial cells. After inhalation of a quantity of bacilli they were found immediately in the bronchial glands, but when only a small quantity were inhaled they were only found to be present after three days. Ballin's experiments with aspergillus spores led to the same results.

This penetration of the bacilli into the minutest air passages was again proved, and has become evident in Calmette's and Guerin's own experiments; their further objection that one cannot be sure that the bacilli they found were not induced by tuberculosis needs no further discussion.

Now it was endeavoured to prove by other means that the bacilli ingested with the food passed through the intestinal and mesenteric glands without producing any changes, then arrived in the lungs by way of the thoracic duct and the right heart, there producing the primary foci.

Calmette, who defended this opinion, believed that he and Guerin had demonstrated it, because he had observed in those animals into which he had introduced bovine bacilli by means of the œsophageal tube, besides intestinal tuberculosis, severe tuberculosis of the lungs, the bronchial and mesenteric glands. But just the fact that the other organs—liver, spleen, and kidney —which also take part in the circulation remained free is a clear proof that we are not here concerned with a hæmatogenous infection of the lungs, but evidently that during the withdrawal of the tube, which by incautious handling might easily happen, infectious matter entered the trachea, and caused the infection of the lungs.

But Calmette's young goats, which he allowed to be suckled in a natural manner by a mother suffering from tuberculosis of the udder, only developed intestinal tuberculosis (see also Calmette, Guerin, Delarde). Beitzke raised the objection against Calmette's and Guerin's further ingestion experiments, as well as those of de Haan, as far as adult ruminants were concerned by eructation of the bacilli which had been introduced, and aspiration may have induced infection of the lungs.

To eliminate the source of error that in feeding by the tube a part of the bacilli might enter the lungs on its withdrawal, Schlossmann and Engel laparotomized young animals, injected bacilli into the stomach, and sewed up the place of injection; when six hours later they excised the lungs, and by inoculating them induced tuberculosis, they thought they had proved their theory that the bacilli might migrate through the regional glands without leaving a trace behind. But the after-test brought to light

the error of the experiment. Strassner pointed out that the very fact of sewing up the thin wall of the stomach introduced germs into the peritoneum, whilst in a similar experiment, without sewing up, even with large doses of 2 grm. of tubercle culture, no bacilli came immediately into the blood; further, in animals which were allowed to live longer, after three months the mesenteric glands, and partially the axillary glands, were tuberculous, while the bronchial glands were spared in a most remarkable manner.

This also refutes at the same time the experiments of Ravenel and Reichel, who had operated in the same manner as Schlossmann and Engel.

The experiments of Oberwarth and L. Rabinowitsch are easily exposed to error by the complicated arrangements (inducing a fistula into the stomach), and are also not decisive on account of the enormous doses. Besides which, Uffenheimer showed that bacilli introduced by clyster rise upwards in an antiperistaltic manner, and even reach the lungs. The fact that tuberculosis by aspiration in similar experiments is difficult to avoid, and cannot be entirely excluded, was confirmed by Dieterlen.

Such experiments are therefore by no means determinative on account of the errors which creep in. Up till now no single experiment proves without objection that tubercle bacilli, especially in full-grown animals, can penetrate the intestinal and mesenteric glands without leaving a trace, without leaving at least visible changes in the glands; not to mention the conclusion that human tuberculosis of the lungs in adults is most frequently of intestinal origin, a conclusion which has no trace of justification. They now endeavoured to demonstrate the penetration of ingested bacilli into the blood, liver, and spleen.

Ficker found in young sucking animals germs ingested with the food already in the blood during the time of digestion, and in older animals when they were starving or working on the treadmill, but the results were not uniform. Kovács, Plate, Reichenbach and Boch, Calmette, Guerin and Breton, Bisanti and Panisset fed animals with matter containing tubercle bacilli; Orth and L. Rabinowitsch introduced it by means of a clyster, and declared that they found tubercle bacilli in the liver, blood, and spleen in some animals after several hours, or several days, respectively.

But these results are not free from doubt; first of all, with similar arrangements, similar results were not always obtained. Thus Orth and L. Rabinowitsch in forty-two experiments only found bacilli in the blood five times.

Strassner, in his experiments, never found bacilli in the blood ten hours after ingestion, and referred to similar negative results with Bartel and Uffenheimer.

To thoroughly criticize each single series of experiments would lead us here too far. The strenuous and painstaking work of Kovács may serve as an example.

Kovács fed new-born guinea-pigs with a culture of tubercle bacilli; after several hours he killed them, and microscopically examined the blood, liver, spleen, kidneys, lungs, marrow, the portal and retroperitoneal glands, and inoculated portions into guinea-pigs. Once he "succeeded" in finding, several hours after ingestion, a few tubercle bacilli in a portal gland, in a streak preparation; all other experiments had negative results.

Then he found bacilli in a portal gland once among eight young guinea-pigs eight hours after feeding, and once in a cervical and axillary gland three days later, when two and a few bacilli respectively were found. Twelve other animals only showed the recognized condition in the cervical and mesenteric glands after ingestion. Animals which were fed with tubercle bacilli in fine emulsion by means of a tube developed tuberculosis, once in the liver seven hours after feeding; in the spleen twenty-four hours after feeding; in the spleen and blood two days; and in the liver ten days after feeding.

One other case of tuberculous spleen is rejected as clearly older; tuberculosis of the lungs was present.

The positive conditions in the bronchial glands prove nothing, for with artificial feeding, as with ordinary taking of food, there can easily, according to Kovács' own statement (*loc. cit.*, p. 297), be some of the ingested bacilli forced into the lower air passages by the current of air.

In these experiments only the most favourable conditions are sought out, new-born or young animals are utilized, and yet, in spite of this, numerous negative results are opposed to solitary positive results. This alone makes their evidence inconclusive, besides which, in solitary cases, one must always reckon with errors in the experiment, unintentional injury to the vessels, infection of the blood, &c.

Therefore, we can by no means agree with Kovács when he says that these results "represent the gravest harm and a contradiction to the accuracy of the law of localization, and force us to other opinions respecting the path of infection, mode of dispersal, and localization of ingestion tuberculosis.

Rabbits injected with human bacilli showed after three to five weeks tubercle in the lungs and kidney without macroscopic

disease of the lungs. This is a peculiarity of the rabbit, established by Oehlecker, which may be explained by the less virulence of the human bacilli for this class of animal, by which the bacilli can pass more easily through the glands without setting up reaction. We also find in rats, when inoculated with human bacilli—perhaps from the same cause—that there is a speedy passing of the bacilli into the blood, but no tuberculosis. These observations have nothing to do with the law of localization of a virulent infection in man.

In all cases a premature penetration of the bacilli into the blood-stream, if it take place, only appears under quite special circumstances, that is, by the use of enormous doses of bacilli, which the filtering power of the glands is not capable of resisting, or in certain classes of animals (rabbits), and at certain ages (in sucking or young animals), or with a type of bacillus which is foreign to the species, but it takes place neither regularly nor frequently, therefore it is quite out of the question that this state of things should be of practical importance for human pathology.

The whole of our experimental experiences are against a speedy migration of the bacillus into the blood, for, according as we infect animals by feeding or inhalation, subcutaneously, intraperitoneally, or intravenously, we obtain in from three to four weeks phenomena which are totally distinct and easy to differentiate before their characteristics have been effaced, and this occurs not only now and again, as I have observed it in about 4,000 animals, Weleminsky in about 3,000, and all other authors taken together perhaps as often or oftener, but with constant regularity. Thus in many hundreds of feeding experiments made by the most various investigators and corresponding to natural conditions (which is best obtained by well-moistened food that does not pulverize or scatter), after three to four weeks nothing appears, as a rule, except isolated tuberculosis of the mesenteric glands, intestinal glands, and eventually of the neck glands.

This would not be comprehensible if the bacilli entered the blood a few hours or days after such experiments, for, as Kovács says, in this their fate can only be the same as that which is observed after direct injection into the blood-stream, that is, they would be deposited and develop in certain organs, such as the lungs, spleen, and liver. Then after three to five weeks such tubercles here and there must appear to be caused by stray bacilli, but we only find them very occasionally, a proof of the saying, "*Nulla regula sine exceptione.*"

Now some authors defend themselves with the assumption that the few bacilli which have come in this way directly into the

blood are destroyed by its bactericidal power. Good! But in the first place this assumption is for the present only a hypothesis of which there is no strict proof; on the contrary, experience shows that it is just in infection of the blood, in intravenous injections that the least quantity of virulent bacilli suffices to cause the most extensive development of tuberculosis. Secondly, if the bacilli were destroyed, then their importance, which has been constructed with so much labour, is again lessened. So up up till now we have only hypothesis and a few experiments which may be construed any way.

There are those who have not studied these questions, but who read the conclusions on both sides and consider them of equal value, although the one theory is based on a few positive observations, and the other supported by experiments on many thousands of animals and painstaking researches extending over many years, which, if they are to be refuted, may at least demand that they shall be refuted with equal thoroughness.

The whole of our experience of morbid anatomy in man contradicts that positive discovery; the numerous isolated cases of tuberculosis of the intestinal and mesenteric glands, the still more numerous cases of genuine isolated tuberculosis of the bronchial glands, the isolated tuberculous neck glands in those in whom throughout the rest of the body no trace of tuberculosis is to be found, must suffice. I refer my readers to the reports of our pathologists, Benda, Tendeloo, Ribbert, &c.

In these cases where have the bacilli gone which were said to have escaped from the lymph passages and entered into the blood? as we can find tubercles nowhere else.

These isolated tuberculous individuals would be much more numerous if man were not so frequently exposed to double infection, for when a tuberculous person has the opportunity of inhaling dust in the vicinity of a consumptive patient with uncleanly habits, the dust containing bacilli may easily settle on his food, so that sooner or later a tuberculous focus may be set up in the intestinal, mesenteric, or neck glands, or, on the other hand, he may inhale bacilli in addition to his tuberculosis of the intestine.

It is just this dual or manifold infection of different organs from the outside which is the principal cause of illusive conclusions about the mode of dispersal of the bacillus in the body, unless the question has been studied by experiments on animals.

But we often meet with such concurrent infections, even in experiments on animals, where we have the conditions more in our grasp, and often they cannot entirely be avoided, especially when we neglect certain precautionary measures.

An example of this may be found in Kovács', Bartel's, &c., animals, which developed simultaneously tuberculosis of the neck and mesenteric glands, or tuberculosis of the neck, bronchial, and mesenteric glands, and of the lungs.

Such dual or parallel infection, to which, unless I make a mistake, Ribbert, Lubarsch, and Harbitz have already alluded, play a greater part, even in one and the same organ, than one commonly supposes, for even in the lungs and intestines not nearly all the foci are to be ascribed to the first infection and its spreading. In contradiction to Meissen, &c., who tried to ridicule this point of view, I have for many years repeatedly pointed out that it is just the phthisical patients who must guard against continued opportunities for further infection of the lungs, which, as a rule, establishes itself in a part which has hitherto been healthy.

To return to those experiments (p. 93) which gave rise to this discussion: they have demonstrated—in contradiction to the statement of Calmette, Schlossmann, &c., that the bacilli migrated through the mesenteric gland, leaving no trace—that in animals which were allowed to live tuberculous foci were regularly found in the nearest gland to the point of entry, the mesenteric gland (see Uffenheimer, Kovács, Orth, L. Rabinowitsch), thus they confirmed the law of localization in this respect, according to which the bacilli are at first retained in the nearest gland.

Bartel's Latent Foci.—A further objection to the law of localization has been made by Bartel, which we must discuss the more, not only because he has distinguished himself by his exact researches, but because his work plays a great part in literary discussions. Bartel demonstrated the presence of living bacilli in the lymphatic tissue, the tonsils, the lymph glands of the neck, and mesentery of an animal on which he experimented a hundred and four days after ingestion, in which, on being microscopically examined, "up to that time no specific changes" were to be observed, and the bacilli were to be put down to the infection which took place a hundred and four days previously. Bartel concludes from this a latent stage up to a hundred and four days.

These and similar observations made under the same circumstances in shorter times after feeding gave rise (1) to the opinion that clinically an organ may very often not offer any characteristic symptom of tuberculous infection, and yet the opportunities for infection are to hand and have been demonstrated (such animals becoming thin, with arrested growth, and occasional swelling of the glands), and must lead one to suspect it; (2) to the opinion that with tuberculous injection, besides the stage with evident

changes of specifically tuberculous nature, we may suspect a stage of quite general, not specific phenomena, which lasts a considerable time; (3) if in the one sort of infection, in this case from the gastro-intestinal canal, a dispersal can take place over all the groups of lymph glands in a concrete case, over the neck, bronchial, and mesenteric lymph glands, then manifest tuberculosis must not always be confined to that region or group of lymphatic glands connected with the point of infection; no self-evident conclusion as to the point of entry may be drawn from older and specially pronounced or isolated changes of specifically tuberculous nature in one or other of the lymphatic glands; a *locus minoris resistentiæ*, a tendency of various groups of glands must be supposed, and it would be quite wrong in every respect to allow oneself to be entirely prejudiced in one's opinion of the point of entry by the phenomena of evident specific tuberculous changes. In other words, Bartel denies the validity of the law of localization.

Those are the conclusions logically developed from Bartel's statements, not to mention the hypotheses built upon them of latency, of destruction of the bacilli by the glandular tissues, &c., to which we shall refer in another place. The results obtained by Bartel may be thus explained. The animal experimented upon by Bartel with its latent focus of a hundred and four days was a rabbit, and was fed with human bacilli. Now, rabbits are hardly susceptible to human bacilli. If a rabbit be inoculated either subcutaneously, intestinally, or by any method, with human bacilli, it causes no appearance of irritation in the glands, being inoffensive to the body of the rabbit, as the numerous experiments of Weber, Oehlecker, &c., have proved; therefore they suffer from no affection of the glands after inoculation, as do men and guinea-pigs; but the bacilli pass through the glands almost like granules of Indian ink, without exciting the glands to reaction, and so arrive in the blood passages and then in the lungs and other organs. Here they may exist for a time (as in Bartel's case for one hundred and four days) without producing any changes, or they induce slight but not specific irritation of the cells, which Bartel designates the lymphoid stage of the tubercle; but in many cases—with a stock that is specially virulent, or in the special susceptibility of the rabbit—they form real tubercles in the lungs and kidneys; but these are mostly of transitory character. The fact that they are to be found more in the glands than in the organs is explained by the fact that the glands are reservoirs for the organs.

The whole of these experiments of Bartel—which induced Weichselbaum to make a stand against the law of localization, and which induced Salge and many other authors to favour the

opinion that tuberculosis of the glands without perceptible anatomical changes had been demonstrated, a view which would inaugurate vast changes in the opinions of the point of entry (Chiari)—lose much of their weight from the fact that Bartel inoculated an unsuitable animal, with unsuitable tuberculous material.

It is not a question here of glands, in which up to that time there were no specific changes, though these perhaps might have arisen later; but it is a question of the presence of bacilli, which, though never at any time capable of producing specific changes in the body, would have died out had not Bartel saved them from extinction by inoculating them into another susceptible animal.

Bartel's and Weichselbaum's protest against the law of localization is, therefore, completely unwarranted, and cannot be maintained, on account of the misdirected arrangements of his experiments.

But also the further conclusion, that the whole of the glandular system, "every group of glands," could be attacked by latent tuberculosis, falls to the ground with it, not to mention that a very natural explanation may be given of Bartel's concrete case, the simultaneous pressure of bacilli, active of themselves, in the neck, mesenteric, and bronchial glands from accidental inspiration of bacilli at the time of feeding, as in analogous cases of Kovács', without assenting to Bartel's theory of "dispersal" over the whole group of lymph glands. This dispersal over the whole group of lymph glands has not been demonstrated in any single case, as direct spontaneous infection of the above glands is not excluded.

Further, if Bartel has, by means of "artificially modified" bacilli, produced in animals such so-called lymphoid tubercles (swelling of the follicles and endothelium lymphoid hyperplasia, which are the lowest degree of specific change of tissue), it may be scientifically very interesting, but as we men have unhappily to reckon with infection by natural bacilli and not those artificially modified and prepared in the laboratory, these laboratory experiments are unimportant for human pathology and infection as it occurs in nature.

But how long will it be before references to these achievements of Bartel, as a protest against the law of localization, disappear from our literature?

The law of localization agrees completely with our experimental experience, on which it is based; till now no proof to the contrary has been adduced which is entirely free from objection.

Weleminsky has also confirmed, in agreement with me, by

experiments on 1,000 animals, that when infection takes place it is always the glands of that part which are first infected; Kossel, Weber, and Beitzke have also arrived at like results after numerous further experiments on animals.

EXPERIMENTAL ERRORS.

Where apparent contradictions occur they may, as a rule, be traced to the faulty arrangement of the experiment or to mistakes in observation, to which such experiments are frequently exposed; frequently a previous spontaneous infection in an organ other than the one inoculated may give rise to illusions, or the animals are allowed to live too long, so that the striking differences are effaced; very frequently a too large quantity of material for infection is employed, against which the filtering power of the glands is quite impotent. Thus experiments have been published which, if made on a man weighing 70 kg., would represent an intratracheal injection of 350 grammes, an overwhelming dose of tubercle bacilli, or an intraperitoneal injection of 1½ litres of infective material. Old cultures of unknown virulence, doubtful vitality, and simply poisonous activity, or an unsuitable type (human type on rabbits) will derange the results; thus, in Paris during the eighties, for a long time "Parisian culture" of the avian type was unintentionally employed, and Oehlecker proved that Weleminsky, in spite of his assurances to the contrary, inoculated human instead of bovine bacilli, without being aware of it. Often the material for inoculation in a different series of experiments is dissimilar. In subcutaneous injections small vessels are often pierced, and unconsciously direct infection of the blood is produced, frequently unintentional double or super infection is associated in the cattle-shed itself, *e.g.*, spontaneous inhalation, or intestinal infection by means of tuberculous material from subcutaneous foci which have burst; or by incautious handling of the material for inoculation on the part of servants; unintentional or even malicious change of the animals by the employees.[1] In most cases, too, few animals are used for the experiments, and so accidental divergencies have the appearance of being the rule.

All these vexatious sources of error take place oftener than one thinks, and may even sometimes happen to the most conscientious and skilful investigator. Many of the experiments which are current

[1] The influence of bicycle riding on the heart was being tested in a clinic, but the cyclists preferred to go to the nearest public-house to quench their thirst with the fee thus obtained, and afterwards had their "cyclist's heart" examined.

in literature and accepted as a revelation, and quoted again and again, carry with them, for those acquainted with the matter, the stamp of their defects and their incredibility. So much the more justifiable, then, is the demand that experiments which claim notice should not be made on twenty or thirty animals, but on a large series, that they should be tested on animals kept to control the experiments and be repeated at least once more under different conditions before they are given to the literary world, and that the arrangement of the experiment and the results should be most exactly communicated even to the smallest detail—a strange demand, perhaps, in the present day, with its more extensive than intensive work and haste to communicate results before the ink is dry on the paper.

The law of localization agrees entirely with the experience of morbid anatomy (Tendeloo, Albrecht, &c.), which teaches that bacilli may migrate through skin and mucous membrane, but are stopped at the next lymph gland, and tuberculous changes are induced. This is further confirmed by anatomical examinations of the lymph system by Most, Beitzke, &c.

We are therefore certainly justified in concluding the point of entry from the seat of a primary tuberculous affection, and also justified in concluding with some amount of certainty its relative age from the intensity of the focus.

We have devoted so much consideration to these objections, because the law of localization is the foundation of a correct conception of tuberculosis and scrofulosis and the paths they follow. That there are exceptions to the rule has never been denied, for Nature knows no hard-and-fast rule; as the heart sometimes lies on the right side, and a man is born with six fingers, so under certain circumstances may the bacteria deviate from their usual paths, especially at their first entrance, but that does not alter the rule any more than the cases just mentioned, and also does not alter their practical importance.

It is a pity, in view of the importance of the law of localization, that many distinguished investigators, evidently without having given any very deep attention to the question, satisfy themselves with a very diplomatic "*non liquet*," and so indirectly abet the most daring speculations.

Many hypotheses have arisen and again disappeared; the theories of v. Behring would have been avoided from the very first by a careful consideration of experiments on animals and their consequences. B. Fischer and others say: "Hamburger rightly remarks that the law of localization is an ever-recurring fact, and is observed again and again by all authors."

A further question, but one not directly connected with the law of localization is, what is the further path of the infection when it leaves the lymphatic glands seated nearest to the point of entry? For further information, see p. 122.

Granted the law of localization, the question of the most important source of infection in man, that of inhalation by the lungs, is settled. Tendeloo, Eugen Albrecht, Goldschmid, E. Kaufmann, Most, Spronck, Ribbert, Lubarsch recently declared themselves for it on the ground of their anatomical experiences; v. Schrötter, Montgomery, A. Fränkel on the ground of clinical facts (at least for adults); and Geipel, Beitzke, Winkler, Medin, Mallinkrodt, &c., for children.

The preponderance of tuberculosis of the lungs over intestinal infection, even if we concede numerically equal opportunities of infection, is to be explained by the fact that, among all classes of animals which have up till now been experimented upon, considerably fewer germs of infection are necessary for infection of the lungs than the intestines.

Thus in parallel experiments by Kuss and Lobstein extensive tuberculosis of the lungs appeared after inhalation, whereas animals fed with the germs remained healthy. Pfeiffer and Friedberger caused animals to inhale 3,000 tubercle bacilli; amongst twenty-nine animals, twenty-two had tuberculosis of the lungs, whilst among twenty-eight animals fed by means of the œsophageal tube with 3,000,000 tubercle bacilli three had slight tuberculosis of the mesenteric glands, four had isolated foci in the lungs from aspiration, and twenty-one showed no changes.

According to Bongert, rats, which are hardly susceptible to tuberculosis, can with difficulty be infected subcutaneously or per os, but with inhalation they were infected without exception. Reference must be made to the small quantity of tubercle bacilli required by Findel, Laffert, Reichenbach, Alexander, Weber, to induce infection by inhalation, against the enormous quantities which were, as a rule, required to produce intestinal infection. (For details and reasons, see p. 114.)

It is an important question, especially with reference to the later fate of those suspected to be suffering from scrofulosis, who have tuberculosis of the tonsillar or neck glands, whether the tubercle bacilli can arrive by a more direct lymphatic passage from the organs of the neck (besides their dispersal by the blood passages through the usual anatomical channels, through the thoracic duct, and superior vena cava on the right side of the heart), either through the supraclavicular glands to the summit of the pleura and the apices of the lungs, or in a continued chain to the bronchial glands, and so produce tuberculosis of the lungs.

Aufrecht, Grober, Rumph, Beckmann, M. Wassermann consider the tonsils to be one of the most frequent points of entry of tuberculosis, and that tuberculosis of the lungs arises from them. (See also v. Behring, Goehedini and Roux, Josserand, Freudenthal.)

Now the tonsils are not so frequently tuberculous that they can be considered as a decisive point of entry. Wex found in 210 cases of pharyngeal tonsil 3·3 per cent.; Lubarsch in Posen 1·5 per cent. among sixty tonsils in children; Friedmann only once found primary tuberculosis; Cahn found primary tuberculosis of the pharyngeal tonsils in about 4 per cent. of the cases of adenoids. Only Gördeler gives higher figures in pharyngeal and palatine tonsils 12·75, but his cases are too few—forty-seven in all—and therefore more subject to chances (see pp. 140, &c.). Gördeler's discoveries (upon which Aufrecht takes his stand) of tuberculosis of the tonsils, neck, and bronchial glands, with and without tuberculosis of the lungs, are just as little confirmatory, as the tuberculosis of the lungs and bronchial glands may just as well have arisen by inhalation, from the same source of infection, independently of the tonsils.

Aufrecht, denying tuberculosis by inhalation, considers the path from the organs of the neck to the bronchial glands as "the only one that has been proved," and attempted to confirm this opinion by seven experiments on rabbits, whose pharyngeal organs were "painted" with a swab of wadding dipped in the lung of a phthisical tuberculous person. No theory can be confirmed by seven experiments on animals. Besides which, two of these animals were healthy after a period of two years; one died prematurely, so only four remain, of which two at most, by the most charitable interpretation, can be said to confirm the possibility of Aufrecht's path of infection, inasmuch as the neck glands and lungs exhibited isolated foci. But there can be no question of proof, for it is infinitely more probable in this case that these foci in the lungs were due to inhalation of the infective material, in consequence of the choking movements caused by painting the walls of the pharynx. It may be noted incidentally that the condition of the glands remarked by Aufrecht is contrary to our experience (Weber, Oehlecker), according to which rabbits, after infection by the human type of bacillus, exhibit no affection of the glands.

Finally, anatomical reasons can be adduced against Aufrecht's path of infection, for both Beitzke and Most found in their examination of the path of the lymph channels that no lymph vessel could be discovered leading from the neck to the bronchial glands (see p. 122). But supposing that now and again bacilli could reach

the bronchial glands by collateral paths, we must not think that, on the ground of this anatomical possibility, the circuitous route is the rule.

Grober supposes that the bacilli reach the supraclavicular glands from the neck glands, and so arrive direct to the summit of the pleura and the apices of the lungs. He refers to his experiments in which, after injecting Indian ink into the tonsils, he traced the granules to the pleura and apices of the lungs.

Beitzke's after-test, however, makes it probable that the result obtained by Grober rests on an error in the experiment; and this result may be explained by the possibility of aspiration into the trachea of some of the fluid used or of some of the injection which had been again pressed out of the tonsil. Neither he, nor Hart, nor Most succeeded in infecting the lymph vessels leading from the lower cervical glands in the pleura (see p. 124).

Wood considers the advance of a tuberculous peri-adenitis from the lowest cervical gland as possible, but rare, whilst Aufrecht, in opposition to Grober's experiments, emphasizes the differences between the unnatural, enormous inundation of the finest non-irritant granules, caused by the pressure of the injection, and infection by bacilli which irritates the tissues. So infection of the bronchial glands and lungs through the organs of the neck is, up to date, not proved with certainty, and although from the results of experiments it is not to be entirely denied (see p. 126), it cannot be taken as of frequent occurrence; for the simple fact that in tuberculosis of the lungs frequently, and with adults as a rule, tuberculosis of the neck glands is not present, refutes this idea. But if bacilli could reach the bronchial glands from the neck glands they would form a necessary connecting link.

If children with scrofulous neck glands develop tuberculosis of the lungs later, we may consider, as a rule, that independent further infection of the lungs has taken place by inhalation, unless we have to do with infection of the blood, an invasion of the bacilli into the blood channels, an admission which imposes increased caution, especially in its prophylactic bearing. (It is not the place here to enter into Aufrecht's further hypotheses on the hæmatogenous genesis of tuberculosis of the lungs.)

B.—BOVINE TYPE.

As we have seen in the spread of tuberculosis, the representative of which (consumption of the lungs) causes eleven-twelfths of all fatal cases, tuberculosis amongst cattle comes, in general, little into consideration. But it forms a very considerable source of scrofulous tuberculosis, especially tuberculosis of the

neck and mesenteric glands. But we cannot sufficiently study its full importance on account of the difficulties of confirmation.

Before we pass on to particulars it would be well to cast a glance at the epidemiological and statistical researches as to the connection between bovine and human tuberculosis, which will open up important points of view for scrofulosis.

Bidert, with his brother, confirmed in Allgäu that, in spite of the great consumption of raw milk, human tuberculosis amongst the entire population is not dependent on the frequency of bovine tuberculosis. According to Meyer, in England and other English-speaking countries, in spite of the customary drinking of raw milk and a large percentage of tubercle bacilli in the milk, the total number of persons suffering from tuberculosis is much lower than on the European continent, where, as a rule, milk is boiled before being used. Inversely, tuberculosis causes a higher rate of mortality in Sicily and Sardinia, although, according to Vestea, bovine tuberculosis is almost unknown in those islands. In Münster and Osnabrück, in spite of frequent human tuberculosis, bovine tuberculosis is very rare. Amongst 6,500 oxen which were slaughtered not a single one was tuberculous (Kasselmann). In nine poor villages in the district of Oderbruch, with 1,637 head of cattle, during six years there was no death from bovine tuberculosis, whilst human tuberculosis is of frequent occurrence in this district (Zippelius).

In the provinces of Denmark the spread of human tuberculosis does not run parallel with that of bovine (Rördam).

In Japan there is high mortality from tuberculosis among children, although till a few years back the consumption of beef, and more especially the drinking of cow's milk, was almost unknown. The same is reported of China, the Philippines, and the Gold Coast, of Turkey, and Greenland (Shiga, Kitasato, Cobb, R. Fisch, Rördam, Heymann). In certain parts of Roumania tuberculosis is very widespread in districts where cow's milk is never given to children. Similar observations have been made by v. Stark in Prussia, Ganghofner in Bohemia, v. Vogel in Bavaria.

Exceptions to this rule, which have been communicated from observations made in small districts, such as from Sabotta, are subject to chance, and therefore cannot be taken into consideration.

The preceding statements compare bovine tuberculosis with human tuberculosis in general, that is, with phthisis of the lungs, and are therefore at the same time valuable documents against the opinions formerly held by v. Behring, that infection by tuberculous milk was the cause of phthisis in later life (it is

known that later v. Behring gave a different interpretation to his thesis). These resuits prove that there is no statistical connection between bovine tuberculosis and the drinking of milk, and they contradict in a decided manner the idea of a change by culture of bovine into human bacilli, also the transition of scrofulosis of the neck or mesenteric glands to phthisis.

We get quite a different picture when we compare bovine tuberculosis statistically with abdominal tuberculosis, which is partly dependent on it. Thus in England, where more unboiled milk is drunk than in Germany, tuberculosis of the intestines and mesentery is apparently more frequent (Cattle). According to Raw, human tuberculosis is on the decline in England, whilst abdominal and bovine tuberculosis is on the increase. In countries where little milk is used, as in India and Egypt (Heyman), bovine tuberculosis is rare (Raw), in spite of more frequent phthisis amongst adults. In India the natives and children are almost free from tuberculosis, whilst Europeans frequently suffer from it; the former take neither beef nor cow's milk, only goat's milk. (Reid, quoted from Raw.) On ninety-seven Norwegian farms Overland found a greater or lesser frequency of human and bovine tuberculosis. On forty-three farms where there were tuberculous persons, 522 animals (6·7 per cent.) reacted positively.

On fifty-four farms without tuberculous persons, 635 animals (2·5 per cent.) reacted positively; on the other hand, on thirty-four farms where there were tuberculous cattle, tuberculous persons were found twenty-one times (61·7 per cent.).

On sixty-three farms without tuberculous cattle, tuberculous persons were found twenty-two times (34·9 per cent.).

The positive reaction may as well have been caused by the bovine as by the human type, and be due entirely to tuberculosis of the neck and mesenteric glands.

According to Tedeschi and Lorenzo, phthisis is very rare in a population which was solely of pastoral habits, living always in the fresh air; but tuberculosis of the glands and bones and scrofulosis were very general.

Davies found in London from 1892 to 1902 a decrease of almost one half in the mortality from tuberculosis, tabes mesenterica, and tuberculous peritonitis, and ascribes it to better weeding out of tuberculous cows and a more careful sterilization of the milk. Raw made the same observation as to Liverpool.

On the contrary, according to Tonzig, tabes mesenterica is more prevalent in Italy, in Bari, Avellino, where very little cow's milk is consumed and where goat's milk is drunk, than in other

towns, *e.g.*, Pavia, Piacenza, Como, Bergamo, where cow's milk is more especially drunk.

Anyway, the spread of bovine tuberculosis appears to exert an influence, statistically proved, on the frequency of tuberculosis of the organs of digestion, which also includes a part of scrofulosis, but which is subject to great variations from the different local manners and customs of the population (consumption of raw or boiled milk, &c.).

Extent, Degree, and Danger of Bovine Infection.

The genesis of scrofulous tuberculosis was in part only intelligible to us through a more exact knowledge of bovine infection in man.

Opportunities of infection through tuberculous cattle differ widely from those through tuberculous persons. In the latter the secretions, especially the dried expectoration of those with an affection of the lungs, play the principal part in infection. With tuberculous cattle this danger falls into the background, for, as a rule, we have here to do with foci, and where open foci appear, the expectoration is swallowed, and only appear again in the excreta; the air of the sheds, which is usually moist, prevents pulverization of the hygroscopic, sticky conglomeration of bacilli; in the open air the dispersal of the bacilli, in the enormous ocean of the air, hardly offers a real danger in the vicinity (Cornet, "Die Tuberculose," second edition, p. 105).

Now and again by the coughing of the cattle, or by nasal secretions containing bacilli, the germs may be dispersed, and, in the case of close contact, may endanger the human respiratory passages.

Adults are, however, protected from actual disease by their high power of resistance to bovine bacilli; but if children are much in the cowsheds or live with the animals, infection of the respiratory organs, especially of the bronchial glands, which runs a favourable course, may take place.

Doubtless meat, milk, and milk products are a far more important source of infection.

Opportunities of Infection by Tuberculous Meat.—The least dangerous of these sources is the flesh of tuberculous animals, especially in its natural form, because as a rule the diseased parts lie at a distance; it is much more dangerous when chopped up, and especially in the preparation of sausages, in which unscrupulous manufacturers offer, with tempting appearance, to the confiding public, big and little, high and low, those parts of the

beast which are tuberculous, diseased, and loathsome. The secrets of the sausage machine, the extensive commerce in sausage meat, and the barrel upon barrel of tuberculous lungs, liver, and scraps form a constant subject for our law courts, and give us an idea of the quantities of meat in the market containing tubercle bacilli.

Also the meat and refuse of tuberculous pigs, especially in sausages, must be included in the opportunities for infection, more especially as the pig is very susceptible to both types of tubercle (Kossel and Weber). The bovine infection is mostly found in consequence of the frequent feeding with tuberculous skimmed milk from dairies.

According to the experiments of Tonzig, the tubercle bacilli retain their vitality a long time in sausages and smoked provisions.

The danger of tuberculous infection by means of meat supplies is in general little considered, perhaps too little, for it seems just the slow mastication and swallowing of solid material, as sausages, although it may not contain so many bacilli as tuberculous milk, must endanger the tonsils and neck glands to a greater degree than the transient passage of milk, and lead to the adhesion of small infectious particles in the recesses of the tonsils, especially when they are in a hyperplastic condition through a state of pyogenous irritation.

Opportunities of Infection by Milk.—The greatest danger of bovine tuberculosis occurs in man, especially in children, by means of milk and its products, butter, cheese, and curds and whey, in which the tubercle bacilli which were present in the milk retain their vitality.

The following figures show the abundance of these sources of infection. According to Glage, there were in the German Empire in 1905, amongst the animals slaughtered, 17·39 per 1,000 cattle, 0·91 per 1,000 calves, 4·26 per 1,000 pigs, which were affected with important forms of tuberculosis, according to the veterinary inspectors; among the cattle the principal contingent was cows.

Tubercle Bacilli contained in Milk.

Examination of the milk itself gives us the best information; 54 per cent. tubercle bacilli were demonstrated in milk samples, and 47 per cent. in samples of butter (Nonewitsh, in Wilna).

In 210 milk samples put on the market in Leipzig, Eber found tubercle bacilli in 22 (10·5 per cent.); in 150 butter samples, 18 (12 per cent.); in 50 cream and curds and whey samples 4 per cent.; 150 margarine samples contained no tubercle bacilli.

In the milk of New York, A. Hess, in 107 samples, could

prove virulent tubercle bacilli in 16 per cent.; Gorton in 10 per cent. Amongst 100 samples of milk for sale in London, Klein found tubercle bacilli seven times, Robertson and Malcolm in Birmingham (America) in more than 10 per cent., and milk from railway stations in 14 per cent. (See also Lindenstein's statistics.)

We must realize in this connection that, according to Ostermann, in 3 c.cm. of milk from a cow with a tuberculous udder, 50,000 to 100,000 tubercle bacilli are not uncommon; there may be even 1,000,000. Bang found in one single field of vision 200 bacilli, a quantity which in the ordinary mixed milk which comes into the market sinks to about 1,000 bacilli in 1 c.cm. of milk, 100 bacilli in butter (v. Bongert, Kuhn, Ostertag).

According to the inquiry of the Agricultural Society, Kühnau reckons the number of animals in Germany suffering from tuberculous udders as 50,000 to 100,000 among a total of 10,000,000 milch cows. These cows with tuberculous udders give, according to Kühnau, 50,000,000 to 100,000,000 litres of milk containing tubercle bacilli, which exposes about 700,000 persons to the danger of taking tuberculous milk.

Primary Tuberculosis of the Intestinal Canal.

Infants are most exposed to danger, both by their great susceptibility for the bovine bacilli and also by their being often fed entirely on milk; but in highly civilized countries they generally have boiled milk, and although the degree of heat is often insufficient, and the one short boiling is not sufficient to destroy all bacilli contained in the milk, the danger is lessened, though not entirely avoided. In the following years of childhood, when milk and butter are freely consumed, the number of opportunities for infection are much greater, in fact, enormously great; but apparently the number of real infections which exhibit themselves mostly in the intestinal, mesenteric, and neck glands does not agree in the slightest with the magnitude of opportunities for infection, for primary tuberculosis of the intestinal and mesenteric glands is, according to repeated experience, relatively rare.

Morbid Anatomy Experience.—According to Baginsky, intestinal tuberculosis is almost unknown amongst infants; in 933 cases of tuberculosis in children, he never found isolated intestinal tuberculosis without disease of the lungs and bronchial glands; and amongst a further 806 *post-mortem* cases most carefully examined, in which 144 persons were tuberculous, six had caseous tuberculosis of the viscera, and most of them between the ages of 5 to 10 years. Mendelsohn found, amongst 278 autopsies on infants (fifty-seven of whom were tuberculous), no

single case of primary tuberculosis. Also, according to Heubner, primary intestinal tuberculosis is very rare; in from 8,000 to 10,000 autopsies, v. Hansemann only confirmed twenty-five cases of primary intestinal tuberculosis; Hunter, amongst 5,142, thirteen cases (0·25 per cent.); Biedert, amongst 3,104 tuberculous children, only sixteen cases.

In the Charité Hospital, during five years, only ten cases of primary intestinal tuberculosis occurred (Virchow); amongst 131 children Orth found intestinal tuberculosis in 1·5 per cent. (Koch). Benda, with his very large number of patients, only mentions two to three cases of really primary intestinal tuberculosis in one and a half years.

Tendeloo also emphasizes its extreme rareness, and Ribbert and Albrecht express similar opinions.

Further, Zahn found in 6,320 autopsies (including a few children), amongst which 2,058 were on tuberculous persons, forty-three cases of primary intestinal tuberculosis, and according to Löffler, Grawitz in Greifswalde, in 1,934 autopsies, amongst which 320 were on tuberculous persons, only four cases of intestinal tuberculosis, and even these could not be stated with certainty to be primary. Also, according to Krabler, primary intestinal tuberculosis is almost unknown in Greifswalde, although Löffler found in mixed butter 88 per cent. of tubercle bacilli. In Tübingen, amongst 1,407 autopsies on tuberculous persons, Grosser only found one case (Koch, see also Lomini, Rowland Godfrey, and Freeman). Heller and Wagener give higher figures. Heller, who at the same time emphasizes the fact that much unboiled milk is consumed in Holstein, found in Kiel amongst 714 children who died of diphtheria, 140 with tuberculosis of the lungs, 53 with primary tuberculosis of the digestive organs —7·4 per cent. of the diphtheritic cases, 37·8 per cent. of the tuberculous cases. In seventy-six autopsies of children from 1 to 15 years of age, Wagener found thirteen (17·1 per cent.) with primary tuberculosis of the intestines and mesenteric glands with evidence of bacilli, and three without bacilli, and seventeen (22·4 per cent.) with tuberculosis of other organs.

Heller and Wagener seem to have reckoned amongst their cases those in which a simultaneous tuberculous bronchial gland and a healed tuberculous focus in the lungs made the primary affection doubtful.

In 220 cases of diphtheria, Councilmann, Mallory, and Pearce in Boston found thirty-five with tuberculous foci, thirteen with primary intestinal tuberculosis, making 5·9 per cent. of diphtheria, and 37·1 per cent. of tuberculosis.

In contradiction to Heller, who attributed the low figures of other authors to faulty technique in dissection, Ganghofner found in the Pathological Institute in Prague 972 persons who died of acute infectious diseases, of whom 252 were tuberculous patients; only five cases of primary intestinal tuberculosis were found, making 2 per cent. of the tuberculous patients. Beitzke reckons amongst tuberculous children 16 to 20 per cent.; Price-Jones (England) about 25 per cent. who suffer from primary intestinal tuberculosis (quoted from Beitzke); Fibiger and Jensen reckon that primary intestinal tuberculosis is to be found amongst 6 per cent. of all patients, and 11 per cent. of all suffering from tuberculosis, and amongst children even 16 per cent., a remarkably high figure (see also Ipsen), for which at present no explanation can be found. The vast differences may be caused, partly by the difference of material, by the age, by the different conception of the changes due to the disease (chalky foci, &c.), and also partly by not taking the smallest foci into account. This much is clear from all these details, that even if we accept the highest figures, primary intestinal and mesenteric tuberculosis is not nearly so widespread as we are led to expect from the excessively frequent opportunities of inundation with bacilli to which the human digestive canal, especially in children, is exposed.

The disproportion between opportunity and infection is so much the more accentuated because, amongst the cases of primary intestinal tuberculosis only part are caused by bovine bacilli and others by the human type.

Milk containing tubercle bacilli, which in calves, pigs, and sheep so easily causes tuberculosis (whilst these animals when fed with tuberculous sputum are seldom or never infected), is evidently not to any great extent dangerous for mankind.

Clinical Experience.—Clinical experience has but in few cases shown in a manner free from all objections, *i.e.*, by absolute proof, that the intestinal malady is of bovine nature, by demonstrating that the food was infectious, and that there was no possibility of any other mode of infection—that a tuberculous disease was the immediate consequence of the consumption of food containing bovine bacilli.

The older observations of the same sort recorded by Ollivier, Grosse, Stange, Johne, Uffelmann, Göring, Schöngen (Koch has collected twenty-eight such cases from literature on the subject and closely criticized them), and the cases of v. Hansemann, Cowie, Hüls, cannot be accepted as conclusive evidence in all respects.

Recently a series of cases has been communicated, according

to which, even after long continued consumption of milk from tuberculous cows, no evil consequences followed (Gallaverdin, and the cases referred to by A. Weber, of Sermasi, Joergen, Stowell).

A. Hess, while pursuing his investigations on New York milk containing 10 per cent. tubercle bacilli, found that some of the children, who had drunk raw milk containing bacilli, on being examined a year later were in good health; a fourth of these on being tested gave a positive reaction, but doubt exists whether it was due to the bovine type of tuberculosis.

As a proof beyond question of the conveyance of bovine tuberculosis by infected milk the following is instructive—Watt's observation. In a farm only inhabited in summer by three children free from any inherited disease, two died of meningitis and mesenteric tuberculosis after the consumption of milk from a cow affected by general tuberculosis and tuberculosis of the udder; in one case (which is quoted by Weber) the character of the disease was established; further, there are two cases by Fibiger and Jensen—Case 11, and especially Case 12. A little girl, aged 1½, coming of a healthy family, died of severe tuberculosis of the glands of the intestines, mesentery, pharynx, and neck after feeding for about a year on raw milk from a very tuberculous herd of cattle, from which shortly before a cow suffering from general tuberculosis and tuberculosis of the udder had been removed and slaughtered.

We may mention here the observation of Weber, in Giessen: a woman, aged 29, during the last two years had lived partly upon raw milk from a cow undoubtedly tuberculous; in her case tuberculosis in the mouth was shown by Kossel to be of bovine origin.

Monsarrat tells of a district of 7,000 to 8,000 inhabitants which, from 1894-1898, derived its milk from very tuberculous cows (thirty-one out of thirty-six being tuberculous). The number of children under 15 dying of abdominal tuberculosis was: from 1891-1894, 9; 1895-1899, 38; 1900-1907, 8.

The scarcity of reliable observations of this kind depends partly upon the difficulty of establishing subsequently when a disease attacks man, the previous consumption of milk that was perhaps infected, and the source whence it came.

Collective Investigation.—The danger of drinking milk containing tubercle bacilli has been tested from another side. On Koch's initiative, cases of proved tuberculosis of the udder of cows were sought out, and then inquiries were made as to how long the disease had lasted and what people, especially children, had for some time taken the infected milk or butter, whether and how the milk was cooked, and what people had been taken ill.

Weber informs us, after investigations lasting over eight years, and not even then completed, that 113 cases were collected; of these there were 69 in which raw milk of cows suffering from tuberculosis of the udder or products from the infected milk (butter and cheese) were consumed by 360 persons (of whom 151 were children) during a long period.

Only in two families (in each one child) could an infection with bovine tuberculosis, namely, tuberculosis of the neck glands of bovine character, be established with certainty; in both cases feeding with infected milk continued from the time of weaning, and lasted from one year to one year and a half. Besides this, swelling of the neck glands occurred in six children and one adult; in four other children and one adult suspicion of abdominal tuberculosis occurred, but "disappeared"! Another child was reported to be suffering from scrofulosis; in 133 other children and 151 adults who had taken milk, said to be cooked, of a cow suffering from tuberculosis of the udder, or had taken mixed milk (in the form of butter) of many cows, twelve children and one adult showed swelling of the cervical glands.

It cannot be denied that these results, in view of the pronounced and long continuing opportunity of infection, appear surprisingly insignificant, even when we reckon all doubtful cases as tuberculous and of bovine origin.

The collective investigation proves that the bovine bacillus in childhood is frequently non-virulent or only slightly virulent.

These researches naturally do not prove that in spite of them a number of persons, unknown to us, may have had tuberculous mesenteric glands without any evident indication, and which, in accordance with the slight pathogenic nature of the bovine type, after some time disappeared spontaneously.

In the same way many small foci in the neck glands may have escaped observation. That does not alter the fact of the circumscribed virulence of the bovine bacilli; but for the understanding of scrofulosis, and especially for the interpretation of apparently motiveless cutaneous reaction, we must keep in mind its possibility, and even its probability.

Unfortunately, at that time v. Pirquet's reaction was not known; this would doubtless have given us many interesting disclosures.

The Difficulties of Intestinal Infection.—The reason of the relative infrequency of distinct infection rests partly on the fact that the intestinal tract is, of all the organs of the body, the least accessible to a tuberculous infection of either bovine or human bacilli.

Thus, for example, Findel found that by ingesting 19,000 to 382,000 tubercle bacilli the animals did not become tuberculous, while twenty bacilli by inhalation were sufficient to produce tuberculosis; after further experiments, he concluded that the minimum fatal dose in ingestion is about six million times greater than the minimum fatal dose in inhalation.

According to Laffert, a single ingestion of 40,000 bacilli and a repeated dose of altogether 1,200,000 in guinea-pigs produces no tuberculosis; a two-millionth part of the dose, which in the intestine produced no tuberculosis, is sufficient to produce, by inhalation, a most severe lung tuberculosis (see also Kuss and Lobstein's researches). In rabbits, according to Alexander, an ingestion of 5 mg. of bacilli of human type repeated six times had no result; an ingestion of even 10 mg. of bovine bacilli repeated five times gave a doubtful result; whereas inhalation of 25,000 to 50,000 bacilli of human type, and of 100 of bovine type, had a very decided result.

Similarly, according to Reichenbach, who attaches special importance to the repetition of infection, guinea-pigs become tuberculous after inhalation of three doses of 3 mg. tubercle bacilli, and after ingestion of 0·02 mg., repeated fifty-one times, which equals 1·02 mg. (see also pp. 102-3). Weber and Titze showed in cattle that for infection by ingestion at least 10 mg. bovine bacilli are necessary, while injection by inhalation, with a thousand times fewer (100 mg.), succeeded. The difference is really greater, for in the case of bacilli sprayed for inhalation only a very small number get access to the deep recesses of the lungs in inspiration.

v. Behring has repeatedly referred to the researches of Vallée, according to whom tuberculosis in cattle is easily obtained by ingestion, but with inhalation is obtained with difficulty, or not at all. But these researches are not of much value; for, as Spronck remarked at the Fifth International Conference on Tuberculosis, in these ingestion experiments milk of a cow suffering from tuberculosis of the udder was employed, therefore quite virulent material; for the inhalation experiments, on the other hand, he employed a pure culture of bovine bacilli cultivated for a period of ten years in the laboratory, and so a material of very doubtful virulence. Therefore, without doubt the intestinal tract is very difficult to infect.

Weber, Flügge, and Ostermann conclude from this that, for infection of the digestive canal, repeated ingestion of an immense number of bacilli is often needed—a number which usually is not found in shop milk, or butter made from such milk. But I

consider the deduction, that repetition plays an important part and is more effective than when the whole quantity is given all in one dose, is not proved (see also Reichenbach's researches). Why should the repeated administration turn the scale? Must we then conclude that the next bacillus, or next but one, that is inoculated takes exactly the same spot for its point of attack in the enormously large intestinal surface as its predecessors, or by the earlier introduction, which was ineffective, the whole body, or at least the whole intestinal canal, is so altered that it is much more receptive for the further ingestion of the bacilli? Neither the one nor the other is proved or probable; on the contrary, perhaps we may rather suppose that a certain protective effect has been obtained.

The frequent introduction of a small quantity will hardly be likely to make infection more probable than the introduction of the same quantity all at once. In the Franco-German war, as is well known, according to statistics, there were about 1,000 discharged bullets to only one wound; but it would not enter into anyone's head to say that a battle in which 100,000 shots were fired was less dangerous than ten battles each with 10,000 bullets.

According to my view, some researches which I made some years ago are of interest, even if their small number (I think it was six) do not make them conclusive.

I kept guinea-pigs without food so that the intestine was at rest. In consequence a much smaller quantity of tubercle bacilli was sufficient for infection of the intestine than without this preparation beforehand. Unfortunately, I have lost count of the exact number of bacilli used. This much appeared to me evident, that the severity of infection does not lie in the insusceptibility of the intestinal mucous membrane, but in the quick passage of the infected material, which does not allow the bacilli to get a firm hold or to settle, and also in the mixing with the intestinal contents and in the Malpighian layer which covers and protects (see also Cornet, "Die Tuberculose," second edition, p. 235).

Conclusions.—If we collect our experiences it is certain that only a comparatively small number of effective, manifest infections, and those almost exclusively in children, are due to the enormously numerous opportunities of bovine infection in the alimentary canal; the reason for this lies, on the one hand, in the relative difficulty of tuberculous infection of the intestine, but more especially in the circumstance that bovine bacilli are almost avirulent for adults, and are only virulent for children to a modified degree, only very seldom producing a pronounced

tuberculosis (such as often occurs in scrofulous glands), and still less often leading to a progressive tuberculosis.

Small as is the danger in individual cases, the multiplicity of opportunities gives it considerable importance for children.

Skin Infection through Bovine Bacilli.—Bovine bacilli may often take a part in the infections caused by filth, which often lead to scrofulosis only in consequence of the anatomical difference of the skin; the clinical effects are distinct from the skin affections of adults previously mentioned (see pp. 64 and 80).

Tuberculous skin affections and lupus have been recorded by Leloir, Grothan, Priester-Heller after fomentations with raw milk and cream, which are customary among the lower classes. Such infections and glandular swellings in the neck, for example, can arise from the mucous membrane, especially in children, without visible primary affection at the site of origin.

Infection of the Lungs and Bronchial Glands by Bovine Bacilli.—Besides the digestive tract and the skin, milk containing tubercle bacilli and other dried materials containing bovine bacilli can dry up, pulverize, or spray, and become a source of danger to the respiratory organs and bronchial glands, just as well as human bacilli.

Such a drying up and dispersal is as little to be contested as a casual infection by the inhalation of such bovine bacilli, "for after much rain one gets wet at last."

Latent Foci.—The entry of a small quantity of bovine bacilli into the respiratory organs does not cause any progressive tuberculosis. On account of their low pathogenic nature either no change occurs in the lungs and the bronchial glands and the bacilli die away after a time; or small lymphoid foci form, with no tubercle formation, such as Bartel occasionally found in his interesting experiments on animals; in both cases, however, the further inoculation of such organs into guinea-pigs, which are highly receptive, after a long time has elapsed, produces a perfectly characteristic tuberculosis, a fact which, although all the bacilli have died off, has given rise to the most remarkable hypotheses on latent inducement. Or a large swelling of the affected bronchial glands, or perhaps the nearest glands, occurs; clinical phenomena appear, identical with those which we will describe further below as symptomatic of scrofulosis of the bronchial glands; finally, a spontaneous retrograde metamorphosis occurs, the foci harden and become chalky, but are evidenced for years, even decades after, by allergie and by positive cutaneous reaction to tuberculin.

Post mortem, such foci in the lungs, bronchial and mesenteric glands, proclaim the (bovine) tuberculous processes which had formerly taken place years and decades later by chalk, exactly like completely healed foci of human bacilli, but which probably run so favourable a course much more rarely. It is probably these foci which have often deceived Naegeli and his numerous followers in their studies of latency and which exactly answer to those we have obtained by doing the reverse, viz., injecting calves with human bacilli.

As it is just the so-called Naegeli foci which have led to the formation of hypotheses which are far reaching but erroneous, it appears to me most instructive to add for comparison extracts from the findings of Kossel, Weber, and Heuss in the subcutaneous injection of human bacilli into calves, for which animals they are only slightly virulent, because they give us at the same time a survey of what may be expected in man, in case of incipient bovine infection, which is important also for scrofulosis. I recommend them especially to the notice of those investigators for whom a long latency of the tuberculous foci is an axiom, and a very chalky focus only the expression of an individually defective disposition, while actually only the general insusceptibility of man for that certain type of bacillus is much more frequently the cause.

Naturally one must bear in mind that in Kossel's researches in cattle infinitely many more bacilli were injected than would have penetrated in the case of natural infection in man, and this would cause the extensive though transitory changes at the site of injection, which would be partly compensated by the fact that cattle in general are much less susceptible to human strain than are children to bovine strain.

H2.—Prescapular gland after four weeks the size of a goose's egg; after three months not any larger; after 139 days in cattle a chalky deposit the size of a pea.

H3.—Prescapular gland after seven weeks the size of a hen's egg; not any larger after three months; no change after 121 days, but induces tuberculosis when injected into guinea-pigs.

H4.—Prescapular gland for a long time the size of a goose's egg, then of a hen's egg; after 121 days two foci the size of a hazel nut of yellowish flocculent pus, or a chalky deposit the size of a peppercorn in the gland tissue.

Further in the low neck glands a small cheesy mass the size of a bean; in a second beast in the prescapular gland

after 159 days one the size of a pea, one the size of a hazel nut, and two also the size of a hazel nut, with caseous and chalky contents.

H9.—Prescapular gland after fourteen days the size of a goose's egg; after two months the size of a walnut; after 136 days two cheesy deposits the size of a lentil bean.

H10.—Site of injection, after three weeks the size of a hen's egg; after two and a half only a slight thickening; after 176 days only thickening of the connective tissue.

H13.—Prescapular gland after fourteen days almost the size of a goose's egg; after six weeks the size of a hen's egg; after 130 days two foci the size of a pea, formed by the union of a number of cheesy nodules.

H15.—Site of injection after six weeks a swelling the size of a goose's egg; softening; after six months slight thickening of connective tissue, with numerous cheesy and chalky deposits, which had a virulent effect on guinea-pigs.

H21.—Prescapular gland after three weeks the size of a goose's egg, then smaller; after 203 days unchanged; produces no tuberculosis in guinea-pigs.

H22.—Site of injection, after 143 days, thickening of connective tissue, with two cheesy deposits the size of a pea.

Prescapular gland after fourteen days the size of a goose's egg; after three and a half months no larger; after 143 days a cheesy focus the size of a hemp seed under the capsule.

H23.—Prescapular gland after fourteen days the size of a hen's egg; after two and a half months hardly any increase in size; after 176 days focus only perceptible by its changed colouring; apparently healed tuberculosis, but capable of infecting when injected.

H25.—Prescapular gland after four weeks the size of a goose's egg; after three and a half months the size of a pigeon's egg; after 133 days, at each extremity, a cheesy mass the size of a hazel nut; besides which, the intermediate cervical glands were the size of a bean, with a caseating chalky focus; the lower cervical glands were also enlarged, but without infective properties.

H26.—Prescapular gland after fourteen days the size of a goose's egg, then a retrograde formation; after 130 days a chalky mass the size of a millet seed.

H28.—Prescapular gland after fourteen days the size of a hen's egg; later no increase in size; after 125 days a yellowish focus the size of a peppercorn, which produced tuberculosis in guinea-pigs.

H31.—Prescapular gland after fourteen days the size of a hen's egg; later of normal size; after 136 days showed a yellow cheesy mass the size of a lentil bean, besides three cheesy nodules in the nearest cervical glands.

H33.—Prescapular gland after four weeks the size of a hen's egg; after 131 days contained a chalky mass as large as a good-sized pea, besides several small chalky masses the size of a millet seed or a peppercorn.

H40.—Prescapular gland after ten days the size of a goose's egg; after two and a half months the size of a hen's egg; after 129 days a scar in the connective tissue the size of a hemp seed, and a caseous chalky mass the size of a pea or a hemp seed.

We often find similar foci, even if less pronounced, in rabbits which have been subcutaneously injected with the human bacillus. In view of the reduced virulence of the bovine bacillus in adults and even in children on the one hand, and the numerous opportunities of infection with the bovine bacillus on the other hand, such old bovine foci will be frequently found in the cadaver of children, and as such chalky masses endure for a long time similar chalky deposits are necessarily and certainly found also in adults.

What Naegeli and Schlenker, Burckhardt, &c., who also studied these latent foci, found, only by the most painstaking investigations, were small cheesy foci in the lungs and the bronchial glands and small chalky deposits. Naegeli, for instance, found a "tiny yellowish-green nodule below the apex of the lung hardly the size of a pin's head, small pleuritic scars, and in a tracheal gland some yellowish-grey suspicious nodules with caseation, giant cells, tubercle bacilli," &c.

In view of the possibility that such foci are caused by bovine or human bacilli it was necessary for Naegeli to prove first that his foci were of human origin, therefore capable of full development and having a progressive tendency, before he deduced from them the much greater importance of the disposition of the body than of the possibility of infection and soared to the serious but happily false statement that "every adult is tuberculous."

If Naegeli's foci were, as must be supposed, for the most part of bovine and similar nature which had spontaneously become calcified and had no further powers of development, the cause of this lies in the generally lessened pathogenic nature of this type for men, and not in the increased power of resistance of single individuals, and thus all the conclusions drawn from Naegeli's results fall to the ground.

C.—AVIAN TYPE.

Man appears not to be threatened by avian tuberculosis to any appreciable degree.

Kruse and Pansini have mentioned the cultivation of bacilli from human sputum which behaved in the same manner as avian tubercle bacilli. Further, Joncsó, and Elfer, Löwenstein, L. Rabinowitsch, each found the avian type in one case; how far this had to do with mixed infection remains uncertain.

If, however, by means of the avian type no progressive tuberculosis is produced, the possibility is not excluded that small foci spontaneously retrograding are formed at the site of injection and the nearest gland. L. Rabinowitsch has many times found avian tuberculosis in apes (animals usually not susceptible for avian type), and de Haan has produced fatal tuberculosis by inoculating them.

III.—THE DIFFERENT EFFECTS OF THE INFECTION.

Experiments on animals have in many cases enlightened us as to the reasons why in scrofulosis, and in infection generally, when the bacteria are brought into contact with the skin or mucous membrane, in one case they produce changes, why in another case they pass by leaving no traces and only develop in the glands, and why in a third case they affect both kinds of tissue sympathetically. This different effect depends on (1) the tissue; (2) the nature of the micro-organism; (3) the closeness of the contact.

(1) **The Histological Nature of the Tissue.**—The closer the formation of the tissue the greater difficulty have the bacteria in passing through it, and the more easily are they held back entirely or in part in a dense tissue; *ceteris paribus,* the bacteria are only conveyed if the continuity is disturbed either before, or by the process which has been induced. The mucous membrane lets bacteria pass through more easily, while the cutis is more prone to retain them. It has been found much more easy in experiments to introduce bacilli into the mucous membrane of the mouth and nose and so to the glands without introducing local changes at the point of entry, than in the skin, where it has hardly ever been done without local injury.

The influence of direct injury, epithelial abrasions, &c., will be spoken of later.

State of Nutrition of the Tissues.—When the skin is saturated and bathed to excess with nutritive fluids, as is the case in young

pasty individuals, the bacteria at once find an infinitely richer nutritive material than when, especially in older people, it is dry and poor in lymph.

(2) **The Size of the Micro-organisms.**—The larger the bacteria are the greater difficulty have they in penetrating, and the more easily are they retained, a simple physical circumstance which is usually quite neglected; that tubercle bacilli are much smaller than pus cocci is well known.

Biological Characters.—Single bacteria which have been retained in the skin by their slow growth, which is characteristic of the tubercle bacillus, are much more easily and completely eliminated by the ciliated epithelium and mucous exudations than other bacteria which have great power of proliferation even at a low temperature; these increase so freely in a few hours that even if a part is expelled at the surface a complete elimination does not occur and those remaining behind in the lymph spaces proliferate and are distributed farther. Only by reactive tissue irritation, inflammation or gradual using up of the material can the body rid itself definitely of them. The relative infrequency of tuberculosis of the skin (lupus, &c.), and the frequency of non-tuberculous pyogenic scrofulous skin affections of various kinds is owing to this.

The Number of the Bacteria.—This acts in the same way as the biological conditions. Isolated bacteria pass through the mucous membrane much more easily, and all reach the glands; but in large collections a part is more likely to be held back. By a sufficiently close contact of the mucous membrane of the eye, mouth, and nose with many tubercle bacilli local changes never failed to appear which advanced to the stage of ulceration (tuberculosis of the glands did not appear); on the other hand, with scanty infection, local changes were not exhibited, and tuberculosis of glands resulted.

Virulence.—*Ceteris paribus*, slightly virulent germs, as well as benign foreign bodies, carbon particles, or granules of colouring matter, are more easily conducted to the glands than highly virulent bodies, which, by their vigorous growth and virus, immediately set up a tissue irritation.

(3) **The Closeness of Contact.**—In the skin with no external injury a simple laying on of bacteria is absolutely without any ill result.

Only with tolerably violent friction did I succeed during my numerous experiments in directing the bacilli to the glands without producing local changes, except a tiny scale, the character of which was questionable. On the other hand, with hard

friction, ulceration or lupoid changes constantly occurs, but in this case the full integrity of the skin is no longer assured.

In mucous membranes an infection results much more easily. It is true there is in this case a simple and transitory contact without further consequences (protective mucous covering), but just as the bacilli settling in the alveoli of the lungs can penetrate like the particles of carbon into the mucous membranes, so did they succeed in obtaining a transmission to the glands, with consequent gland tuberculosis, while the integrity of the mucous membrane was retained; in the case of the conjunctival sac and vagina by a simple deposit, and in the case of the other mucous membranes by slight rubbing with a very small quantity of bacilli. In the intestine the peristaltic movement alone with a very scanty quantity of material is enough to produce infection, and with a larger quantity of material infection is produced in the mucous membranes and in the glands.

It is only by carefully weighing all these facts that we can come to a full understanding of the infection.

IV.—THE DISPERSAL OF TUBERCULOUS INFECTION.

The lymphatic glands and the lymph system play an important part in the dispersal of tuberculosis from the point of entry.

My experiments on animals have shown that after subcutaneous injection in the region of the abdomen, at the end of from three to five weeks the following exhibit macroscopic changes in the descending scale as to size and extent: the glands around the iliac vein, lumbar glands, splenic and portal glands, and those of the liver, then the bronchial and pulmonary, which both exhibit slight changes; in the further course of infection the cervical glands often become involved.

Weleminsky, who has studied the question on a large number of animals (1,000), arrives at similar results, namely, the inguinal, iliac, lumbar glands and so on; he emphasizes at the same time the fact that after the glands in the area of infection, the lymph glands leading to the bronchial glands are affected, then the bronchial glands themselves.

Westenhoeffer (by experiments on 120 guinea-pigs) confirms this course, apparently without knowing of my experiments, which are sixteen years older and thirty times more extensive. Beitzke, by experiments on 150 animals, gives the order as: inguinal, iliac, and, later, the bronchial glands.

Oehlecker describes the course as about the same, namely, inguinal, para-iliac (retroperitoneal, Tendeloo's para-aortal, above the kidneys, which Weleminsky describes as middle organ), then the portal glands; the tracheo-bronchial glands are at first only slightly attacked or not at all; in the spleen a few nodules occur, the portal glands become caseous, and later the liver is involved; simultaneously or later, pulmonary tuberculosis with considerable enlargement of the tracheo-bronchial glands sets in; then the para-aortal glands are attacked, iliac glands of the opposite side and retrogressively the inguinal glands of the other side.

In the main, therefore, the infection of the glands follows the course of the lymph-stream, forming a chain of glands like a row of beads which gets smaller as it approaches the centre; it extends from the place of infection in a circumscribed manner as the process radiates, on account of the numerous anastomosing branches which connect the lymph-vessels one with another, and now and again it extends sideways and sometimes, but rarely, retrogrades as the result of congestion; the germs of infection are all the more forced to take a side course when the direct paths are more or less obstructed by previous processes (see p. 222).

In this course no important intervening organ, connected with the glands, is ever passed over, tuberculous glands never appear in any part of the body without intermediate steps. It is only later that hæmatogenous dispersal takes place.

Weleminsky, Westenhoeffer, Bartel, &c., share this opinion.

When, however, Weleminsky states that the whole of the glands unite in the bronchial glands, and when he attributes to them the character of a heart for the whole lymph system, he doubtless goes too far; he must stand alone in his opinion, in which he has been strengthened no doubt by making the mistake of using human bacilli in rabbits (as shown by Oehlecker, see p. 100), and in the statement that organs infected hæmatogenously do not infect their glands. But I must agree with Weleminsky in the one case, that in subcutaneous injections in the region of the abdomen the chain of tuberculous glands can be traced in their proportionally decreasing size, often as far as the bronchial glands and in isolated cases even farther; so that one may get the impression of close connection between the conveying inguinal, iliac and bronchial glands; the spleen and liver glands are usually attacked before the lungs and the bronchial glands.

It is the same in inoculation of the upper portion of the body, in experiments on the gums, nose or ear, after a few weeks a chain of glands of decreasing size goes from the neck glands to the bronchial glands, but the iliac glands, &c., remain free. The

legitimate path of the bacilli is from the glands to the thoracic duct or to the vein. Now, it is a much disputed question whether the tubercle bacilli can travel directly from the iliac and lumbar glands, and in the upper part of the body from the neck glands, into the lymph-vessels directly to the bronchial glands, or if they must take the recognized path through the blood-vessels (see v. Behring, Harbitz, Pottenger, Weichselbaum, Leroux, Westenhoeffer, Karlinski).

Weighty anatomical grounds are given for the blood-vessels as the only path.

Recently extensive researches with respect to the lymph passages have been made by injection into living animals and on dead bodies; in these investigations great credit is due to Most. We abridge his account as follows.

According to these researches the whole of the lymph of the entire human body meets on both sides of the junction of the bulbus jugularis with the subclavian, and thus :—

(1) The deep cervical lymph glands which take up the whole of the lymph from the head in part directly, and in part by means of the submental, submaxillary and subauricular glands, the mastoid glands, the prælaryngeal, prætracheal, and paratracheal glands.

(2) The interthoracic lymph passages, namely :—

(*a*) Those of the tracheo-bronchial region,

(*b*) Those of the lungs,

(*c*) Those of the retrosternal lymph vessels, and on the left

(*d*) The thoracic duct.

(3) The axillary lymph channels flow towards the above-mentioned junction through the truncus subclavius.

According to Most, the separate lymph areas come into more intimate local connection at that point; but he considers an exchange of lymph in the different areas and a passing over of the germs from one region to another impossible, as this would presuppose a deficiency and obliteration of the valves, which lie close together, and are efficient in their action. According to anatomical researches a change in the direction of the stream, a forcing back or straining of the valves, could not be obtained in spite of forced injection. The supposition of a retrograde passage is, therefore, to be accepted with great caution.

According to Most, there is no proof of any connection between the lymph vessels of the cervical lymphatic region and the summit of the pleura, or with the bronchial glands; the passage to those regions is anatomically impossible, a regular or even a frequent transmission is not to be thought of (see p. 103).

"All we can believe is, that by morbid anatomical processes new passages are created, or the infection is carried by contiguity from gland to gland, from gland area to gland area" (Most).

Beitzke, basing his theory on researches obtained by infection of the dead bodies of children and guinea-pigs, considers that infection of the intrathoracic glands from the deep cervical glands is impossible, and denies a communication between the cervical, mesenteric and retrosternal glands. Kitamura has arrived at the same results, and Albrecht expresses a similar opinion. But against this, Henle mentions a connection of the lower deep cervical glands with the glands of the axilla and the thorax by branches which run in different directions and act as vessels leading to and from them.

In the lower half of the body the thoracic duct collects the lymph of the abdominal organs and the lower extremities. It consists of three trunks:—

The right and left lumbar trunks, which have their confluence at the level of the upper lumbar vertebra, and which the intestinal trunk joins. The lumbar trunk collects the lymph of the pelvis and of the lower extremities (external and inter-inguinal glands), lumbar glands (about the iliac vessels), and the retroperitoneal glands (or para-aortal glands of Tendeloo). The efferent lymph vessels leading from the stomach reach the retroperitoneal glands.

From the intestine the lymph goes into the mesenteric glands, which lie in several layers over each other, and then to the radix mesenterica and the retroperitoneal glands, which also receive the lymph directly from the testicles and ovaries.

Intestinal infection, therefore, travels by way of the mesenteric and retroperitoneal glands and the duct into the vena cava superior, the right heart, pulmonary arteries and the lungs. No other passage from the abdominal organs to the bronchial glands exists (Most, Beitzke).

How can the results of the experiments on animals be made to agree with anatomical facts?

In many cases after-infection may take place during the confinement of the animals by sporadic germs (from ruptured subcutaneous places of inoculation, &c.), by way of inhalation, or by swallowing food infected with the germs; the swelling of the neck and bronchial glands thus caused can give rise to the illusion that the lymph glands have taken a course contrary to the anatomical course.

Doubtless we are all now and again deceived by such results, which are difficult to be avoided, and all the more so as by inhaling fewer germs the lung itself often remains free.

One might also imagine an inspiration of bacilli which have entered the mouth into the deeper air passages, as Nenninger, Paul, Ficker, and Bartel especially note; but these authors used such drastic methods (deluging the mouth with cultures of prodigiosus, closing the wind-pipe by pressure, &c., see criticisms in Cornet's "Die Tuberculose," second edition, p. 295), that no conclusions on natural conditions can be drawn from them.

In the experiments of Beitzke, who fed animals with cultures of *Bacillus prodigiosus* and killed them by a blow on the neck, it might have been the stertorous breathing of the dying animal which caused the aspiration (Aufrecht). Under natural conditions a moderate quantity of bacilli, introduced into the mouth without artificially inducing laboured breathing, cannot enter the larynx.

But the chain of gradually decreasing glands from the neck or inguinal glands to the bronchial glands, and also the frequently radiating dispersal of the tuberculous processes, exhibits itself in cases where an after-infection is almost impossible.

Again, if we infect in a hind leg, we observe a caseation of the inguinal and peritoneal glands, tuberculosis of the liver and spleen, and on killing the animal later we find pulmonary tuberculosis and moderate enlargement of the bronchial glands. Why does the infection of the lung appear so late if the toxin has dispersed by way of the blood-vessels, as the capillaries of the lungs are the first filter (and the lung is alleged to have a special predisposition for absorption)? On the other hand, if we infect in the area of the neck glands, how is it that caseation of the neck glands appears sooner, with tuberculosis of the lungs and bronchial glands; and infection of the liver and spleen only later?

It will be difficult to explain this phenomenon without acknowledging the possibility of infection from near-lying systems of lymph glands, even if they are anatomically separated. It remains an open question whether very fine capillaries and anastomosing channels exist which have hitherto escaped our researches (see also Bartel and Neumann), or whether the infection in many cases is not conveyed by contiguity (Most). Concerning retrograde infection, we have a series of reliable observations by Tendeloo. Sappey and Küttner have proved, on fresh dead bodies of children, a connection of the lymph passages between mediastinal and parapancreatic lymph glands passing through the diaphragm, and Bartel calls to mind with me the lymphogenous metastasis of tumours, which also do not keep strictly to the lymphatic system (see p. 222, Retrograde Dispersal).

V.—THE PART PLAYED BY THE LYMPH GLANDS.

In scrofulosis the lymph glands play quite a different part from what was formerly supposed. On account of the frequent and obstinate affections of glands the conclusion was come to, *post hoc*, that patients with a tendency to scrofulosis are of specially weak constitution and not capable of coping with pathogenic germs or irritants, whilst the lymph glands of healthy persons can cope with them.

According to our opinion, it is their exposed position near the periphery, the outer boundary of the body, their characters as the point of union of the lymph passages leading to the inner parts of the body, which stamps them as a sort of second line of defence, an inner fortress, so diverting the attack of the pathogenic germs to themselves, and thus concentrating and often sacrificing their existence for the protection of the organism. It does not depend on the nature and constitution of the glands nor on their individual and different power of resistance, but on the greater or less power of protection of the front rank (as to which we have to consider the skin and mucous membranes), whether they form the more or less frequent field of battle.

A few even are of the opinion that certain groups of glands are more especially disposed. For example, Suchannek declares that the tubercle bacilli conveyed by the placenta, scantily and irregularly dispersed over the whole body, only thrive after birth in certain places suitable for their further development; for example, the bronchial and cervical glands. But our experimental and clinical experience (see pp. 79 and 85) shows the contrary, that with animals the affection of the glands exhibits itself in the gland nearest to the place of infection and continues from there in distinctly defined succession, and that in man, wherever a tuberculous focus is formed the affection of the glands, if it should declare itself and be noticeable, always declares itself according to rule in the nearest region and not in an irregular way anywhere.

The greater frequency of infection of a certain group of glands—for example, the bronchial glands—leads to the conclusion that this area of absorption is more exposed to opportunities of infection.

A statement to the contrary would make it our duty to contradict it, basing our opposition on facts confirmed by thousands of experiments on animals.

If one accepts the mesenteric, bronchial, or cervical glands as having a special tendency to scrofulosis, it is about the same

as if we were to consider the inguinal glands specially disposed to syphilis.

Anatomical Protective Effect of the Lymph Glands.—The designation of the lymph glands as protective organs and filters is justified by their anatomical construction. The corpuscular elements of every sort, such as cinnabar, and carbon, and bacteria, brought to them by the afferent vessels are detained first in the lymph sinuses, which surround the follicles of the cortex, through the dividing wall of the dense reticulum, which opposes itself as a system of defence, which has now become broader and so frees the lymph here and in its further course from foreign bodies.[1]

Naturally this protective power has its limits, if all at once enormous quantities of germs penetrate (100 mg. pure culture, as is often employed, contains, according to L. Rabinowitsch, about 40,000 tubercle bacilli), or when they are injected under great pressure, the filter becomes insufficient and is broken through; in the case of mixed infection and trauma the filtering power appears to fail more easily (see also Noetzel).

The filtering power also depends very much on the nature of the foreign body, and in the case of germs on their virulence. Thus granules of Indian ink are on the whole more easily let through than bacteria; inoffensive bacteria, such as the human bacillus in the rabbit, which do not irritate the tissues, pass through more easily than the bovine bacillus; according to this we may take it that, on the other hand, bovine bacilli in susceptible persons pass more easily through the glands than human bacilli, a consideration which perhaps may explain many contradictory results. These consequences will be again annulled, as the non-virulent bacilli will not produce any virulent effect in the place where they are further deposited. But, against this, they form one of the most frequent causes of the so-called latent foci, for the deposition of tubercle bacilli, which are virulent to the guinea-pig, but in the human body produce few or no changes of tissue—Bartel's lymphoid tubercle.

Toxic Protective Influence of the Lymph Glands.—The lymph glands form (with the exception of the afferent and efferent blood-vessels which nourish them), on account of their capsules, organs which are entirely enclosed. The toxins produced by the bacteria —I refer here to the tubercle bacilli which excite the periphery of the tuberculous foci to reaction and inflammatory encapsulation and so form the real foundation of natural healing—as explained in my book on "Tuberculosis," second edition, p. 682—will therefore not diffuse themselves so easily into the further sur-

[1] For the construction of lymph glands, see also Bartel and Stein.

roundings but will be retained in one place. On the one hand, on account of their high degree of concentration the growth of the bacilli is hindered, and on the other hand they cause an intensive reaction of the tissue, and, owing to a chemical substance contained in them which induces coagulation, lead to stasis and thrombosis of the blood and lymph vessels in the area of the focus. The interruption of the lymph and blood currents resulting from the latter is specially important, because by means of this a further dispersal of the germs is prevented.

It cannot at present be judged how far the presence of numerous lymph corpuscles in the lymph glands, in Metchnikoff's sense, or in the sense of being an antitoxin, &c., has any influence.

At a certain stage we find with the tubercle an immigration of leucocytes, evidently as the expression of a certain tendency to heal. Leucocytes are already present in the lymph glands, and thus a later stage of the tubercle is anticipated at a time when the tubercle bacillus has not yet arrived in the neighbouring tissues.

Manfredi and his pupils have made extensive researches, and proved an influence which weakens the virulence.

Bartel and Neumann, on the basis of their researches, ascribe a far-reaching part to the leucocytes in making the tubercle bacilli innocuous (see also Livierato).

The lymph gland cannot play the part of a protector in all diseases with the same success as with the tubercle bacillus. In those diseases in which the causative agent grows in the blood itself—for example, anthrax bacillus—they do little or nothing. The glands cannot then prevent the bacillus from forcing a way through; at the most they can but delay it, and in a short time we find all the glands of the body swollen. Much depends upon the power of motion in the bacteria, on the chemical nature of their poison, on the rapidity of their proliferation, and many other circumstances, in judging how far they can fulfil their task. It is a mistake to go too far in exemplifying one result of infection by another, as if every species of bacteria had not its own specific action, which needs to be considered in all its consequences and irritation phenomena.

As we no longer consider, as formerly, an affection of the glands to be a predisposition only of the affected gland area, an expression of dyscrasia, and as we must always keep our eye on the absorption area, I think an anatomical *résumé* of the glands coming principally into consideration is advisable. I draw my material chiefly from the works of Hyrtl, Hoffmann, and especially Henle. The knowledge of the area of the source and distribution is important for prophylactic and therapeutic purposes, because it is our duty to close the paths of entry.

Name	Afferent vessels from	Efferent vessels to
Facial, anterior superficial auricular glands. *Situation.*—On and in the parotid, in front of the external auditory meatus	Temporal region	To the sub-maxillary and superficial cervical glands.
Deep facial glands (buccinator) *Situation.*—Hinder part of the buccinator. Lateral wall of the pharynx	Temporal, spheno-maxillary group, eye and nose cavity, upper jaw, palate, pharynx, to part of the brain (Arnold)	Superficial and deep cervical glands.
Occipital glands *Situation.*—Origin of the trapezius.	Parietal and occipital region	Superficial cervical glands.
Mastoid glands (sub-auricular, post-auricular) *Situation.*—Insertion of the sterno-mastoid behind the ear	Back of the ear	Superficial and deep cervical glands.
Sub-maxillary glands *Situation.* — Sub-maxillary glands and between them and the inner surface of the lower jaw	Face, lips, floor of the mouth, salivary glands, forehead, eyelids, bridge of the nose, alæ nasi, upper lip, gums of the lower teeth, chin, tongue, efferent vessels of the superficial facial glands	Superficial and deep cervical glands.
Superficial cervical glands. Superficial jugular. *Situation.*—Upper side of the neck in front of and over the sterno-mastoid along the external jugular vein	External ear, skin of the nape of the neck, efferent vessels of the occipital glands, sub-auricular to part of the superficial, facial, and sub-maxillary glands	Deep inferior cervical glands.
Superior deep cervical glands (superficial jugular). *Situation.*—At the division of the carotid, along the internal jugular vein to the base of the skull	Efferent vessels of the deep facial glands, lingual, and a part of the sublingual gland, the cranial cavity to a part of the tongue, larynx, thyroid gland, lower pharynx, deep neck muscles	Deep inferior cervical glands.
Inferior deep cervical glands (inferior jugular, supra-clavicular). *Situation.*—In the supra-clavicular fossa to both sides of the trunk of the great vessels	All the lymph vessels of the head and neck, efferent vessels of the superficial cervical glands, and the upper deep cervical glands	Unite with the jugular lymphatic trunk on the left, opens into the thoracic duct on the right into the common lymphatic duct, or the sub-clavian vein, or the internal jugular vein. Branches leading to and from the axillary and thoracic glands. The inferior deep cervical glands are often united in a continuous chain through certain glands met with in the middle of the neck.

Name	Afferent vessels from	Efferent vessels to
Anterior mediastinal glands. *Situation.*—In front of the pericardium, close above the diaphragm, in front of the aorta and the left innominate vein	Efferent vessels of the sternal glands. Greater part of the liver, the front half of the diaphragm, the thymus, pericardium, and heart	The right and left common lymphatic trunk.
Posterior mediastinal glands. *Situation.*—Along the thoracic aorta	Œsophagus, hinder septum of the pericardium and diaphragm, to part of the right border of the liver	Direct thoracic duct or bronchial glands.
Bronchial (pulmonary) glands. *Situation.*—Smaller (pulmonary glands). In the hilum of the lung to the bronchial branches, larger vessels to the under surface of the trachea (tracheal glands) their divisions and the bronchi	Especially the lungs, trachea, the posterior cardiac wall, the efferent vessels of the posterior mediastinal glands. Œsophagus, hinder surface of the pericardium and hinder part of the diaphragm, right border of the liver	On the left with or without efferent vessels of the sternal and mediastinal glands to the thoracic duct; on the right the broncho-mediastinal trunk which receives the efferent vessels of the remaining right thoracic glands.
Lumbar glands. *Situation.*—Three rows on the hinder surface of the abdominal aorta, the medium-sized at the bifurcation and the trunk of the aorta, the lateral group between the transverse processes and the lumbar vertebræ	Efferent vessels of the entire group of pelvic glands (iliac, hypogastric and sacral), indirectly the inguinal glands, the deep lymph vessels of the posterior abdominal wall, back muscles of the corresponding part of the vertebral column and the lumbar cavity and the under surface of the vertebral part of the diaphragm, the lymphatics of the sigmoid flexure, the abdominal viscera and a part of the pelvic viscera	Unite on each side to the lumbar trunk root of the thoracic duct.
Mesenteric glands. *Situation.* — Between the folds of the mesentery	The lymph vessels of the small intestines, chyliferous or lacteal vessels and those of the colon to the sigmoid flexure.	Unite in the intestinal trunk, a root of the thoracic duct.
Cœliac glands. *Situation.*—In front of the aorta over the origin of the superficial mesenteric artery, between and behind the folds of the transverse meso-colon and the gastro-hepatic ligament	A part of the liver, the stomach, and the upper half of the duodenum, the pancreas and the spleen	Take part in the intestinal lymphatic trunk, also connected with the upper lumbar glands.
Anti-brachial glands *Situation.*—Exceptionally to the forearm in the course of the lymph vessels accompanying the radial and ulnar arteries.		

Name	Afferent vessels from	Efferent vessels to
Superficial and deep ulnar glands *Situation.*—The median epicondyle over the elbow joint	The superficial ulnar receive in part the lymphatic vessels of the hand, while the lymphatic vessels on the radial side mostly go direct to the axilla.	Axillary glands.
Axillary glands *Situation.*—The vessels and nerves of the axilla and the inner border of the pectoralis major	Upper extremity, upper part of the anterior and posterior body wall, navel and lumbar region, the mamma United with the deep	Axillary lymphatic trunk or chief vessel, or a large cervical vein. inferior cervical gland.
Popliteal glands *Situation.* — The popliteal vein	Superficial vessel of the leg from the lateral border of the foot	
Superficial inguinal glands. *Situation.*—From Poupart's ligament to the fossa ovalis, thence surrounding the great saphena vein	Abdominal wall, nates, perineum, anus, and external genitals, external lymphatic vessels of the lower extremities	Deep inguinal glands.
Deep inguinal glands. *Situation.* — To the lower limb vessels as far as the septum crurale by the crural ring	The deep lymphatic vessels of the anterior side of the thigh and the efferent vessels of the superficial inguinal glands, epigastric and circumflex iliac vessels Numerous anastomoses with	Iliac glands. the superficial branches.

VI.—MODE OF INFECTION IN MAN.

Experimental proof exists as to the possibility of an infection of the skin and mucous membranes and the glands connected with them by direct contact with the bacteria, which we shall now take into consideration. Clinical observations confirm, as far as the process can be observed in man, that similar conditions produce similar effects. And now we must show in everyday life, especially in the child, the opportunity of a direct contact with the various bacteria corresponding to these experiments, in order to establish full analogy with experiments on animals and arrive at logical and correct conclusions from our findings.

In another place (p. 150) we shall show that bacteria only enter the body from the outside, and that in the case of tubercle bacilli a uterine transmission cannot be taken into practical consideration.

(1) RELATIVE FREQUENCY OF VARIOUS LOCALIZATIONS.

Accurate and reliable examples are wanting as to the frequency of scrofulous diseases of various organs and gland

structures. Surgeons do not often come in contact with the endless number of bronchial and mesenteric scrofulous diseases, and consequently ignore them. Again, students miss a large number of advanced external forms of scrofula because they require operative interference. Many cases of scrofulous eye and ear diseases go to a specialist; the morbid anatomist sees in the main only the most severe tuberculous forms, while the numerous pyogenous cases which have mostly healed escape his notice.

The following examples afford us an approximate survey. In the Empress Elizabeth Children's Hospital at Bad Hall there were under treatment during forty years, according to Rabl:—

	Cases.
Affections of bones and joints	2,147
Affections of glands	1,550
Affections of the eyes	1,787
Affections of skin and cellular tissues	1,113
Affections of mucous membranes	230
Affections of ears	145

According to Monti, in Salzbach and S. Pelagio:—

	Cases
Scrofulous disorders of nutrition	308
Affections of the eyes	173
Affections of the ears	5
Affections of the nose	48
Affections of the skin	102
Simple hypertrophic swellings of lymph glands	362
Periostitis	33
Tuberculous lymph glands	291
Caries	717
Caries of the spine	165
Coxitis	167
Fungous joint disease	182
	2,555

Even in the diseases of the glands these examples do not suffice for statistical purposes.

According to Volkmann, of external glands, the neck glands are most often affected, then the ulnar, more rarely the axillary, and very seldom the popliteal and inguinal glands.

The following give the results as to frequency:—

	According to Balmann	Wohlgemuth (430 cases)
Neck and occipital glands	81·0 per cent.	93·00 per cent.
Axillary glands	6·0 ,,	2·78 ,,
Inguinal ,,	7·0 ,,	0·93 ,,
Ulnar ,,	5·0 ,,	0·23 ,,
Popliteal ,,	0·7 ,,	0·23 ,,
In front of and behind ear	—	2·9 ,,

In Loano, among 288 tuberculous gland affections, there were treated :—

	Cases
Lateral cervical glands	132
Submaxillary and cervical glands	114
Axillary, lateral cervical, and submaxillary glands	10
Parotid glands	8
Popliteal	1
Multiple	23

Lebert, among 158 cases of scrofula of the external glands, found the neck glands alone affected 108 times, and in conjunction with clavicular axillary and sternal glands thirty times.

If one excludes the bronchial and mesenteric glands, one can justly term the cervical glands "the true representatives of scrofula" (v. Bergmann). But according to the experience of morbid anatomy, which affords us relatively accurate information respecting the bronchial and mesenteric glands, though they often escape the most careful clinical observation, yet they surpass all other series of glands in frequency in tuberculous scrofulosis. For instance, Müller (Cornet, "Die Tuberculose," second edition, p. 361) in 500 autopsies under 15 years of age found tuberculosis of the lymph glands 126 times, in which tuberculosis of the bronchial glands occurred 103 times.

How far they occupy a more or less prominent place in the pyogenous form cannot be estimated; such swellings, although chronic, yet after a time again retrograde, and cannot be easily demonstrated at the autopsy, and in most cases are only brought to light if they have caused fatal complications.

Biedert found in 1,346 autopsies of tuberculous children, with or without tuberculosis at the seat of origin of the disease (*i.e.*, the lungs and intestines), that the bronchial glands were affected in 78 per cent., and the mesenteric glands in 10 per cent. of the cases. Hecker in 96 per cent. of the cases of tuberculosis in children which ended fatally found the lymph glands affected in 92 per cent., and the bronchial glands in 50 per cent. Carr in 120 autopsies of tuberculous children found the bronchial glands implicated in 80 per cent., and the mesenteric glands in 54 per cent. Frobelius, in the foundling hospital at St. Petersburg, among 416 autopsies on cases of tuberculosis, found the bronchial glands tuberculous in 99·2 per cent., and the mesenteric glands in 16·1 per cent. Brüning in 400 autopsies on children found tuberculous changes of the organs 44 times, of which 77 per cent. were in the bronchial glands, and 57 per cent. in the mesenteric glands. Stirnimann in 591 autopsies on children

under one year found 42 cases tuberculous, but only one child in whom the organs of respiration were not affected.

Mendelsohn found that 292 (or 23·27 per cent.) were tuberculous out of 1,255 autopsies on children; primary isolated tuberculosis of the organs of respiration only (including the bronchial glands) in 29 (10·51 per cent.); primary tuberculosis of the organs of respiration, with disseminated foci throughout the body, in 94 (34·06 per cent.); primary tuberculosis of the intestines only in 18 (6·52 per cent.); primary tuberculosis of the intestines, with disseminated foci throughout the body, in 7 (2·54 per cent.).

Albrecht had similar results. According to him, among 3,213 autopsies on children, of whom 1,060 were tuberculous, the tracheo-bronchial glands were prominently affected. Feldmann also, among 752 autopsies on children, of whom 19 per cent. were tuberculous, found tuberculosis of the bronchial glands and lungs most frequently. Schlossmann, who regards infection from quite a different standpoint, admits that the bronchial glands are without exception affected in tuberculosis. Heubner says phthisis in children has its seat in the bronchial glands. Thus we see that the bronchial glands decidedly hold the first place in frequency in tuberculosis.

Watson Cheyne computes the frequency of diseases of bone on the basis of the reports of various authors (Billroth-Menzel, Jaffé, Schmalfuss, and his own cases).

Vertebral column	23·2 per cent.
Knee-joint	16·5 ,,
Hip-joint	14·6 ,,
Tarsus and ankle-joint	14·4 ,,
Elbow-joint	6·3 ,,
Cranium and face	5·5 ,,
Breast-bone, clavicle, ribs	5·2 ,,
Pelvis	5·2 ,,
Femur, fibula, tibia	3·5 ,,
Shoulder-joint	1·5 ,,
Shoulder-blade, ulna, radius	1·0 ,,

According to Sprengel, the frequency of bone and joint disease is as follows: Spondylitis, coxitis, tuberculous ostitis of the small bones of the hand and of the foot, inflammation of knee-joint, tuberculous ostitis of the long bones, tuberculosis of the ankle-joint, tarsus, elbow, shoulder and wrist.

According to Jaffé the vertebral column was affected in 26 per cent., the tarsus in 21 per cent., the hip-joint in 13 per cent., the knee-joint in 10 per cent., the hand bones in 9 per cent., the elbow in 4 per cent.

(2). THE CAUSES OF DIFFERENT LOCALIZATIONS.

It would lead us too far to enter into, and to discuss, here the occasions in which infection of the skin and mucous membranes takes place, and the conditions which favour and retard infections in particular parts of the body.

A detailed account respecting the tubercle bacilli is to be found in the second edition of my "Tuberculosis." Almost the same conditions apply respecting the pus bacteria, with the difference that the latter increase more quickly and locate themselves more easily. We will limit ourselves here to a short sketch.

As the skin on account of its first tissue is capable of retaining the whole or part of any germ which penetrates it, we can, in the case of the skin, establish much more easily by the local effects the frequency with which certain places become the point of entry of the infecting germs than in the case of mucous membranes in which the position of the diseased glands must give the clue to the place of infection. When changes are met with in the glands we can, with greater probability, take for granted a bacterial invasion of mucous membrane.

The diseased glands, and the knowledge of their seat of election, affords us the best guide as to the most frequent point of entry of infection, according to the law of localization (see pp. 63 and 88).

According to Most, who has thoroughly investigated the matter, in two-thirds of the cases of scrofula and tuberculosis the deep cervical glands are most often affected, and especially the glands lying to the middle and side of the jugular vein, and the lymphatic glands at the angle of the common facial and internal jugular veins. The result of experimental infection of the palatine and pharyngeal tonsils tallies with this.

Most lays special stress upon the regularly descending and rarely disseminating course of the glandular swelling, which diminishes as they extend downwards. The glandular swelling ceases about halfway up the neck at about the crossing of the omohyoid and the jugular vein (where the middle of the deep cervicals divide and become the cervical trunk). The supra-clavicular, which lie deeper down, and which receive the lymph from the trachea, œsophagus and the lateral deep cervical glands, are very seldom affected, and only in very advanced cases.

In a small number, in about one-third, the glands at the border of the jaw are affected, the submental, submaxillary, and subauricular alone, or with their effluents and the deep cervical glands. They point to a disease of the front half of the face, scrofulous eczema, affections of the mouth, teeth, nose, eyes and ears.

SKIN.

In the frequency of pyogenic scrofulous diseases a striking distinction is met with in the various regions of the skin. Most often the skin of the face and scalp forms the seat of scrofulous diseases, much less often the hands, and very seldom the feet and trunk. In 116 cases of scrofulous skin diseases observed by Lebert, 91 were situated on the head, and of these 31 were on the scalp. In the tuberculous form alone, Neukirch found in 55 cases of lupus 44 on the face (including the forehead and nose), two on the neck, five on the hand and arm, one each on the leg and foot. According to Cramm's list of cases, 573 instances of lupus occur on non-hairy parts, 69 on hairy parts. In Hahn's 424 cases of lupus, only 105 occurred on the extremities, and singly only in eight cases, while 44 times in the 105 cases the face was first affected.

The skin of the face in its outward appearance is much softer, freer from wrinkles, and smoother than that of the hands, for instance, which, by use, often become quite indurated. The fact that the head and face are often uncovered and are thus more exposed to dirt and infection is of more importance. Added to this, children, especially under one year, rummage on the floor with their little hands, seize matters of a doubtful nature, and then in happy ignorance smear their dirty hands over their head and face or in their ears, or are " made clean " by their relations with dirty cloths or pocket-handkerchiefs. Thus a little girl got lupus of the nose from constantly using the soiled handkerchief of her tuberculous sister (Leloir, Baginsky). In another case chronic eczema in a child of a tuberculous mother was connected with crusts of bread sucked by the mother; from this act lupus developed.

The researches of Preisich and Schütz show us how the virus of tuberculous parents and relatives is conveyed. In a polyclinic they found tubercle bacilli in the dirt under the finger-nails in 21 per cent. of consumptive children, amongst sixty-six cases, and Baldwin, in twenty-eight consumptives whose hands were washed without warning, found bacilli in eleven cases. Graziani in eight consumptives found virulent bacilli in four cases. The latter found bacilli on his own hand after the exchange of a hearty handshake with a consumptive. Ostermann, however, had a negative result in a similar case. On the other hand, Ostermann examined the hands of forty-two children of phthisical families, and demonstrated tubercle bacilli in the water in which four children had washed, in fourteen adult consumptives only in seven cases, and similarly on the hands of a nurse, and also

established that the germ was easily set free by putting the fingers in the mouth and nose, for instance.

The same applies to pus cocci.

The scalp, as opposed to the face, is protected by the hair, but that is often not kept clean, as the frequent nesting of vermin shows.

Special opportunities of infection often occur from stings of gnats and insects, irritation of seborrhœa, acne pustules, which cause scratching with infected fingers, little scratches with sharp combs and hairpins, by a fall, or in play.

Of other parts, it is usually the thin surface of the back of the hand which is the seat of infection, especially the groove of the nails, which furnishes a lurking place for the bacteria.

Compared with each other, the tuberculous form of scrofulosis of the skin is less frequent than the pyogenic form, because the tubercle bacilli are less widely distributed, and especially because, by the low temperature of the skin, they grow more slowly, and thus can be more easily eliminated than pus cocci and other bacteria.

MUCOUS MEMBRANES.

As from the greater permeability of the child's mucous membranes, isolated germs, especially tubercle bacilli (see p. 29), not infrequently reach as far as the glands, it is often only from the diseases of the glands that we can judge of the frequency with which the mucous membranes form the point of entry and also of the more exact position of the latter.

Those mucous membranes which are the points of entry of air and food which are so frequently infected, that is to say, those which come most into contact with the outer world, namely, the mouth and nose, by far surpass in the frequency of the disease the usual outlets, the anus, urethra, and in certain cases the vagina. These differ among each other according to the degree in which they are exposed to infection, and according to the sufficiency of the protection.

In the case of the nose, the germ-laden inspired air forms the source of infection which, as has been explained elsewhere, is here exposed to a process of deposit by the vibrissæ and the various ridges and depressions, the side current formed by these, and the sinuous course of the breath current. Further opportunities are now and again given by the bad habit of picking the nose, caused by the irritation of worms in the intestine, and the introduction of foreign bodies by dirty fingers, whereby bacteria adhering to them and tubercle bacilli are often undoubtedly rubbed in. If we may take the seat of tuberculous changes in the nose

of adults as a stardard, the septum and anterior nares may be especially considered as points of entry for scrofulosis (see Symptoms, p. 193).

In the case of the naso-pharynx, the inhalation of bacteria must be taken into consideration in the first place for this spot on anatomical grounds, and, according to Kayser's dust experiments (p. 139), just this position next to the nostrils forms the chief depôt for the deposit of dust. Besides which, the lymphoid tissue of Luschka's tonsil and the surfaces full of crypts are especially suitable for absorption and retention.

From this spot, by coughing and other forced actions, by sneezing or retching, germ-laden secretions are driven through the Eustachian tube to the middle ear, the bacteria flourish on the mucous membrane, which may be either intact or weakened after measles or scarlet fever, &c., produce middle ear catarrh, or are carried to the glands by the clefts of Santorini (Ferreri), which are broader in children. For instance, in five cases of what was apparently primary tuberculosis of the ear in infants, Haike has been able to trace the path of infection from the pharynx to the tympanum, sometimes through tuberculous deposit in the palate, and sometimes through affection of the Eustachian tube. For infection of the outer ear, which often is the seat of eruptions, dirty fingers, foreign bodies, ear scoops, play an important part, and now and again earrings of tuberculous persons, as in cases related by v. Düring, Unna, Leloir, and Schiele.

In the mouth the sources of infection are principally from food which is derived from tuberculous or diseased animals or is decomposed, or is accidentally contaminated by pathogenic air-carried organisms. On the other hand, the bad habit of children of putting dirty fingers (see Preisich and Schütz, p. 137) or other things into the mouth is the cause of infection. Tubercle bacilli and other germs can easily enter the open mouth with the respired air; bacilli may be conveyed by kissing tuberculous persons, for although the saliva is generally free from bacilli, particles of sputum may be hanging on the lips or moustache.

Whether the bacteria can cause infection at all, and in what part of the digestive tract in the mouth or the intestines—apart from a weakening of the germ in the stomach—depends upon the rapidity of their passage. Fluids will more easily affect the intestines; solid foods, which have to be masticated, or micro-organisms, accidentally introduced into the mouth by the fingers or other objects, and which need no special act of swallowing and remain longer in the mouth, are more dangerous to the buccal cavity.

Oehlecker gives a striking example: "Bonbons, and the

affectionate consumptive friend," one who retained till shortly before her death the appetizing custom of allowing children to take bonbons, chocolates, &c., out of her mouth, whereby three children developed tuberculous glands.

The lips, tonsils, and carious teeth are favourite sites of scrofulous infection, the lips because they are exposed to contamination, especially in children who use them for cleaning their soiled fingers, and which hold dirty objects put into their mouths, such as trumpets, baby comforters, &c.

Waldeyer's pharyngeal area is very important in infection as, being specially adapted for the retention of foreign bodies which may have penetrated owing to its abundance of lymphoid tissue (Freudenthal and others), it may be looked upon as a series of advanced ramparts and trenches.

The tonsils are especially fitted for the absorption of germs by reason of their pitted structure, which gives a hold to infectious particles, by their defective sieve-like epithelium (Stöhr), and by the close contact into which they enter in the act of swallowing with all the ingesta passing down the œsophagus; Dmochowski even attributes suction properties to the crypts. Goodale and Hendelsohn established these facts by various powders of fine substances, carmine, and soot which penetrated the tonsils. Pirera used pus cocci; Lexer brushed on virulent streptococci. Hypertrophy of the tonsils is a regular accompaniment of scrofulosis.

Respecting tuberculosis, the researches of Strassmann, Schlenker, Dmochowski, Krückmann, Walsham, Scheibner, Escomel, Schlesinger, Grawitz, &c. (Cornet, "Die Tuberculose," second edition, p. 223) have shown that, when the opportunity of infection is caused by a large number of tubercle bacilli, the tonsils are always attacked in the course of advanced consumption, that under such circumstances frequent occurrences of tonsillar tuberculosis, sometimes accompanied by tuberculous swelling of the glands, have misled certain authors into claiming the neck glands to be almost the only point of entry of the tuberculous virus.

That tuberculosis of the tonsils is a primary disease has been shown by Schlenker, Krückmann, Orth, Goerdeler, Ito, in single cases; by Friedmann five times in ninety-one tonsils of children after death, and by Lubarsch in twelve cases.

Clinically, Abraham found apparent tuberculosis of the tonsils (in a scrofulous woman); Hopkins, Sacaze, Ruge, Hofmann relate similar cases (in the last case the patient, aged 18, was accustomed to use the pencil of her consumptive neighbour and to bite her finger-nails); Kingsford, among seventeen

children with swollen cervical glands, found tuberculosis of the tonsils in seven cases, but all these cases together are not numerous, and go to balance frequent negative findings.

In the same way Friedmann never found tuberculosis of the tonsils among forty-six living children with hypertrophy of the tonsils and pharyngeal tonsils, and among six children with decided tuberculosis of glands (excepting in one child who showed evidences of lung disease). Ito, among 104 children, found after death secondary tuberculosis of the tonsils five times, but no case of primary tuberculosis (see also p. 103).

Bandelier, among 200 hypertrophied tonsils which had been removed in tuberculous persons, and eight pharyngeal tonsils, established tuberculosis in ten cases; only two cases were apparently primary tuberculosis.

Tarchetti and Zanconi obtained negative results in fourteen cases during life by inoculation of hypertrophied tonsils and vegetations. Escomel had the same result in eleven non-tuberculous persons during life.

Dieulafoy produced tuberculosis only eight times by injection of tonsils in sixty-one guinea-pigs.

v. Scheibner, in sixty tonsils which he examined histologically, declared four to show probably primary tuberculosis, but he also declared that he could not obtain an entirely convincing proof of the existence of primary tuberculosis of the tonsils.

In the face of results which have hitherto been produced, we are not justified in attaching any great importance to the tonsils in tuberculosis or scrofulosis of the cervical glands, to say nothing of making them almost entirely answerable for their causation.

Without denying their considerable importance in scrofulosis, we have no ground for considering the permeability of all other parts of the mucous membrane, which has once and for all been established as of no special importance in conditions which come before us in practice, and which does not now and again give rise to actual infection.

Rosenberger, among nineteen cases of severe tuberculosis with suppurating glands, found in nine cases no hypertrophy of neck area, and no tuberculosis macroscopically.

This exclusive point of view has been refuted by the fact that the cervical glands connected with the tonsils are not always primarily affected, but often, in about one-third of the cases, there is quite a different zone of absorption.

The pharyngeal tonsils form by their irregular, uneven structure a favourable spot for the collection of bacteria, especially tubercle bacilli. In the vault of the pharynx the respired air

undergoes a change of direction, and the bacteria contained in it are directly projected on to the tonsils; the ciliated epithelium, the office of which is to provide for their further progress, is, especially in young persons, often replaced by squamous epithelium (Dmochowski), and is damaged in its functional capacity by frequent inflammation.

The occurrence of tuberculous disease of the pharyngeal tonsil is very variously estimated. Many writers do not record it once in 100 cases; others record 8, or even 20 per cent. (see Suchannek, Dmochowski, Koschier, Brieger, Lewin and Gradenigo).

My *résumé* of the works of Lermoyez, Gottstein, Brindel, Broca, Pluder and Fischer, Gourc, Bride and Turner, Hynitsch, Luzzato, Piffl, Pilliet, Wright, Brieger and Lewin, Ito, Wex, Uffenorde, Poliakov, Réthi, Baup, Cornil, Zwillinger showed tuberculosis 71 times in 1,745 cases (4·1 per cent.); Lachmann found in a later collection of 2,065 cases 89 cases of tuberculosis (4·3 per cent.); Cahn found tuberculosis of the pharyngeal tonsil in 4 per cent. of persons affected with adenoids (see also Barstow, Escomel, Ivens, Lachmann). These figures reduce the exaggerated conception of the pharyngeal tonsil to a more modest proportion (Trautmann, Jessel, Zarniko, Beckmann).

A good number of swellings belong to the non-tubercular form of scrofulosis.

Nebécourt and Tixier found quantities of adenoids, hypertrophied tonsils, and enlarged glands in twenty-two children, but nothing of a tuberculous nature (see also Simon, and others, p. 195).

The glands of the lingual follicles and the other divisions of the tubal prominences of the pharynx seldom form an entrance for bacteria.

Zickgraf's investigations do not support the hypothesis put forward by Freudenthal respecting the lingual tonsils as a point of entry for tuberculosis.

Apparently the cavities of carious teeth are a focus of infection, oftener than has hitherto been admitted. In the last few years Odenthal, Hoppe, Berten, Starck, and Körner have especially called attention to the connection of carious teeth with chronically swollen neck glands or hyperplastic lymphomata.

Among 700 children with enlarged neck glands in whom Odenthal examined the teeth, 346 were found with carious teeth, and no other manifest cause for the enlarged glands, 79 with caries and other simultaneous affections at the roots of the teeth which could be considered as the cause. In 175, gaps between the teeth showed the former existence of decayed teeth. Accord-

ing to Rosenthal, some affection of the teeth was the cause of 50 to 60 per cent. of enlarged cervical glands (see also Anschütz). As Partsch pointed out with caries, enlarged glands in the neck only occur when the process has invaded the pulp and advanced to the roots of the teeth. From sympathy the submaxillary and submental glands become specially involved.

The simultaneous occurrence of caries and affected glands does not warrant of itself any causal connection, and from the above figures it is not perceptible how far the occurrence of the enlarged glands can be identified with scrofulosis. A near connection, however, cannot be denied, since the existence of tubercle bacilli in carious teeth has often been proved, and a gland tuberculosis following it has been frequently confirmed. (Grawitz, Ungar, Starck, Moorehead, and others).

Partsch informs us of a case of tuberculous periodontitis in a carious tooth with infection of the neighbouring cervical glands. Euler and Müller relate a similar case; the suspicion of the tuberculous character is especially justified by the further progress of the gland processes. Hoppe says that he has found tubercle bacilli in recently extracted carious teeth six times in sixteen cases, and in the excavated decayed substance seven times in eleven school children, and ten times in the saliva and sordes on the teeth of twenty school children. It must remain undecided whether, on looking back on this astonishing result and the want of further proof, *e.g.*, by injection tests, an interchange with other acid-fast bacilli (smegma or butter bacillus) must be admitted. Körner twice found tubercle bacilli after testing twenty persons.

Moeller found tubercle bacilli six times, and pseudo-tubercle bacilli eighteen times in forty-one cases of sordes of the mouth in healthy school children. In 194 school children with lung disease, in 133 carious teeth he found tubercle bacilli fourteen times, and pseudo-tubercle bacilli twenty-three times; in 182 mouth secretions tubercle bacilli thirty-five times, and pseudo-tubercle bacilli forty-two times.

The wound caused by tooth extraction was considered by Doutrelepont to be the point of entry of tubercle bacilli (see also cases by Schlieferowitsch, Neumayr, Lenzmann, Ehrhardt [? infection by dentist's instruments]).

Besides carious teeth in dentition, the rupture and loosening of the epithelium, an inflammation of the gum or irritation from the formation of tartar, lead to the admission of germs.

But when Westenhoeffer says that perhaps the greater number of cases of tuberculosis in children (not only single

scrofulo-tuberculous glands) are to be traced to infection through injuries connected with dentition it is not substantiated by anything, and the infrequency of regional gland enlargement in teething, and according to Most the scanty delicate lymph channels in the stretched alveolar mucous membrane, contradicts it.

In the eye staphylococci and tubercle bacilli (as has been repeatedly demonstrated) in such processes are introduced chiefly by dirty fingers, handkerchiefs and towels, coughing and kissing. Many of the germs thus implanted are rendered harmless by the property which the tears possess of checking their growth and are quickly removed by the flow of tears.

Foreign bodies purposely introduced, such as so-called "eye stones," and the bad practice customary in many places of licking the eye (Pregel) or smearing with saliva, are modes of infection, though perhaps not in frequent use.

The swelling of the pre-auricular and subauricular glands with those of the maxillary and neck glands especially points to this source of infection (Haab, Most).

The very large area from which the neck glands derive their lymph, including the skin of the face as well as the mucous membrane of the mouth, nose, ears, and eyes, explains the great frequency of affections of the cervical glands.

Of the other mucous membranes which communicate with the body surfaces and from which exogenous infection can be derived we find in the anus in early infancy the fewest derangements.

In the genital mucous membranes there is often in early childhood irritation during the process of cleansing and more often than is usually supposed for other purposes by unprincipled persons. The frequency of true gonorrhœal affections in little girls with proofs of the gonococcus furnishes the sad evidence that in diseases of the vulva and vagina in children we must seek the source not in a special predisposition of this mucous membrane, but in the first instance in the uncleanliness or in the sexual aberrations which are prevalent in their environment; often in poor districts the close association at night of children with lodgers gives opportunities. Besides, an opportunity of infection presents itself in onanism, which not infrequently occurs in quite little girls. "It is hard to believe," says Henoch, "that little children, 2 years old and even younger, masturbate, either by actual manipulation or by rubbing the thighs together, and often by rhythmical swaying of the body when in a sitting posture." Nursemaids often give encouragement to this when for their own amusement or to quiet a crying child they play with the genitals.

The foreign bodies which are often removed from the child's vagina (hairpins, sticks of sealing-wax, needle-cases and forty-two pebbles in the case of a girl aged 16) afford further evidence of the mode of infection in such affections of the genitals and the enlargement of the neighbouring lymphatic glands.

Wild observed six cases of tuberculosis verrucosa and one of lupus in children of 3 to 12 years of age near the genitals, where children rub the chamber in sitting, and he suspected a contamination with sputum or tuberculous motions. In a girl aged 3 primary tuberculosis of the vulva was produced by sliding about on the ground in the room of a tuberculous neighbour (Hamburger).

Scrofulous changes in bones and in various internal organs arise on account of their position, shut off from outward connections, not by exogenous infection, but doubtless without exception by a focus existing already in the body. Albrecht has collected 325 cases of fungous joint inflammation, of which he attributed a third to scrofulosis. Rupprecht, Sprengel, &c., have referred to scrofulous diseases of the skin and sense organs as the starting-point of bone and joint infection.

About a third of bone and joint diseases occur in the first ten years of life, the time when gland affections are most frequent and the tendency to a generalization of tuberculous processes is most pronounced. Half of all the cases occur during 1 to 20 years of age (Billroth). The primary focus generally lies in the glands, and not only in the easily noticeable cervical glands but probably more often in the deeper seated bronchial and mesenteric glands; to this may be attributed the frequent and apparently primary formation of the focus in bone. Direct infection from the adjacent skin must always be kept in mind in the case of superficial bone foci, as was perhaps the case in that mentioned by Middledorff, in which a lad aged 16 injured himself by a blow of a hatchet, bound it up with a pocket handkerchief, and later tuberculosis of the knee-joint occurred. The focus is often very small and defies the most careful anatomical examination. Should bacteria enter the blood-stream from such a focus they would be deposited just as the other corpuscular elements suspended in it, more especially in the marrow and also in the liver. It is to be supposed that for tuberculosis of the spine, ribs and sternum, which represent about a third of all scrofulous bone affections, the genesis is (besides the lymph passages) from the neighbouring bronchial glands; for the pelvis and hip-joint from the mesenteric glands. Scrofulosis of the bones and joints thus forms a later stage of scrofulous disease and will therefore be treated of further on.

CHAPTER IV.

INFECTIOUSNESS OF SCROFULOSIS (SPREAD OF THE DISEASE.)

The association of bacteria in scrofulosis gives it, in consequence, a certain power of infection. The observation of the various metastases of scrofulous material within the body, the successive transference of the disease from gland to gland, from organ to organ, leads one to the idea of infectiousness.

For a long time, especially since scrofulosis and tuberculosis were identified, or at least accepted as being related, its infectious nature was affirmed and found supporters in Baumès and others, at least for the more severe forms; he warns us, for example, against using instruments that have been used for scrofulous persons for non-scrofulous patients. But Lugol (1845), who only recognizes the effects of heredity everywhere, contests the contagiousness both of scrofulosis and tuberculosis, referring to the attempts of different investigators to transfer the disease to dogs and men by means of scrofulous pus, as these attempts up to that time had been followed by negative results. These experiments are now of little value in view of the many positive inoculations and were clearly badly managed.

It is, however, from Lugol's works that we see how widespread was the conviction of the contagiousness of scrofulosis among doctors and laymen even at that time. For after a question concerning this had been asked by the Parliament in Paris of the medical faculty there, and had been answered in the affirmative, and after discussion had taken place, an edict was issued which led to precautionary measures being taken. The remark of Lugol, an opponent of the theory of contagion, is interesting in that he said that scrofulosis had become very frequent in Nice since so many people suffering from pulmonary tuberculosis had been sent there—a historical, and in this case an ingenious testimony opposed to the contradictory statements from health resorts and institutions of to-day.

In infection we must distinguish between closed foci and

superficial foci, or such as are in any way connected with the surface by their secretions.

A dissemination of germs naturally cannot take place from closed foci, either in the neck, bronchial or mesenteric glands, or in bones and joints, of whatever nature these may be. As such foci fill numerically, and as regards duration a large space in the clinical picture of scrofulosis, the infectiousness of the disease is thereby much reduced.

In superficial and open foci the degree of infection depends principally on the nature of the causative agent of the disease whether we have to do with pyogenic bacteria or tubercle bacilli.

A secretion containing tubercle bacilli which is discharged from a ruptured gland or bone fistula and open abscesses is just as dangerous under certain circumstances as tuberculous sputum to the environment of the patient and more especially to the patient himself. Dried and pulverized on the body or on dressings it is a source of danger to the respiratory tract and its glands, also either moist or dry and when mixed with food it is a danger to the intestine, and in children leads to tuberculosis of the mesenteric glands. It threatens the other glands by contact, as I have shown in the illustrative cases cited in the second edition of my book on "Tuberculosis."

In consequence of the anatomical construction of the child's skin such infection in the case of the younger brothers and sisters of our young patients frequently takes the form of an affection of the glands, of scrofulosis, by which an impression of a family peculiarity may easily give rise to a pseudo-heredity.

The extent of the danger of infection from a tuberculous scrofulous patient varies greatly in individuals. It is clear that a scrofulous patient with a scanty quantity of pus, poor in bacilli, is as a rule not so great a source of danger to his environment as a person suffering from phthisis who is careless with his expectoration. Anyone who would take the trouble to ascertain the quantity of bacilli dispersed in the one way and the other would get a statistical table of the matter. Exceptions occur to this rule, but that a person suffering from phthisis may disperse few bacilli and a scrofulous patient many does not affect the fact.

The demonstration of virulent bacilli in scrofulous and tuberculous persons respectively shows that there is a possibility, even if remote, of their spreading such infections.

A person hitherto in health can also be infected from the pus of pyogenous scrofulosis in the same way as from any other pus focus, and children naturally more easily than adults.

But one single transmittance is not followed by the whole complex of symptoms of scrofulosis as might be the case with

the tubercle bacillus. If a child have the anatomical qualifications above described of skin, mucous membrane and lymphatics, intercourse with a scrofulous patient who disseminates notoriously virulent pus cocci can be an essential excitant of actual disease.

The question whether scrofulosis can be transmitted by vaccination was much discussed, and was answered in the affirmative by the opponents of vaccination. But hitherto this has not been confirmed by any conclusive observation. On the contrary, Baginsky emphasizes the fact that in many thousand vaccinations he had never observed a spread of scrofulosis by means of vaccine. Vaccination is mentioned by some authors as being the exciting agent of lymphatism or the non-tuberculous form of scrofulosis respectively. A transmission, as far as the tuberculous form is concerned, is hardly to be thought of (see G. Cornet, "Die Tuberculose," second edition, p. 213) even theoretically, because as a rule, excepting in miliary tuberculosis and very advanced pulmonary tuberculosis, no bacilli are found in the blood and lymph. In the case of miliary tuberculosis children cannot be taken into consideration as they do not form the majority of those vaccinated. Statements to the contrary are based either on bad observation or may be traced to accidental contingencies. Bierdert gives us a striking example of this; he says, on a certain day which had been arranged he was prevented from vaccinating a child; when it was brought a week later a general eczema had broken out in the interval which would certainly have been put down to the vaccination if it had taken place at the appointed time. Since calf lymph has come more into general use and the health of the calf from which the vaccine has been taken can be ascertained by immediate autopsy the question loses its importance. One thing, however, must not be contested, namely, that by carelessness and insufficient cleanliness micro-organisms do enter the vaccination wound; not infrequently these may produce local affection and swelling of the glands. But that has nothing whatever to do with the nature of the vaccine. The appearance of lupus and changes resembling lupus on the vaccination scars as Besnier, Demme, &c., mention, does not depend on the vaccination, but is caused by after-infection.

The apparently frequent finding of tubercle bacilli in the blood, not only of those suffering from advanced phthisis but in initial early cases, and even in persons who seem to be healthy, leads us to suspect some palpable source of error, one of which we already know to be the presence of acid-fast bacilli in the diluting fluid or in the water or the pipes conveying it (Brehm, Beitzke, Schern and Dold, see p. 248).

CHAPTER V.

HEREDITY.

THE supposition that scrofulosis is an hereditary disease has formed the Alpha and Omega of its etiology for many authors for centuries. Many simply revel in relating the hypotheses according to which scrofulosis may be handed on from parent to child. The representation of heredity as an axiom accepted from time immemorial and the conflicting opinions of our days renders a closer criticism of this theory desirable.

Lugol considers heredity as "the sole and general cause which we can demonstrate"; he grants no exception to the law of heredity. According to him, scrofulosis is a legacy to the children: (1) When the parents are scrofulous; (2) when the parents suffer from lung disease, for tuberculosis prevails amongst half of those who suffer from scrofulosis; (3) if the parents were formerly scrofulous but now healthy; (4) in healthy parents whose brothers and sisters are scrofulous; (5) if the parents were syphilitic or given to excess in venere (either "the semen may not have remained long enough in the seminal vesicle or external irritation has preceded the coitus and therefore the semen and its products have lost their force"); (6) from parents who have performed the act of reproduction, either too early, before the 25th year, or too late, the man after 52 the woman after 40, therefore with not fully developed powers or powers already weakened; (7) when there is a great difference of age between the parents; (8) with paralytic, epileptic, insane, or half-impotent parents.

Other authors consider alcoholism in the parents answerable, mercurialism, near relationship, and especially diseases in feeble constitutions. Birch-Hirschfeld mentions diabetes, leucæmia, malignant tumours, exophthalmic goitre, &c.

If we were to accept Lugol's theories we should have so many possibilities of inheritance that we should never be at a loss, even with non-scrofulous children, of finding one which fitted, especially as Lugol offers the supposition of adulterous intercourse for all cases, but this is difficult of confirmation on account of the delicacy of the question.

In opposition to the disciples of heredity doctors have in all times, ever since this term has been used in a sense nearly resembling that of the present day, come to very different results on the ground of their clinical observations. For example, Th. White (1788) contested the heredity of scrofulosis, and said it was the same as if we should say that the children of lead-workers, who also work in lead, get lead poisoning.

Lebert (whose book on "Scrofulosis" is even now worth consideration by reason of the sharp criticism to which it has been exposed) especially attacks heredity, which he considers to be not the chief cause, but only one of the conditions under which scrofulosis will be found with comparative frequency. "Strictly speaking," says Lebert, "only this is certain, that a number of scrofulous and tuberculous patients have children who suffer from the same affection as themselves. It is better to rely on insufficient but real facts than to hide one's ignorance under hypotheses and high-sounding sentences."

Birch-Hirschfeld, who considers heredity as one of the most important etiological factors, was obliged to admit that it cannot be confirmed by statistics.

We must endeavour in our division into the pyogenous and tuberculous form of scrofulosis to keep the two distinct, also in considering the question of heredity.

THE INHERITANCE OF TUBERCULOSIS.

The inheritance of the tuberculous form of scrofulosis must be considered in the same light as the inheritance of tuberculosis itself. We distinguish congenital tuberculosis as a transmission of the germ itself, which may be either germinative or placental transmission of the bacilli as well as the transmission of a certain tendency or disposition to tuberculosis; heredity in the proper sense of the term, according to Martius.

TRANSMISSION OF THE GERM.

Our researches on tuberculosis (see the detailed account of the question of Heredity in my book, "Die Tuberculose," second edition, pp. 432-476) have yielded the following results:—

Germinative transmission. A germinative transmission on the part of a tuberculous father presupposes that tubercle bacilli are to be found in the semen. The positive finding of the tubercle bacilli in the semen, testicles, and seminal vesicles in cadavers, especially with miliary tuberculosis, communicated by Sirena and Pernice, Spano, Jäckh, Nakarai, Simmonds, may just as well

have been the consequence of dissemination of bacilli in the body before death, and therefore no conclusions can be drawn from these cases for living sexually-active men.

Besides, their importance is reduced by the negative findings of Rohlff and Westermayer, Walther, Dobroklonski, and the relatively rare occurrence of primary genital tuberculosis in women, especially in puellæ publicæ, in spite of the well-known sexual activity of thousands of men suffering from phthisis.

Even in experiments on animals, where we can create the most favourable conditions for such transmission and have at times inundated the testicles with enormous doses of bacilli, the experiments of Cavagnis, Gärtner, G. Cornet, Binaghi have testified that the embryos and young bred from such semen were free from tuberculosis.

Friedmann was the only one to obtain positive results, that is to say, he found tubercle bacilli in the embryos, but the arrangement of his experiments was far removed from natural conditions, and these experiments, on which v. Baumgarten, &c., rely so implicitly, were not confirmed by the after-tests of Seige.

The experiments of Karlinski are also unconvincing; he inoculated the testicles of a he-goat with human bacilli and then caused it to cover a healthy she-goat; the female remained healthy, but the young exhibited tuberculous foci in the mesenteric glands, enlargement of the cervical glands, and peritoneal tuberculosis, a picture which does not coincide with what might have been expected from such a mode of transmission.

We arrive, then, at this result, that up till now no conclusive cases are to hand which prove the possibility of the transmission of tuberculosis by means of semen containing tubercle bacilli, to say nothing of assuming that such transmission can take place with men under natural conditions. Bongert expresses a similar opinion in his critical reviews, as also do Crouzon and Villaret.

Placental transmission. The case is somewhat different with placental transmission.

The normal placenta forms an impenetrable filter to corpuscular elements and bacteria, but under the influence of various infectious diseases, accompanied perhaps with high fever, lesions occur, epithelial defects which render the passage of the bacteria into the fœtal organism possible. In the case of a tuberculous mother such a passage is apparently only possible if a tuberculous focus is in the placenta itself, as happens now and again in acute miliary tuberculosis. Tuberculous foci in the placenta have been demonstrated by F. Lehmann, Schmorl and Cockel, Auché and Chambrelent, Runge, Sitzenfrey (among twenty-six

mothers suffering from placental tuberculosis seven times with tuberculous changes). Jung, Monaco, Schmorl and Geipel found tuberculous changes nine times in twenty cases of severe tuberculosis and once in incipient phthisis (after 2,000 preparations, but the virulence was questionable). The researches have been facilitated by the antiformin method, by the help of which Novak and Ranzel demonstrated tuberculosis in ten placentas seven times by antiformin and three times histologically (see p. 247).

Amongst cattle, placental tuberculosis appears to be more frequent, and from this the relatively more numerous cases (according to Arvid Bergman 0·42 per cent. of new-born calves are tuberculous) is to be explained.

But even the tuberculous placenta appears, according to the histological findings of Schmorl and Cockel, to offer in many cases a protection against the entry of bacilli. Carl, Benecke, and Kürbitz, Henke, Hamm and Schrumpf, Schlömpert (five cases) could find no tuberculosis in the fœtus in spite of placental tuberculosis.

In other cases of Schrumpf, Warthin and Cowie, Lobenstine and Wollstein a transmission of the bacilli to the fœtus was consequent upon placental tuberculosis.

Whether a transmission is possible without tuberculous changes in the placenta is doubtful (Geipel). Aschoff and Bernard, Courmont and Charier inform us of a placenta free macroscopically and microscopically, but tubercle bacilli were demonstrated in the liver of the fœtus; in such cases small placental foci may have been overlooked. Bossi, who in twelve cases inoculated the placenta and liver of the miscarried fœtus of tuberculous women, only found bacilli in one placenta which was not intact.

But it might always be supposed that under the influence of high fever, especially in miliary tuberculosis, there may be breaks in the continuity, and it is just at these spots that the bacilli may have entered (see cases by Schmorl and Birch-Hirschfeld, Hochsinger).

The actual occurrence of tuberculous fœtuses is more important especially in the new-born, in which tuberculous changes have been demonstrated so soon after birth that the seat of these changes and their degree of development entirely exclude the idea of infection *post partum*, which therefore conclusively prove intra-uterine transmission. A few such cases in man which stand the test of critical demands more or less were recorded by Charrin, Berti, Sabourraud, Lannelongue, v. Rindfleisch, Hochsinger, Honl, Bugge, Auché and Chambrelent, Henke, Brindeau,

Heitz, Lyle, Stoekel, Hamburger, Schmorl, and Birch-Hirschfeld (the first authenticated case in man), Armanni, Thiercelin and Londe, Georgi, Ritschel, and a few others.

Gärtner has been able to demonstrate experimentally in a few cases the presence of tubercle bacilli in the ovum after inoculating pregnant animals with a very large quantity of bacilli; also Friedmann and Galbo have found the same if the female were inoculated before copulation.

Jezierski injected tubercle bacilli into animals in an advanced stage of pregnancy, and in half the cases the fœtus proved to be tuberculous on inoculation. Naturally such experiments, when the body is inundated with bacilli (which according to weight would be as if one should inject 350 grammes of tubercle bacilli into the trachea or 1½ litres into the abdominal cavity), admit of no comparison with natural conditions in men.

On the contrary, the inoculation of parts of the organs of the fœtus of a tuberculous mother into man and animals has very frequently had a completely negative result: Straus, Nocard (forty fœtuses); Galtier, Grancher and Straus (forty-nine inoculations); Sanchez and Toledo (sixty-five fœtuses); Vignal (eleven fœtuses and seventeen placentas); G. Cornet (233 ova, partly entire embryos or parts of an organ); Jaquet could demonstrate no tubercle bacilli in several human fœtuses of tuberculous mothers.

The possibility of placental transmission is therefore confirmed without doubt; but of what account are the few (hardly twenty to thirty cases) which the most industrious of pathologists in all civilized lands have been able to collect in the course of the last twenty years, against the 100,000 new-born children and fœtuses of tuberculous mothers which have passed through their hands.

Placental transmission is doubtless possible according to clinical and experimental results, but it is practically unimportant, because as a rule it presupposes a mother who is tuberculous in the highest degree, or suffering from general miliary tuberculosis. According to all experience hitherto gained, such infected progeny die after a short existence either from weakness and atrophy or from their inherited intra-uterine tuberculosis. This is confirmed by the progressive and generally fatal course of infantile tuberculosis, besides which, clinical and anatomical conditions confute the theory of placental inheritance of the germ as the cause of scrofulo-tuberculosis, for in this case the primary seat of the disease is in the neck, bronchial and mesenteric glands; the internal organs, bones, and joints are only secondarily attacked, whilst with placental transmission the organs which may be

considered as the point of entry, the liver and the glands of the porta hepatica are first attacked. Further, according to numerous results of *post-mortems*, caseous glands only appear at about the second month after birth, and so at a time when extra-uterine infection may have taken place; lastly, experience has shown that in orphanages and foundling hospitals, whose occupants are descended for the most part from tuberculous parents, scrofulosis and the tuberculosis which in general follows it are extremely rare (Epstein, &c.); therefore the real cause is to be sought after birth in the association with affected parents. The greater frequency of tuberculosis ("Die Tuberculose," second edition, p. 463) is no contradiction, but is caused by faulty hygienic conditions which favour the transmission.

The experiments of Schreiber, Bertheraud, and Behrend are of special importance. According to them, the fact that tuberculin injections in infants of tuberculous descent was followed by no reaction, pointed to hereditary transmission. The more recent findings by v. Pirquet's reaction had almost entirely negative results in infants of tuberculous parents (according to Moro 3 per cent. were positive; see also Bondy, Escherich, Siegert, &c.).

Hitherto for ordinary pyogenous scrofulosis, since we have separated this from tuberculosis, the hypothesis of intra-uterine transmission of the germ has not been even advanced.

HEREDITARY TENDENCY TO TUBERCULOSIS.

How does the case stand with regard to further proofs of the theory of heredity if we except the few trustworthy cases of congenital tuberculosis? If we deprive it of its hypothetical adornment, belief in authorities, and the old purely subjective view which has been "accepted from generation to generation without thinking," the theory is based on the uncontested facts that children of tuberculous parents frequently—more frequently than others—become tuberculous also, and that in many families a number of cases of tuberculosis occur by which the appearance of a family affection is caused.

All former works, and, unhappily, most of the more recent, on the influence of heredity which are confined to reckoning percentages as to how often among the forefathers of a tuberculous patient tuberculosis has occurred, are nothing more than an arithmetical game.

With the great frequency of tuberculosis there would naturally be countless examples of the descent of sufferers from tuberculosis (or tuberculo-scrofulosis) from tuberculous or scrofulous parents.

These cases are absolutely no proof of hereditary tendency; they just as well admit of the interpretation of mutual infection, for if of two possibilities, heredity and infection, the latter cannot be excluded, the former logically is not proved.

Naturally, those descended from tuberculous parents must have increased opportunities of infection on account of living closely together with their tuberculous relations, and show frequency of tuberculosis in an increased degree. So what do the statistical figures produced prove?

The presence of tuberculosis and scrofulosis amongst the parents and brothers and sisters of such patients is in no way a proof of "the general spread of the disease in the same family," which, according to the famous Lugol, is "unavoidable," and, according to the no less famous White, is "contrary to general experience."

I contrast the opinions of two old and recognized authors as an example of the contradictory views to which the subjective contemplation of the question leads.

Nearly all statistics suffer from the radical fault that they are based on too scanty material; only large figures are statistically valuable; only such give legitimate results in which chance circumstances disappear. A further fault in such statistics is that everything is thrown pell-mell together; persons who really are descended from parents who were tuberculous at the time of conception, and those whose parents at the time in question were in the best of health, and therefore could not pass on what they themselves had not, if these parents became tuberculous after ten or twenty years, or even later after the birth of their child, then tuberculosis can stand in no etiological connection with the tuberculosis of their descendants. To every unprejudiced person the idea that the parents were infected by the child will appear more probable.

But in spite of these oft-repeated objections (see "Die Tuberculose," second edition, p. 467) recent works contain such insufficient calculations and arrive at quite different figures, according to the material employed.

For frequency of inheritance, Durand and Gentes give 12 per cent., Mongour 20 per cent., Zilgien 32 per cent., Nikolski 50 per cent., Bugajewski-Goldstein 52 per cent. sure, and 27 per cent. probable. Sachs mentions that of the children of tuberculous parents 29 per cent. were tuberculous; Miller and Woodruff, that of 150 such children 36·8 per cent. were tuberculous, 18 per cent. suspected (see also Oliari); Dotti found (in 9,000 cases) inherited tuberculosis in 48·1 per cent. persons, and in 22·6 per cent. of those suffering from exudative diathesis. One might even

doubt if progress in knowledge would ever be obtained when I can prove the case of a well-known statistician who on one page of his books tells us that a girl died at a month old, and on the next page says that thirty years later she married a widower and had seven children; and who writes of a person who is only born twenty-four years after her marriage, and a great many other things of the same sort; an author whose works are full of the grossest faults (see criticism in my "Die Tuberculose," second edition, p. 472), who will recognize no case of transmission from person to person, and of whom Beitzke says that he is not to be taken seriously; when, in spite of all this, he is quoted without scruple as trustworthy by the believers in heredity, even by Martin, Kirchner, and Martius, or his writings are brought forward as counter-proof to other painstaking works.

Of the works that I know, that of Weinberg strikes me as being the most carefully thought out. He has studied the subject in a series of thorough investigations, and has also done justice to statistical fundamental laws. He found, too, that the children of tuberculous parents, especially of tuberculous mothers, died more frequently from tuberculosis than those of non-tuberculous parents.

But more important is his further verification that this hereditary affliction has about the same influence as living with a tuberculous spouse, in which case the survivor becomes tuberculous double as frequently as if reciprocal infection had not taken place.

If conjugal life, which on account of its functions is limited as to its duration with a tuberculous partner, can of itself bring about the same results as that of a child living with tuberculous parents, what is left over for the influence of hereditary disposition?

Mongour and Thom have given figures which about agree with those of Weinberg.

Burckhardt's comparison of 250 phthisical patients in the hospital at Basle, and 250 non-tuberculous patients in the Polyclinic, shows in the former a greater frequency of tuberculosis in the families than in the latter, but it is more marked in the side branches in the brothers and sisters and in the uncles and aunts than in the direct line of ascent, therefore says more for infection than for heredity.

In Reiche's 1,843 cases between the ages of 15 to 50, 29·7 per cent. males suffering from phthisis and 44·4 per cent. females were descended from tuberculous parents; whereas in persons without pulmonary tuberculosis there were 12·8 per cent. males and 17·6 per cent. females.

Reiche considered it an advantage in such questions to select older persons because the ultimate state of the parents is better known. I look upon this as a great source of error, because in this case all those parents who had been infected long after the birth are included as passing on their disease, which is clearly inadmissible.

The investigations among groups of people living in localities cut off from communication with others are valuable.

Boeg, who studied the question in the distant Faröe Islands, found no evidence of heredity, but much of infection, as, on account of the cramped dwelling accommodation, even men-servants and maid-servants in tuberculous families became tuberculous, and were thus drawn into the apparent sphere of heredity. Similar investigations of Fischer's in two villages in the Black Forest in Baden gave like results, namely, that tuberculosis is not a disease running in the different branches of one family, but of single households.

Johnson, Kristen, Storen, Kluge, Dörner, and others, arrived at the same result, namely, that tendency, to which formerly excessive consideration was given, now falls into the background. The fact may frequently be confirmed that a person suffering from phthisis is the source of infection, and further cases group themselves about him whether there is any family relationship or not.

We know further from countless examples, but more especially from experience, that most of those descended from tuberculous parents when they are separated from them, and are protected from the ordinary opportunities of infection, remain healthy in spite of all hereditary tendencies (Epstein, Hutinel, and Bernstein). Feer also experienced in Heidelberg that hereditary tendency was unimportant, that new-born babes of phthisical mothers remained healthy when given to healthy wet nurses.

Thus statistics, in as far as they satisfy scientific demands, and are not simply based upon an uncritical stringing together of figures, give no conclusive support to the acceptance of hereditary tendency having much influence. Clinical experience, when it does not rely on figures, is too dependent on personal opinion, and therefore is of little weight (see above, Lugol and White).

Therefore, only special investigations, such as those carried out by Boeg and Fischer, and others, which really express clinical experience in an exact manner can be taken into account, and this experience teaches us, as a rule, that apparent heredity is to be taken in the sense of contagion.

Single observations are just as little determinative, because in them chance and conditions which we cannot grasp turn the scale; for example, according to Schönborn, in a family where

the father was tuberculous eight children died of tuberculosis; of five foster children living in the same house only one died, apparently a striking case of hereditary affection; but in another family all the children were affected with tuberculosis excepting the son, who grew up with healthy relations. There are hundreds and thousands of such cases.

Lugol considers a difference in the age of the parents as a cause of heredity has been proved because he treated many scrofulous patients in whom he found no other cause. Who would acknowledge such a proof of heredity *à tout prix?* Yet there are authors even in most recent times who, out of reverence for their origin, echo all these reasons without even making an attempt at independent argument.

Pégurier, who has recently investigated the question of the influence of inequality of age in marriages which have taken place too early or too late as affecting the susceptibility to tuberculosis in 300 families, could get no positive proof of it.

Tuberculosis and scrofulosis and the other factors above-mentioned are too widely dispersed, and life too diversified, and so various are the consequences of this that we could find examples for any theory even the most arbitrary.[1] From this it is quite explicable that now and again several children of the same family are attacked by the same form of scrofulosis, such as coxitis, or spina ventosa, an occurrence which is then emphasized as remarkable. Dent, for example, treated a girl aged 19 who had lupus in the leg, and her two sisters (who had always slept with her) had lupus also. Very often certain customs or bad habits peculiar to a family may lead to an infection of the same organ; for example, picking the nose might lead to the affection of several children with the same disease of the nose. Besides, such analogous affection in several families is by no means the rule; much more frequently one child will suffer from neck glands, another from tuberculosis of the bones, and a third from phthisis.

The mistaking in former times of syphilis for scrofulosis, from the retarded form of which severe scrofulosis is hardly to be distinguished, may have had much to do with the view of the excessive importance of heredity. The frequency emphasized by earlier authors (including Lugol) of stillbirths and abortions in scrofulous families points to this.

The experience of Volkmann that fungous inflammation of the joints, caries, tuberculous swelling of the lymph glands, &c.,

[1] A short time ago a notice appeared in the papers that three members of one and the same family had been run over after long intervals.

are not generally found in healthy families agrees very well with the theory of infection; for in such affections we have to do for the greater part with a class represented by young persons, or, at least, with such whose maladies had already begun in childhood, although perhaps in another situation, and in children living among a number of persons with whom they are crowded together, and who are thus subjected to tuberculous infection; we have to do with a disease which is represented in the parents and nearest relations ("pseudo-heredity"). For the same reason, especially in children, physicians meet with such supposed heredity at every turn, if they do not take into consideration the opportunities for infection and give them their due.

On account of the long period of incubation of tuberculosis, it may happen that the parent, after several years of illness, only gives rise to infection in the last few weeks whilst confined to bed; tuberculosis of the bronchial glands develops extremely slowly in a child (even with the small animals used in our experiments an inoculation of a small quantity of material is hardly perceptible eight weeks later). After six months to a year one or other bacillus reaches a joint, and weeks and months go by before any changes worth mentioning appear; thus between the death of the parent, and the clinical symptoms of the child, a long period often elapses.

Latham, who in his collection of reports points to the entirely insufficient grounds for the acceptation of hereditary tendency, admits rather a gradual increase of resistance to tuberculosis, for, as he thinks, almost every adult is somewhat tuberculous (?), and therefore most of our forefathers must have been tuberculous, yet turberculosis is decreasing instead of increasing.

Neither the older nor the newer writings on the subject have as yet supplied any positive proof of the great influence of heredity, exclusive of contagion.

As the case stands, numerous authors arrive at a more or less complete repudiation of hereditary predisposition (Comby, Piettre, Parienté, Crouzon and Villaret, v. Behring, Calmette; see also Hazen's investigations).

On the whole doctors are for the most part convinced that the heredity of tuberculosis practically plays a very unimportant part, a fact which I record with some satisfaction after my twenty years' struggle with the theory of heredity in its all-prevailing forms, a struggle which at first brought me general opposition.

Individual variations in the susceptibility to tuberculosis within certain bounds have never been denied. But the opinion that certain individuals, on account of the slightness of their

hereditary tendency, enjoy almost certain protection from tuberculosis has been contested; that the greater or less predisposition alone turns the scale, and that the exogenous cause, the bacillus, is comparatively unimportant, is a point of view which is as much unproven as it is to be repudiated for practical, hygienic, and prophylactic reasons. Schlüter, in his excellent work written under the ægis of Mars, comes to the conclusion that there is no specific tendency to tuberculosis "as an inherited or acquired condition which can be consistently defined, and which exhausts itself in a definite anatomical or physico-chemical quality."

One of the few who hold a fixed idea as to the general predisposition is A. Robin, who propounds the theory of demineralization (see p. 52). Sobotta suspects poverty of lime also in a predisposed person.

As far as a general special predisposition of the body to tuberculosis and tuberculo-scrofulosis is concerned, we may expect to gain exact knowledge less from chemical studies than from further researches in bacteriology and immunity, for probably the higher or lesser degree of susceptibility depends on deviations in the formation of protective material.

As a sort of hereditary predisposition it is conceivable, though not yet proved, that on account of bacterial toxins in the blood of a highly tuberculous father, the semen becomes changed, and it is still more possible that the toxins of a tuberculous mother pass on to the fœtus by endosmosis. In practice this occurrence does not play an important part, for parents who are highly tuberculous only rarely beget children or carry the ovum the full time, and because such embryos soon die either in utero on account of the quantity of bacterial toxin or extra utero from debility and atrophy, as we have observed experimentally in animals. But now and again a small quantity of such poison may, by transudation, induce over susceptibility to tuberculous poison which we can bring about experimentally, and which with a further supply of tubercular toxin by infection might perhaps have a further influence on the course of the disease.

This theory is approved by Soltmann, but this author pronounces scrofulosis to be a non-bacillary toxic tuberculosis depending on pathological chemotaxis (see p. 59).

The question of local readiness for pulmonary tuberculosis on account of the shortening of the cartilage of the first rib mentioned by Freund-Hart, or of the paralytic thorax according to Stiller, lies outside our subject.

I will only mention that Danges studied the possibility of inheriting the so-called phthisical habit in 194 phthisical patients,

and comes to the conclusion that inheritance of the habitus is just as often exemplified as it is questionable from convincing counter-proofs.

Transmission of the Tendency to Scrofulosis.—We have hitherto spoken of tuberculosis, or the tuberculous form of scrofulosis. The transmission of hereditary predisposition to the true scrofulous character of the disease lacks convincing statistical or clinical proof. If one be difficult to bring forward for tuberculosis, a further difficulty presents itself in the case of scrofulosis, for the family history of the former scrofulosis of the parents can only be accepted with the most extreme caution, and very often a simple swelling of the glands, a simple rash or enlarged tonsils are mistaken for scrofulosis.

On the other hand, it cannot be denied, even if the disease itself cannot be inherited, yet certain anatomical peculiarities in the skin and lymph vessels, which we are inclined to call a scrofulous tendency, may be inherited, just as a large mouth, large eyes, &c., can be transmitted from parents to children.

We have no certain data as yet whether this scrofulous tendency is connected with a certain bodily weakness, or whether it appears quite independently of it, whether it depends on some physical inferiority in the parents, or if specific disease, such as tuberculosis, is specially adapted for the procreation of children with such predisposition; the often repeated statement of a causative connection between scrofulosis and stoppage of growth, arrested development, as well as the high mortality amongst the children of a family needs further proof, unless infection plays a part.

Only by extensive comparative statistical and anatomical studies can a firm foundation be laid. It is not enough to confirm a more or less frequent number of cases of scrofulosis in a numerous line of forefathers; at the same time proof must be brought that the same factor does not present itself in a like number of non-scrofulous individuals; it must appear less seldom or not at all.

Ponfick referred his scrofulous diathesis with increased tendency to exudative and proliferative reaction to an inherited want in the morphology and chemical composition of the organism of a child. Czerny claims for his exudative diathesis "a congenital defect in the chemical processes of the body." A decided heredity, especially on the mother's side, but which is difficult to confirm in the case of the parents at the time of their youth, he considers the diathesis not as a special sign of bodily inferiority in the parents (syphilis and tuberculosis), for in children of

tuberculous parents they are not more frequent than in other children, though they appear with special frequency in the children of neuropathic and psychopathic parents.

The findings of Moro and Kolbo are brought forward in the sense of hereditary influence. According to them the signs of exudative diathesis show a grouping in families, and it appears six times as frequently in the brothers and sisters of children suffering from eczema as in those of control children. The appearance of exudative symptoms, lichen urticatus, eczema, &c., in the first year of life in four-fifths of cases, emphasized especially by Moro, confirms this. Escherich, on the contrary, considers the acceptance of a congenital scrofulous condition to be inadmissible, because the scrofulous symptoms only appear towards the end of the first year, and then there is already a positive reaction to tuberculin, and allergie exists. Preisich also contests the direct heredity of scrofulosis (see his work).

CHAPTER VI.

FACTORS WHICH FAVOUR INFECTION.

The development and spread of scrofulosis is influenced by a series of external factors. Many authors vied with each other in bringing forward, with a certain amount of sophistry, new favouring factors; in doing this, critical research was sacrificed to a semblance of thoroughness. For what is the good of bringing together all sorts of factors which appear adapted to destroy the health of man without a shadow of proof as to their near connection with scrofulosis?

Even the frequent occurrence[1] of a fact does not become an argument; for example, bad, small dwelling-houses do much for the dissemination of scrofulosis; such dwelling-houses are the natural consequence of small means and a low social position. Therefore, all other factors which are invariably connected with this low social position, unhygienic conditions, insufficient nourishment, overwork, scanty clothing, perhaps also too little sleep,[2] are more to be found amongst these scrofulous persons than among others, without it being admissible to take each separate factor as a favouring agent.

Social Position.—Social position takes the first place amongst the influences promoting the disease. It is true scrofulosis appears in all classes, amongst high and low, rich and poor, still it is agreed by all authors that it is found infinitely more frequently amongst the poorer classes than amongst the well-to-do. The worse the outward conditions, so much the more plentiful, as a rule, are the opportunities of infection of every kind. The

[1] Here, as with heredity, the logical and statistical fundamental rule is broken, that it is not enough for such proof to confirm the frequent occurrence in scrofulosis of a fact. It must at the same time be proved that amongst the same number of non-scrofulous persons the same fact is observed much more rarely.

[2] Poor children have often to be out hawking at night, and in the morning to be up early to deliver newspapers, hot rolls, &c.

localization of the disease seems also to vary somewhat with the social position. In grouping the observation of Kanzler on this head, we find among 100 children of the rich 40 per cent. with enlarged cervical and occipital glands; of 100 children of the poor we have 70 per cent. with local affections, accompanied by eczema on the head and face.

Bad housing conditions come most into consideration. But we do not find, as was thought formerly, that the principal mischief is in the chemical condition of the vitiated atmosphere, but in the quantity of germs it contains. The closer and more crowded the housing conditions, the more easily do dirt and micro-organisms of all sorts accumulate, the more often can the bacteria enter the body, deposit themselves on the tender skin of the child, and cause either transitory local irritation or scrofulous processes. The greater the population the more likely are we to find tuberculous persons amongst them, and their dissemination of bacilli has the sad consequence of tuberculous scrofulosis.

Dark rooms in which the sun scarcely ever enters are noted as breeding places of scrofulosis. Long experience has taught us that the inhabitants of small dismal streets, in houses which look on narrow courts surrounded by high walls, suffer from scrofulosis with excessive frequency; in streets that are equally populous on both sides, it is noticed that the shady side will have more cases than the sunny side.

Bacteriologically, this is reasonable, for the sun is an incomparable disinfector which can destroy even the highly resistant tubercle bacilli in a few minutes, or perhaps hours, in its direct rays, and in a few days in dispersed light, and it acts in the same way on those light-shunning germs, the other pathogenic bacteria.

Besides this, want of sunlight has a bad influence on other bodily functions, the formation of blood decreases, oxidation is faulty, and the powers of resistance may be lowered. We cannot at present estimate how far these factors, which are partly founded on theory, come into consideration in the production of scrofulosis.

Damp, musty cellar dwellings are rightly considered a developing ground for scrofulosis, as humidity of itself preserves bacteria longer than dry air. Besides, damp dwellings are, as a rule, dark, for rooms are quickly dried in the light, a second reason for the longer existence of bacteria.

In dry dwellings the bacilli are more easily dispersed, and are inhaled in greater quantities in childhood, inducing pulmonary tuberculosis, which runs a speedy course. In damp air (see my experiments) the fine pulverization becomes more difficult, and the danger of tuberculosis by inhalation is lessened, perhaps avoided.

Thus in damp dwellings infection by contact may come into prominence as a source of scrofulosis which runs a long course.

The theory often propounded that damp, dark dwellings favour the growth and proliferation of the tubercle bacillus outside the body is in contradiction to the biological laws of this bacillus, which requires a high temperature and special nourishment to thrive outside the body. A damp and dark environment as a favouring medium for growth may be conceded to the pyogenous bacteria.

The same may be said of damp, dark workshops, only in the case of adults the danger of scrofulosis is less (see above).

The old prisons and dungeons, damp, dark places in which cleanliness was looked upon as a luxury, have been rightly mentioned as breeding grounds for scrofulosis (prison scrofulosis); while scrofulosis may be introduced into our modern light and airy prisons and reformatories, noted for their great cleanliness, it may be considered to have disappeared as a disease engendered in prison.

The same may be said of prisons as has been said of dwellings, namely, that infection by contagion is evident.

The harmfulness of such places has a better foundation bacteriologically than the far-fetched notion of Kanzler and Mordhorst, that in their vitiated atmosphere respiration becomes superficial through imperfect aeration of the venous blood, by which engorgement of veins arises, followed by engorgement of the thoracic duct and lymph-stream. Overheating and enervation, which have been put down to living in such places, is of a more problematical nature.

Uncleanliness is highly conducive to the production of scrofulosis; uncleanliness in dwellings, because it accumulates germs and multiplies the opportunities of infection; want of care of the skin, because it favours contact of the exterior covering with bacteria, and their detention; dirty underlinen easily becomes a culture ground for bacteria, bites from vermin and scratching afford them entrance.

In southern lands the lax ideas of cleanliness are compensated for by the more intense light of the sun, which destroys the germs at once, and also by the population living more in the open air.

We have gained a decided impression that repeated and emphatic instruction in the prophylaxis of tuberculosis has not been without fruit. Ostermann, in testing the surface of floors in ten instances, found half of them free from bacilli, in spite of extreme dirtiness (see also Preisich and Schütz, Hillenberg).

We meet with decided infection by dirt also in the better

classes, and, in combination with it, shocking uncleanliness of the body itself, though often more covered, and not noticeable externally.

On the whole, however, the severe forms of scrofulous skin affections seldom appear in well-to-do families, in spite of tuberculous infection, in spite of "lymphatic constitution" and Czerny's over-nourishment. On the other hand, we find in a less noticeable form tuberculosis affecting the glands, though with cleanliness in other ways, by the instrumentality of sputum incautiously treated, such as spitting into the handkerchief, kissing tuberculous persons, tuberculous milk, &c. This may often occur in all the children of a family.

Insufficient, and especially unvaried nourishment, which may also be improper and faulty, is mentioned as a favouring agent in scrofulosis.

From the standpoint of infection, children nursed at the breast of a healthy mother will become scrofulous much less easily than those nourished with cow's milk, especially milk from tuberculous cows, or shop milk, or milk turned sour.

Feeding infants with pap, especially when a tuberculous mother or nurse has tasted the food previously, may be a possible cause of infection. Demme has published such a case; a nurse with lupus of the nasal septum and tuberculosis of the antrum of Highmore, in this way caused isolated intestinal tuberculosis in four children (Nothnagel, vol. xiv, 3, p. 201). Coarse food mechanically irritating the walls of the intestine may perhaps facilitate the entry of the bacilli into the intestines, into the mucous membranes, and mesenteric glands. Scrofulosis may often be observed in children who are fed at too early an age with farinaceous foods, coarse bread and potatoes, or with vegetables rich in amylaceous properties and cellulose, which overload the intestines by their bulk. It remains undecided whether other causes are present which have nothing to do with infection.

The overfeeding with milk and eggs mentioned by Czerny may in many cases keep up and aggravate the production of tuberculosis, especially the exudative symptoms, but whether it has any great influence on purely tuberculous persons (the most important form of scrofulosis) requires further proof.

According to many authors, want of exercise favours scrofulosis, but perhaps remaining in close rooms which accompanies this, and the increased opportunities for infection consequent upon it, should bear the principal blame. According to others, overwork or hard bodily labour acts unfavourably; others, again, accuse onanism.

Pregnancy is said to influence the production and course of scrofulosis. Formerly the legend was prevalent that scrofulosis was caused by pregnancy during menstruation. Lebert very appropriately calls such causes "etiological windmills."

In any case we must be careful not to over-estimate these and similar factors. Thus Virchow, for example, expressly emphasizes that when hunger typhus raged in Upper Silesia, "in spite of living on potatoes and in bad dwelling-houses, scrofulosis and tuberculosis were very rare." Lugol informs us that neither the besieging army, who were for a long period exposed to damp, all sorts of privations, most unwholesome food, famine, constant exertion by day and night, discouragements, &c., nor the besieged, whose fate was still worse, had many cases of scrofulosis, though they suffered from scurvy and dysentery.

Concerning the spread of scrofulosis in towns and in the country, many authors confirm a decided difference in favour of the population of the country. The fact that country people suffer less from scrofulosis may be due to their living more in the open air, and so incurring less risk of infection, either from tubercle bacilli or pus cocci; and also in the country there are no narrow streets and dark courts. These advantages are, however, in many cases counterbalanced by the close, unventilated, small-windowed rooms of country cottages in which the people live day and night during the long winter months. In many cases there is barely a division between the living rooms and cowsheds and stables, so that man and beast live amicably together; human and animal secretions are carelessly heaped up together in the country. Local conditions and customs are too various to set up a general rule, therefore authors making observations in narrow circuits arrive at results contradicting one another. Scrofulosis has even been described as a peasants' disease, and been put down to a too large consumption of milk and butter.

Lebert and others find no difference between country and towns.

The acknowledged favourable influence of a sojourn in the country for townspeople can naturally lead us to no conclusions respecting the country people themselves, as the two live under entirely different conditions.

Scrofulosis appears to depend little on climate and soil. It has been stated that damp, cold, low-lying places are much more conducive to scrofulosis than dry, warm, highly-situated districts; indeed, formerly low-lying places were mentioned as a direct cause of it; but older authors referred to the contradiction of this theory in practice. Thus Lugol pointed out the frequency of scrofulosis

in Spain on the table-land of Castile, especially in Madrid, while (on the other hand) it is often little met with in the dampest districts.

Here, as in tuberculosis, we must in the first place take into consideration how far the climate tends to cause the population to live in closed rooms full of germs. This point of view leads us to consider that seasons must also exert a certain influence; winter would afford increased opportunities for infection, as the cold, cheerless weather would lead to staying indoors, and thus infection would declare itself after weeks or months, and according to the energy and growth of the germ in question would declare itself by a local or glandular affection. In fact, some authors mention that scrofulosis affects people more especially in the spring, that it gets worse about January to March, and then decreases.

Scrofulosis is undeniably favoured by certain illnesses, especially the acute exanthemata; in fact, they appear now and again to induce a direct outbreak of the disease. For a long period measles and whooping-cough have had a bad name in this respect, and after an epidemic of these diseases an increase of scrofulosis has often been observed (Albrecht and others). Obstinate spasmodic cough consequent upon swollen bronchial glands, and the pressure on the nerves induced by it, has been erroneously mistaken for the pertussis which leads up to scrofulosis. Scarlet fever, diphtheria and small-pox, frequently precede scrofulosis.

In a case of Gougerot, for instance, lupus which had existed for sixteen years increased in size after small-pox.

The epithelium becomes loosened, and the continuity of the protective covering is destroyed by the catarrh of skin and mucous membranes which constantly accompany these affections. Bacteria adhere then more easily, and thus penetrate and deposit themselves. Such infection is specially favoured when children live in an environment full of germs, especially in tuberculous surroundings, and when the sick-room is scrupulously closed, darkened, not ventilated, and therefore full of germs.

In a great number of cases affections of the glands have existed before the measles, &c., occur, especially latent (or even manifest) affections of the bronchial glands. Such have been demonstrated by Loomis, Pizzini, G. Cornet, Spengler, Harbitz, Weber and Baginsky, Weichselbaum and Bartel, Gaffky, and others, and as accidental conditions (see Cornet, "Die Tuberculose," second edition, p. 370).

The usual accompaniments of measles and other exanthemata. —namely, the swelling of the lymph glands already infiltrated

with pre-existing foci—loosen and mobilize the bacilli and incite new growth; the glands, hitherto latent, manifest themselves at this time. Mechanical and chemical processes, the softening of the tissues or the toxins of the secondary bacteria (measles), wash a few bacilli out of the gland. Severe inflammation can even cause the tense capsule to burst; the bacilli thus freed disseminate themselves over the hilum of the lung, and induce the exanthematous phthisis of the lungs—so-called by the older physicians. Or they enter the bones and joints, or cause acute miliary tuberculosis, or induce in the skin multiple lupus, multiple tuberculosis, tuberculides, or scrofulides (Adamson, du Castel, Haushalter).

It is often difficult to decide whether we have to do with a new infection or a manifestation of a pre-existing focus. In the tuberculous form multiple and rapid appearance points to the latter.

The dissemination of scrofulous foci and metastases appears to be greatly facilitated by the speedy loss of flesh resulting from these diseases, also by faulty nourishment, for reasons explained before (see Cornet, "Die Tuberculose," second edition, p. 682), by the increased absorption of bacterial poison in the body, and the increased difficulty of healing consequent upon it and the easier propagation.

In many cases slightly virulent bovine bacilli which have entered accidentally, and which have been held in check by the power of resistance, in consequence of a reduced power of resistance as a result of measles and similar affections, may develop and disperse. But I consider it unjustifiable to impute considerable vitality to such latent foci of bacilli in case their further development is hindered; at least, the reasons hitherto brought forward are not conclusive.

I consider the explanation given by Henoch, and others, of the connection between scrofulosis and measles unsatisfactory, namely, that where a tendency to scrofulosis exists it will suddenly break out under the influence of these acute maladies.

The observation has been often made by Happe that scrofulous children, or those whose parents are phthisical, show a very great mortality from the above-mentioned diseases, whilst in children of healthy families, where the opportunity for infection is lacking, these diseases as a rule pass off well, and it is only in the rarest cases that tuberculosis is developed from them.

Syphilis is accredited with a prejudicial influence on the production and course of scrofulosis (this is contested by others). (For vaccination as a possible promoting agent, see p. 148.)

Rickets, struma, cretinism have been suspected, without due grounds, to be favouring agents.

Erysipelas takes a special place. Sometimes it precedes scrofulosis, and may form a point of entry for the particular germ. But in other cases it appears during the course of scrofulosis, and now and again has even a beneficial influence on the scrofulous processes localized in its area for example, lupus (Berturelli, Winternitz, Koliath, Isnardi, Hallopeau); this was also known to earlier physicians, for instance, Lugol, and reminds us of the similar temporarily favourable effect on pulmonary phthisis (see Cornet, "Die Tuberculose," second edition, p. 779).

Trauma is often mentioned as a further accidental cause of scrofulosis. Superficial injuries, stings of insects, and bites of vermin, scratches, burns, and chilblains, so frequent in scrofulosis, open a way of entrance for bacteria and tubercle bacilli.

Staphylococci and streptococci especially avail themselves of every injury to the tissues for depositing themselves, and easily induce mixed infection. Germs are washed away from larger wounds by the bleeding.

Awkwardness, mischief, play, and daring cause numerous wounds during childhood, which are taken little notice of, and are hidden from the reproving eyes of the parents. In many parts it is customary to bind up small superficial wounds and contusions with rags smeared with a mixture of milk and cream, often from suspicious sources, or to smear them with saliva and blow upon them; lupus can be induced in this manner. Leloir informs us of such a case. Special importance is attached to coarse forms of trauma in the production of tuberculosis of the bones and fungous joints. We can only refer to what has already been said of tuberculosis, especially as in bones and joints we have only to do with the tuberculous form of scrofulosis.

v. Baumgarten supposes that inherited bacilli find in the lymph glands and marrow a suitable nidus, and there pass their larval existence till external conditions reduce the vitality of the tissues. But if only on account of the rarity we cannot agree with the opinion of this highly-esteemed investigator. Another hypothesis is that the bacilli circulate harmlessly in the blood of an individual suffering from scrofulosis of the bones caused by trauma, and only at the moment and in the place "where, on account of trauma, a suitable culture ground has been prepared for them" do they deposit themselves. Now as a rule virulent bacilli only appear in the blood in acute miliary tuberculosis, rarely in phthisis, to say nothing of the blood of apparently healthy persons, therefore the *conditio sine qua non* is wanting. Surgical experience declares against bacilli circulating in the blood, a theory which has recently been pushed to the front, for we know

that with scrofulous and phthisical persons a wound sometimes after severe trauma and extensive laceration requiring months to heal never becomes tuberculous.

In my opinion, in some of the cases of bone and joint scrofulosis which are associated with trauma there exists somewhere, and, as pathological experience teaches, most frequently in the bronchial glands, a latent tuberculous focus. The distended capsule of the swollen tuberculous bronchial glands can, either directly or by *contrecoup*,[1] which is often transmitted from a distance, be compressed or injured, and one or another of the bacilli squeezed out by the sudden shock and so reach the lymph and blood systems. At the exact place where the trauma has been effected, where the path of the vessels is disconnected by the contusion, the bacilli will be interrupted in their regular course, force themselves into the tissues, and there set up a metastasis. According to the experiments of Schüller, the bacteria which have entered the blood appear to deposit themselves more easily in a contused joint than in a non-contused joint. But we come across certain difficulties in this theory. The fact that such affections are caused especially by sprains and dislocations is to be explained by the fact that in greater injuries the bacilli are washed away by the hæmorrhage.

Our theory is supported by the proof of latent tuberculous foci as already mentioned, the presence of which, even in considerable numbers, must necessarily result from the following considerations: In Prussia, for instance, over 17,000 young persons under 20 years of age die yearly of scrofulosis and tuberculosis. We must suppose if only a three or four months' period of latency for this low age is accepted, there are about 4,000 or 6,000 persons in Prussia suffering from latent tuberculosis.

Blows, falls, and contusions are such everyday occurrences in youth that latent foci and trauma must be everlastingly happening together. Such coincidence has not always sad consequences, for how often does trauma happen to children without metastasis occurring, in spite of all hereditary affections, and in spite of manifest tuberculosis? Therefore, great reserve is necessary in an estimate of a causative connection.

In many cases the trauma may be the effect and not the cause; an already existing bone and joint disease in its initial stages produces no symptoms whatever, but after a certain time it interferes with concerted movement; generally, at first unconsciously, it makes the movements uncertain, and on this account leads to a

[1] Perhaps tearing of the knee-cap may be caused by excessively hasty movements, in a fall to preserve the balance.

fall, which again may lead to further extension and aggravation of the disease.

Henoch is sceptical about the very great importance of trauma, and supposes that a bone disease was already existing, and the external influence only hastened its course, while in other cases any traumatic influence may be excluded with certainty.

I would also refer to the recent works of Friedrich, Honsell, and Sprengel, who place the influence of trauma on a minor footing.

SECTION II.

Morbid Anatomy.

In considering the morbid anatomy of scrofulosis we must separate the two principal forms, the pyogenic and the tuberculo-scrofulous, as we did in considering the etiology of the disease.

(1). PYOGENIC FORM.

We gather from former statements that the pyogenic form carries no pathological signs in itself which differentiate it in any pathognomonic sense from similar affections of a non-scrofulous nature.

Scrofulous catarrh of the mucous membrane shows exactly the same changes as ordinary catarrh, distension of the vessels and hyperæmia, swelling and thickening of the mucous membrane, increased mucous secretion, and enlarged mucous glands, increased casting off of epithelium, and secretion of blood serum mixed with corpuscular elements of the blood.

Analogous symptoms are met with in eczema, in catarrh of the skin, whether it be of scrofulous nature or not, distension of the capillaries, often considerable swelling of the papillæ, increased shedding of thickened epidermis, transudation of blood serum and corpuscles, infiltration and thickening of the epidermis and corium.

The number of cells in the secretions mentioned by Rindfleisch as characteristic of scrofulosis, and the closer cell infiltration of the parenchyma rich in connective tissue, to which Rabl had before referred as characteristic, are found also in chronic non-scrofulous inflammations as noted by Birch-Hirschfeld. The swollen nose and upper lip are not specific, but occur also through congestion in other layers. The long duration and frequent invasion of germs bring the toxic principals to a climax, and induce a gradual intensifying of the symptoms till the formation of ulcers occurs.

A description of the morbid anatomy of the skin and mucous

membranes in pyogenic scrofulosis would be, therefore, only a repetition of descriptions of simple catarrh of the skin and mucous membranes, simple conjunctivitis, rhinitis, adenoid growths, bronchitis, catarrh of the intestines, vaginal catarrh, &c., already given in other portions of this work. The peculiarity of the scrofulous form of disease consists in its very slow course, consequent upon anatomical conditions, its frequent temporary concurrence with similar affections in different places, its multiplicity and frequent recurrence.

We will devote a few words to the lymph glands only, on account of their dominating character in the phases of the disease. We have to do with those changes which were formerly called the first, or, according to Virchow, the hyperplastic stage.

At this stage we rarely see scrofulous glands, because, as a rule, they rarely need surgical treatment, and in the cadaver advanced and combined processes are generally the objects of investigation.

At first the gland is only slightly enlarged up to perhaps the size of a walnut, and is of a soft elastic fleshy consistence, the blood-vessels are injected, more especially in the capsule, and chiefly when the acute stage is investigated. On incision the surface is flat and regular, marrow like, moist, glossy, and slightly transparent, of a blue-grey colour, but sometimes reddish on account of hyperæmia, sometimes whitish owing to an increase of lymph corpuscles.

At a later stage the surface is drier, the structure of the tissue is altered and more homogeneous, and the consistence firmer owing to the aggregation of cells. Under the microscope one sees besides a great distension of the blood-vessels, an enormous increase of lymph corpuscles, especially in the capsule. Therefore the scrofulous gland swelling is a "hyperplastic lymphoma abounding in cells" (Virchow). In many cases the inflammatory formation of connective tissue in the capsule is in excess of the connective tissue, septa, and the reticulum (fibrinous hyperplasia induration).

The swelling of the gland may continue for a long period in this condition. If it has not continued too long involution will take place, as the hyperplasia may be absorbed and disappear by the metamorphosis of fat (scrofula fugax), and only the thickened walls of the capsule and the denser fibrous septa of connective tissue, forming a slight enlargement and hardening of the gland, remain as evidence of what has taken place. Pus foci may be formed if the addition of virulent germs exacerbates the process; these are recognizable on the incised surface as yellow

spots and isolated patches; if the extent is slight they will often involute, thicken and calcify. Generally they blend together, the inflammatory irritation extends to the periphery of the gland, forming periadenitis, a further area becomes phlegmonous, and after the discharge of pus the wound cicatrizes.

We cannot at present decide whether foci are deposited in bones and joints from non-tuberculous scrofulous glands, or whether the scrofulous bone and joint affections are, without exception, of tuberculous nature from the beginning. The probability of the former theory is not to be entirely laid aside, but in such cases the characteristic fungous character will not develop. According to the knowledge hitherto obtained of the histological structure and the bacteriology of scrofulous bone and fungous joints, such an event must be considered quite exceptional, and as a rule we may consider bone and joint scrofulosis and bone and joint tuberculosis identical.

(2.) TUBERCULOUS FORM.

I can put the matter concisely as regards the tuberculous form. Its chief characteristic, the tubercle, and its histological nature and development, have been thoroughly discussed in my "Tuberculose," second edition, p. 59, on the basis of the masterly works of Virchow, Schüppel, and v. Baumgarten. As lupus and scrofuloderma have been described anatomically in the volume on "Diseases of the Skin" (Nothnagel, vol. xxiv), I will only mention that lupus is represented histologically as a granulation tissue with typical tubercular nodules, which are specially distinguished by their dearth of tubercle bacilli (possibly on account of the low temperature of the skin, which hinders their development); the nodules may disintegrate and be absorbed; in other cases ulcers form (lupus ex-ulcerans), covered with a thick, coloured crust; in others, again, there is diffuse infiltration and hyperplasia of the connective tissues between the nodules which extend over the skin (lupus hypertrophicans); often we find on the lupus nodules reddish-brown, scaly, smooth patches (lupus maculosus), which give way under the pressure of the probe (Neisser). Besides caseous disintegration and absorption, the nodules can undergo a fibrous transformation.

Scrofuloderma is a subcutaneous warty granulation tissue with tubercles and tubercle bacilli; it is much more sharply defined. Its changes are discussed on p. 184.

We meet with several types of tuberculous lymphatic glands. In pure tuberculosis there are deposited in the parenchyma of the

glands more or less numerous tubercular nodules; the inflammatory irritation and the redness and swelling attendant on it is slight. The development of tubercles of the lymphatic glands is on the same lines as that already described at the above-mentioned place in the inoculation tubercle of the iris, and the differences are only in degree, inasmuch as " the proliferation of the cells is more moderate and proceeds more slowly, and the infiltration phenomena are more insidious and less numerous " (v. Baumgarten). This is explained by the fewer number of germs of infection. The glands have a relatively favourable chance of resolution after remaining long in this condition.

In other cases the nodules gradually enlarge, merge into each other and form a conglomerate tubercle, the nodules caseate in the centre, the caseous matter may remain enclosed for a long period, and calcify by taking up lime salts, or it softens, undergoes changes from periadenitis, ruptures, and discharges.

Apparently in this case the tubercle bacilli soon die after caseation has set in, probably owing to the bacterial poisons which are concentrated and retained in the tubercles of the lymph glands; bacilli can but seldom be demonstrated in the softened caseous matter.

In the changes arising from bovine infection, Benda noticed the scarcity of giant cells and the quantity of tubercle bacilli which, as we know, are only to be found sparsely in human infection.

The whole process often only consists of a building up of epithelioid, spindle-shaped cells (with few bacilli), which suppress the lymph gland tissue; caseation is absent for a long time, and the glands remain stationary at the size of a hen's egg—large-celled hyperplasia (Ziegler).

After inoculating tubercle bacilli into animals not susceptible to the type inoculated, Bartel found swelling of the follicles and endothelium and lymphoid hyperplasia, and designates this the lowest grade of specific change of tissue of a tubercle which has been arrested in development; similar conditions in man are etiologically to be considered as caused by non-virulent bacilli in like manner.

On the other hand, caseation and softening take place very quickly when in the further course a different kind of inflammatory process (mixed infection) is set up. In these cases, which are not rare, the glands which for a long time have remained stationary with little enlargement exhibit more or less acute inflammation, swell considerably, and break through in so short a time that the caseous mass mixed with pus, which is then thrown off, could not

possibly have been formed in so short a time, and, indeed, from its appearance indicates a longer existence than the incidental inflammation.

In other very frequent cases the tubercle develops in a gland which is already changed by cell infiltration, and generally considerably enlarged, which condition we have already described as the attribute of pyogenic scrofulosis. Dull, greyish-white points and spots appear, which enlarge and turn to whitish-yellow, opaque, dry, dotted foci in the grey hyperplastic gland and then gradually coalesce; at last the whole gland appears to be a homogeneous caseous mass, which, when cut in two, "looks like a new potato, only not quite so moist" (Virchow).

In this case, too, caseation and softening take place speedily. Isolated glands are absorbed as the result of periadenitis; we frequently find extensive cellulitis, and at last rupture occurs in one or several places, in favourable cases externally through the skin, but now and again, according to the position of the glands, into the bronchi, the larger vessels, pericardium and peritoneum; several times a miliary tuberculosis development has been seen also in the surrounding muscles.

In cases of mixed infection, no matter whether the tubercle bacillus or the pyogenic organism has established itself first, the principal danger lies in the two processes, which would easily make a dissemination of the tubercle bacilli over the whole body possible. The danger appears less when the tubercle bacillus alone settles, because it grows much more slowly, and, as experience has shown us, is easily encysted in the glands (see p. 125). The point of lesion only closes when all caseous material is removed, either spontaneously or artificially, generally only when the gland has ceased to exist. The scar is usually much retracted.

In favourable cases the caseous mass becomes calcified even at this stage, and is closed by indurated connective tissue either for a time or altogether.

The hyaline masses which are found in the lymph glands are referred to by Warthin as healed tuberculous foci.

In scrofulous, or more properly tuberculous, bones we find in the marrow grey or greyish-red granulation foci in which Köster demonstrated typical tubercles, and more recent authors tubercle bacilli. These granulations or fungus growths break down the lacunæ of bone tissue around them (caries sicca), spread to the periphery, and caseate from the centre.

The trabeculæ of bone within the caseous mass become necrotic when they are destroyed; they form bone sand, and are

the more numerous the quicker the caseation extends; with rapid caseation larger pieces of bone become necrotic and covered with granulations which have caseated.

Then there are found in the bones several spaces, cloacæ surrounded by granulations, containing caseous pus in which are found bone sand and sequestra.

Small and even larger foci can, especially in youth, be caused to heal by reactive granulating ostitis. We do not know with certainty how long the bacteria can retain their vitality in encysted foci, and therefore how long before they can resume their harmful activity when set free by later traumatic influences or by measles, scarlet fever, whooping-cough, &c., but their length of life is generally over-estimated (Cornet, "Die Tuberculose," second edition, p. 375). Larger foci also attack the periosteum and the surrounding soft parts, even involving the joint.

Proliferations in the neighbourhood of the tuberculous focus are followed by absorption of the bone, and apposition to neighbouring parts. Absorption taking place within the bone, and at the same time apposition to the periosteum, leads to the apparent distension of the bone known as spina ventosa, which takes place, especially on the phalanges of the fingers, toes, and the ends of the long bones, for example, the ulna. If the apposition is greater than the absorption the bone naturally becomes thickened.

Tuberculous periostitis is caused by the extension of the focus in the bone to the periosteum, but also in the primary seat of disease, or from the joint. We find granulations containing tubercle bacilli which lead to the absorption of the adjacent bone (peripheral caries). By the caseation and softening of these granulations so-called cold abscesses are formed; they are covered with granulation tissue containing tubercle bacilli, and are often very large; owing to the movements of the muscles they are frequently considerably displaced (wandering abscesses). Their inspissated contents consist of a caseous disentegrated mass, pus corpuscles, and pieces of necrotic bone. Generally in the process spontaneous rupture takes place with tedious formation of fistulæ.

The especially favoured site of tuberculous osteomyelitis and periostitis in the spongy ends of the bones explains the frequent secondary participation of the neighbouring joint; these may also, but in very rare instances, be affected primarily. Their infection by the bones takes place by direct ingrowth of the tuberculous focus or by the lymph channels.

Most frequently we find proliferations of the synovial membranes and inflammatory affections; less often single detached tubercles in a synovial membrane which is little changed.

At a later stage more or less numerous tubercles and greyish-yellow caseous foci have formed in the synovial membrane, which becomes red and thickened, and is changed into a spongy granulation tissue (Köster). The joint cavity shows an exudate at various stages, either sero-fibrinous (hydrops tuberculosus) or of a purulent nature (empyema articuli tuberculosum). The free bodies, corpora oryzoidea, often met with, consist of detached lumps of fibrin from the synovial membrane.

A serous or sero-fibrinous hydrops of the joint is formed by transudation of tubercle toxins of a neighbouring bone focus, the same as occurs in the pleura and pericardium from a tuberculous lung or bronchial gland. In the fibrinous matter thus cast off, a development of tubercles may take place by the tubercle bacilli which enter later, but we may not on that account come to the conclusion that the deposit of fibrous material arises from an entirely different, perhaps pyogenic infection, and that the tuberculosis is only secondary and accidental, as Biedert seems to have done. The absence of tubercle in such melon-seed bodies just as little contradicts its tuberculous origin, for they may, as well as a hydrops of the joint, be a product of the toxin.

If the fungous state has entered the cartilage we find it eroded and destroyed, and when growths are present in the subchondral tissue, it is often completely raised from the bone and detached from it. After quick disintegration of the fungous tissue we often meet with extensive destruction of the joint (tuberculous caries of the joint); from the caseated and softened granulations the above-mentioned cold abscesses are formed.

The soft parts around the joint are affected at the same time and become œdematous, the connective tissue dense and thickened, the whole joint looks waxy and shiny (tumor albus).

The more exact histological condition of bones and joints, and the changes which take place in the various regions of the body, cannot be considered here; for information respecting them I refer to works on surgery and morbid anatomy.

I will here just mention the changes similar to bovine infection which are found now and again in the further extension of the tuberculo-scrofulous processes.

Virchow and Askanazy have drawn our attention to their occurrence, and A. Uffenheimer found bovine characters in the affected intestines of a child; Ipsen and Maccallum have observed similar cases.

The further inoculation in a calf in Ipsen's case had a negative result.

SECTION III.

Symptoms.

THE symptoms of scrofulosis show certain deviations both in their local and general character, according as we have to do with the tuberculous, the pyogenic, or the mixed form.

As a rule, in infancy it is especially the skin and primary symptoms in the mucous membranes which predominate, then the secondary processes in the mucous membranes follow, and lastly swelling of the lymphatic organs; these especially predominate from the fourth to the tenth years.

In pyogenic scrofulosis the local phenomena of the area from which it arises are chiefly in evidence, then follows swelling of the glands, and it is only rarely that the process invades the bones. The general symptoms are less marked than in the tuberculous form on account of the less toxic qualities of the bacteria.

In the tuberculous form, for reasons which have been given in another place, the symptoms in the skin and mucous membranes are less marked than the changes in the glands; to these, bone affections are added later. The general symptoms in the tuberculous form rarely attack so deeply or are so acute as in tuberculosis of other organs, the lungs and brain, for instance. As has already been pointed out, the reason for this is in the anatomical conditions, which offer certain hindrances to the dispersal and proliferation of the bacilli, also the skin glands and bones in which the pathological changes take place are less important organs for the existence of the individual, and lastly, because the less virulent bovine bacillus is the active causative agent.

In the mixed form sometimes the symptoms of one form, sometimes those of another appear, and are indistinguishable one from the other.

As hitherto sufficient care has not been taken to ascertain with which form we have to do in single cases, but as all have been

joined together under the general heading "Scrofulosis," the character of each symptom has not been indicated with that precision which in the interest of diagnosis would be desirable.

A.—LOCAL SYMPTOMS IN THE SKIN.

(1) Non-tuberculous Form.

Non-specific skin affections, which are the first signs of scrofulosis, are much more frequent than specific tubercular disease.

For the sake of completeness we will mention what are, according to Czerny, the first manifestations of the exudative diathesis, viz., affections of the skin and mucous membranes, although they do not exactly belong to scrofulosis. They are:

A mapped tongue[1] (lingua geographica), sometimes the first sign, though not always a regular one. This appears without pain, and is shown by exudation and severe desquamation, with white streaks in the mucous membrane of the tongue and prominence of the papillæ. The symptoms disappear of themselves, but return after some days or weeks.

Seborrhœa, which appears in infancy, often in the first week of life; scales of a dirty grey brown, which adhere closely, occur (even in children who are kept clean), especially about the head; after removal of the scales by means of ointment, the hyperæmic skin underneath either becomes again covered with scales, or it exudes, especially in fat children, a crust is afterwards formed, and there may be secondary infection and eczema.

Milk-scurvy, also appearing in infancy, exhibits itself as a marked, sharply-defined redness and scaliness on the skin of the cheeks, and about the auricle, which after a time disappear; it is accompanied by loss of weight. The itching now and then connected with it leads to scratching, loss of epithelium, secondary infection, and eczema.

Prurigo (strofulus or urticaria infantilis) shows itself generally after the first year, and may last, with interruptions, for years. It appears chiefly in fat children, especially about the hips, in large patches of reddish weals like insect bites. The redness or swelling disappears after a day or two, and leaves for a time a coarse warty infiltration; in thin children the redness is not so decided. In this case also secondary infection and eczema is induced by irritation and scratching.

Intertrigo and soreness, especially behind the ears, in the folds

[1] Lublinski considers that a mapped tongue (as noted in fifty cases) is hereditary (running in families), and denies any connection with the exudative diathesis.

of the neck, armpits, &c. Hairiness between the shoulder-blades, about the elbows, and on the thighs, and further symptoms, such as phlyctenæ, circular caries of the teeth, &c., are decided signs of scrofulosis in our sense.

Eczema is the principal skin affection amongst scrofulous persons, and is to the skin what catarrh is to the mucous membranes.

As already remarked, these skin affections have no specific signs by which to distinguish them from similar diseases in non-scrofulous individuals, but proclaim their connection with scrofulosis only by their obstinacy and their frequent recurrence. They occur chiefly on the face, and especially at those points most exposed to mechanical injury, where transition from skin to mucous membrane takes place, at the entrance of the mouth and nose; on the eyelids, on the scalp, and behind the ears, on the hands and fingers, red swellings occur irregularly scattered, and almost always accompanied by intense itching (eczema papulosum). On account of the severe exudation we meet with blisters, sometimes of large size, either transparent and clear (eczema vesiculosum), or with muddy purulent contents from the absorption of cell elements (eczema pustulosum). If the blister bursts, a red, exuding, excoriated surface appears, and the secretion dries and becomes a cloudy yellow colour, or if the blood from the hyperæmic capillaries is mixed with it, a brownish scab forms, under which, if it adhere closely, the secretion may be retained with injurious consequences. At a later stage the secretion becomes less, and the surface drier, scales are formed, some of which fall off; at last new skin is definitely formed over the infiltrated area.

Œdema and chronic swelling take place at the seat of the eczema, the face becomes puffy, the nose thick and swollen, the lips puffy and dry; at the corners of the mouth and on the upper lip are obstinate cracks, which bleed easily, and the facies scrofulosa is engendered; sometimes all stages are observed simultaneously, but the impetiginous form of eczema is found especially frequently in scrofulous individuals, as well as ecthyma, chiefly on the back, buttocks, and thighs, which often turns to sharply-defined ulceration, in many cases healing with difficulty (Henoch). Perspiration, uncleanliness, and want of care favour these affections.

Eczema is, as a rule, not of a scrofulous nature even in tuberculo-scrofulous persons, but is induced or maintained by other bacteria, pus cocci, &c.

The accidental appearance of tubercle bacilli (Demme, Volkmann, Ritter) can only be considered an exception. We may

suppose that the numerous open places of eczema facilitate the entry of tubercle bacilli; but generally, as in catarrh of the mucous membranes, the bacilli which have been deposited upon these are either washed away by the plentiful secretions of the surface, or else incrusted; in any case, they are rendered harmless.

Unna distinguishes in children a tuberculo-scrofulous or scrofulous, and a nervous dentition eczema; the former is met with on the nose, eye, ear, head and mouth, with impetiginous characters; the latter on both cheeks, the back of the hands, symmetrically on the forehead and chin, first as itching papules or swellings, which undergo further changes as a result of scratching, and are repeated at each recurrence of dentition.

Eczema and erythema arise on the nose and ear owing to the skin being irritated by the acid secretion which exudes with catarrh; a thickening of the skin often supervenes.

We often find, especially in children who are not kept clean, multiple small skin abscesses, suppuration in several places one after the other, caused by the staphylococcus aureus.

Sittler mentions roundish, rather sharply-defined patches with small scales on the mucous membrane of the cheeks of scrofulous persons, which disappear after a few days.

(2) Tuberculous Form.

Lupus.—Lupus is chiefly situated on the face, the entrance to the nose, in the neighbourhood of fistulæ, more rarely on the hands and other places. It appears as a nodule the size of a pin's head, or a hemp seed, of dark-red or yellowish-brown colour, at first isolated, but afterwards scattered in groups, or coalescing; at first deposited in the tissue of the skin as a reddish-brown patch (lupus maculosus), then projecting above the level of the skin. When pressed under a glass the lupus nodules are distinctly contrasted as yellowish-grey spots, reminding one of sugar-candy. The surface is smooth and shiny, or covered with scales, the epithelial growth warty. At the edges, which are generally semicircular, a peripheral spread of the nodules may be observed (lupus serpiginosus), or the nodules may be in a state of disintegration; ulceration may arise as the result of secondary infection (lupus exulcerans), having a soft circumscribed edge and suppurating base, which easily bleeds, granulates, or becomes covered with a yellowish-brown crust, or thick scab, whilst in the central parts a white irregular scar is formed. Now and again we see prominent granulations resembling a tumour (lupus tumidus); on the extremities there may even be changes resembling elephantiasis.

At a later stage of its very tedious course one side will often heal, whilst the lupus on the other side extends into the upper layers of the skin, or attacks the hypodermic tissues and the deeper parts; this leads to extensive destruction, and in the face to terrible disfigurement, such as ectropion of the eyelids and lips, falling in and deformity of the nose, pear-shaped enlargement of the lobes of the ears, destruction of the auricle, &c.

Scrofuloderma.—Scrofuloderma, which by its structure and the demonstration of tubercle bacilli is, in contrast to lupus, more sharply defined, and is described by Neisser as a subcutaneous granuloma, is developed alone, or in groups, in the cellular tissues of the true skin, and appears at first as a hard nodule under the loose skin; if there is no absorption, stretching and thinning of the skin slowly takes place later; this either gives way or a roundish softened lump the size of a pigeon's egg appears, the so-called cold subcutaneous abscess—the *gomme scrofuleuse* of the French (Desprès, Besnier)—and its further course proceeds without trouble or pain. Scrofuloderma is either associated with lupus, by the bacilli which have been taken up in the lymph-stream depositing themselves and proliferating in their normal course in the lymph vessels or in the subcutaneous lymph glands, or sometimes a tuberculous fistula is formed from a deep-lying scrofulous bone focus. At a further stage of its slow course the skin which has been raised from the tissues lying beneath it is blended with the scrofuloderma, becomes thin as paper, of a bluish-red colour, and breaks down, a thin fluid resembling whey is discharged, and afterwards a round tumour is formed, with flaccid walls and deeply undermined, a so-called scrofulous skin ulcer (scrofuloderma ulcerosum), which tends to serpiginous extension and occurs in the main as a spongy granulation tissue, with tubercles scattered about in it. According to the conditions found by Leistikow, who demonstrated the *Staphylococcus aureus* (by a development in culture) as well as the tubercle bacillus in scrofuloderma, at the base of a nodule whose surface was entirely intact, it may be supposed that now and again we have to do with mixed infection.

TUBERCULIDES.

Besides the classical bacillary skin tuberculosis, lupus vulgaris and scrofuloderma, the scrofulous nature of which has long been attested, other skin diseases have very recently (hardly a decade since) acquired symptomatic importance for scrofulosis, which clinicians formerly passed over without noticing and which awakened but little interest even for dermatologists.

I refer to those skin processes defined by C. Boeck as tuberculous exanthemata, which Darier comprised under the generally accepted term, "skin tuberculides," viz., lichen scrofulosorum, folliculitis, erythema induratum, to which recently, and apparently rightly lupus erythematodes, pityriasis rubra of Hebra, lupus pernio, &c., have been added.

We have especially to thank Boeck, Darier, Klingmüller, Jadassohn, Zieler, Alexander, and others for a more exact knowledge of these diseases.

Their frequent appearance in tuberculous individuals showed their connection with tuberculosis (Boeck). In many cases bacilli were demonstrated, and apparently more frequently since, according to Much, investigations have been made by Gram's method.

The positive cutaneous reaction indicates their tuberculous nature (especially local reaction, which is common), and the similar reactions with tuberculin injection, or v. Pirquet's papule reaction, and the observation that after the cutaneous tests entirely similar erythematous tuberculides, such as lichen scrofulosorum, appear at or near the point of injection (Moro, Pfaundler, Klar, and others); also their appearance directly on an infectious malady, such as measles, &c. (Messa and others).

Their mode of production will occupy our attention later; we will here only investigate the symptoms and establish their connection with tuberculosis, or tuberculo-scrofulosis.

A strict separation cannot always be made, as numerous intermediate grades and transitions are often present in the same patient; a clear division is often rendered very difficult by the abundant use of special terms having the same meanings without any evident necessity for so doing, a custom which does not increase the interest of the practitioner in the matter.

Lichen scrofulosorum occurs on the trunk, rarely on the extremities (Comby), especially in children with older latent tuberculous lesions and also with intercurrent affections (measles, &c.). When they spread they are found as isolated, clearly-defined, circular groups of the size of a millet seed or a pin's head, somewhat raised above the level of the skin, but the nodules or papules, which are of a yellowish-brown colour, though sometimes bright red, are flat, and occasionally conical. They start from a follicle or near one (Kaposi) and render the skin rough and greasy. On the surface they are covered with a small scale, sometimes with a little pustule the size of a poppy seed, which dries and leaves behind a yellowish-brown crust.

Under the pressure of a lens the efflorescence becomes paler

and appears as a tiny brownish spot. After weeks or months spontaneous involution takes place, the spots become paler, disappear, or leave a little pigmented spot or an atrophic depression; in rare cases they disintegrate and form small ulcers. As they run their course without inducing any disturbance and generally without itching they are easily overlooked (giving rise to the idea of frequent recurrence).

In several cases besides the conical forms, Schurmann describes flat nodules, which are distinguished from the typical form by size, colour and polish.

In the lichen scrofulosorum (tuberculosis miliopapulosa aggregata) of Neisser, epithelioid and giant cells are found histologically (Jacobi, Lesselliers); Klingmüller found perivascular inflammation alone eleven times in sixteen cases, Jacobi and Wolff succeeded in demonstrating bacilli, Pellizari and Haushalter's experiments on animals gave positive results (with Hallopeau and Bureau these were negative). The occurrence of lichen after cutaneous tuberculin tests characterizes it as being connected with tuberculosis (Moro and Leszczynski), see also Comby, Symoneaux and Nobl. Whether lichen is of a tuberculo-toxic nature or whether it is induced by weakened or dead bacilli, as affirmed by Jadassohn and Escherich, and especially by Neisser, is of minor importance in relation to the question in hand.

Folliculitis.—Papules often appear in batches and symmetrically, especially on the edges of the auricle, on the face and forehead, at the elbows, the ulnar edge of the forearm, back of hands and fingers, the knees, thighs, shins, and insteps; at first they are deep in the skin and then come to the surface, they can be better felt than seen and vary in size from a millet seed to a pea, their colour is deep red merging into blue, their appearance is often preceded by pain at the affected part. After two to five weeks they disappear leaving no trace, or they leave behind a patch of brownish colour; sometimes small pustules are left, the heads of which contain pus; now and then a hard scurfy depression forms which, after disintegration and involution, leaves little white-pitted scars which can be recognized years after and give the ears a jagged appearance.

Folliculitis is identical with the form first described by Boeck (1880) as lupus erythematosus disseminatus, which is again distinguished from the lupus erythematosus disseminatus described by Kaposi, but it is the same as the affection described by Brocqu as the folliculites disséminées symmétriques des parties glabres à tendances cicatricielles, for which Bronson chose the name acne varioliformis; Lukasiewicz used the term folliculitis exulcerans,

whilst Pollitzer called it hydradenitis destruens suppurativa, but Dubrenilh called it hydrosadénites suppuratives disséminées. I am sorry not to be able to give other terms for this malady except those of papulo-necrotic tuberculides and granulome innominé (Lerrede and Martinet) and tuberculides acnéiformes et nécrotiques (Bureau). (See Boeck, "Die Exantheme der Tuberculose," S. 7, 9 u. 10).

Neisser, Juliusberg and Alexander have found a positive tuberculin reaction to be followed by folliculitis-papulo-necrotic tuberculides (Barthelemy). Zieler, in contradiction to Philippson, could not confirm the presence of bacilli either microscopically or by inoculation. The form of the efflorescence was termed by some authors tuberculous or tuberculoid (Macleod, Oronsby, Alexander, Hallopeau, Tenneson and others).

Recently acid-fast bacilli were demonstrated by Leiner and Spindler without, however, the granular form described by Much, and in four cases inoculation had positive results. Burnet had a similar experience (see also Darier and Walter).

The following are described as special forms.

Pustulo-necrotic tuberculoids, or ecthyma scrofulus (Kren), isolated nodules which change after one or two days into blisters containing pus, similar to impetigo; the blister often has a thick covering. When this falls off a loss of substance takes place leaving a sharp edge which heals by granulation and forms a scar similar to small-pox.

Papulosquamous skin tuberculides are often isolated but are sometimes numerous and of the size of a pin's head to a hemp seed, the papules are slightly prominent at first, of a bright red colour, after a few days becoming livid; in the centre a brownish scale or scab forms, often having fine projections, on being rubbed off a cone-shaped depression with dry base is left; often there is no scab and a shallow depression, or simply a loss of substance with clearly-defined edge, is left.

Hamburger, who emphasizes the appearance of the affection especially in infants and its diagnostic importance, mentions as characteristic the lack of tendency to ulceration, the central depression, the livid brownish colour and the glazed appearance caused by the distension of the skin. Latemer has found tubercle bacilli and had positive results with inoculation.

Acne scrofulosorum and folliculitis scrofulosorum are included here.

Erythema induratum forms hard, rough painless nodules in the skin, the size of a cherry to a walnut, sometimes flattened, of a purple or livid appearance, chiefly on the lower extremities,

especially on the calves of the legs, seldom on the upper extremities; it occurs especially in young girls, but also in the male sex (Hutchinson, and Colcott Fox); they can last months, even years, without change and generally end by absorption, seldom in softening and discharge, with the formation of a shallow or deep, obstinate, often painful ulcer (Hutchinson, Söllner, and others). Iodide of potassium is said to be harmful; the horizontal position has a beneficial effect.

Erythema induratum (Bazin) shows its connection with tuberculosis by a positive cutaneous reaction (Jadassohn, Harttung, and Alexander) and the disappearance of the eruption after tuberculin injection. Hidaka has found bacilli. The inoculation of animals with particles of the lesion leads to tuberculosis (Thibièrge, and Ravaut, Söllner, Colcott Fox, and Carle).

Its coincidence with other tuberculous eruptions or internal tubercle points to its tuberculous nature (Schidacki, Thibièrge, and Gastinel, Carle and Kuznitzky), but apparently this does not agree with every case. Clemens could demonstrate no bacilli, either with antiformin or by experiments on animals.

In lupus erythematosus (or erythema perstans) the frequent accompaniment of tuberculous skin and other affections proclaims its tuberculous nature (C. Boeck, Hutchinson, Besnier, Herxheimer, Roth, and Saalfeld). Arndt and Hidaka found bacilli, but Brocqu, Finger, Kreibich, Kraus, Bokac and Robbi attribute it to various causes, only tuberculosis amongst others. Neisser denies direct connection with tuberculosis.

Observations such as Polland's lupus erythematosus occurring with acute miliary tuberculosis, Appel's case in which the disease was cured by tuberculin, and Arndt's demonstration of tubercle bacilli make the tuberculous nature probable to a certain extent, but experiments on animals had negative results (see Reitmann and Zumbusch, Campana, Hübner, Kyrle, and Schönfeld).

Lupus follicularis disseminatus appears acutely or subacutely as a brown livid red, remarkably soft nodule, the size of a pin's head or a pea, on the face.

In lupus follicularis disseminatus faciei (lupus miliaris) there are histologically nodules which are certainly lupus (Leiner and Spieler and Loewenberg), and tubercle bacilli have also been demonstrated (Schlassberg, Finger, Bellmann and Arndt); besides inoculations have been attended with positive results (Jadassohn).

Cohn and Opificius also take the tuberculous nature of the affection into account, whilst Delbanco considers it assured by the observations of Reunert, who brought about healing by new tuberculin.

Boeck's sarcoid is an affection beginning in the lower layers of the skin, which forms firm nodules and sometimes diffuse infiltration on the face, the surface of the skin is bright red, livid, later becoming yellowish-brown and tensely stretched over the seat of infiltration.

Opificius found in Boeck's benign miliary lupoid (the connection of which with tuberculosis was accepted by Kreibich and Alfred Kraus), in one case, decided reaction to tuberculin and epithelioid cells but no bacilli.

Lupus pernio, the infiltrations of which resemble chilblains, forms bluish-red or pale blue puffy prominences on the surface, often feeling rather soft, but at times brawny, especially on the ears, nose and hands.

The tuberculous nature of lupus pernio is accepted by many authors as probable (Polland, and also Jarisch). Kreibich, Kuhlmann, and Zieler deny it, because neither the antiformin method, nor that of Ziehl or Much, yielded tubercle bacilli, and inoculation was without result; Bogolepow has demonstrated tuberculosis histologically, but met with a negative conjunctival reaction.

Acneiform tuberculosis consists of numerous bright red nodules, the size of a hemp seed or a pea, rising gradually from flat efflorescences, often symmetrically, on prominent parts and on the abductor surface of the extremities, on the elbow, hand and ankle, rarely on the face. The nodules turn bluish and become flat in the centre, after turning yellow they at last dry up to black deep-seated crusts. A scar filled with blood is left with a bluish hyperæmic areola which later becomes white and faded.

Acnitis is also reckoned by many amongst the tuberculides (Hallopeau and others), but sure grounds are wanting (Barthelemy, Pick and Alexander).

Pityriasis rubra of Hebra, the connection of which with tuberculosis is noted by Jadassohn, Wertheim and Finger, and Bruusgaard was found with tuberculosis of the lymph glands, by Müller, Halle, and Fabry. Tubercles and bacilli were in many cases demonstrated, they were found chiefly in chronic tuberculosis, or tuberculosis under the guise of pseudoleukæmia, but it is not yet decided if they are connected with each other.

Eczema scrofulosorum remains to be mentioned; it occurs especially in young adults, as more or less infiltrated red or yellowish spots or raised surfaces often only forming scales, but sometimes moist and covered with a crust; on the lower extremities especially we find large or small papules, passing into pustules. Places of predilection are the anterior and hinder surfaces of the

thorax, the outer side of the upper arm, and part of the pars capillata.

Scleroderma is also found connected with tuberculosis. In five cases Reines obtained percutaneous tuberculin reaction and in four cases certain tuberculosis. We must also include the parapsoriasis of Brocqu, which Verotti, on the basis of histological findings, termed psoriasiform, papulosquamous tuberculide. Sutton accepted the tuberculous nature of lichen nitidus.

For the bearing of the tuberculin cutaneous reaction on this subject, see pp. 19 and 258.

As already mentioned, the skin tuberculides do not always form sharply-defined groups, but many, such as folliculitis, acute hæmorrhagic miliary tuberculosis of the skin, and lupus miliaris disseminatus, often exhibit transition forms (Leiner and Spieler).

Gaucher described pustulo-ulcéreuse tuberculosis as a sort of impetigo which leaves ulcers, the secretion of which induces tuberculosis running a slow course when injected into animals; Doutrelepont has made a similar observation. In these cases we have probably to do with a secondary immigration of tubercle bacilli.

Hallopeau and Bureau define as acneiform folliculitis small pustules on the site of which crateriform depressions speedily appear, leaving later scars with sharply-marked edges; they are dispersed over the trunk and extremities, sometimes arranged in groups, and followed by tuberculous adenitis. Thibièrge also describes a disseminated folliculitis with tuberculosis of the lymph glands.

Persons suffering from scrofulous syphilis often show a small papulo-pustulous scaly exanthem which ends with dark pigmentation and forms a scar; giant cells have been found in it (Neumann, Michelsohn, and Ehrmann). Ehrmann considers the exanthem to be a direct mixed form of scrofulosis and syphilis.

On being treated with mercury these eruptions only partially disappear, the rest involute only with cod-liver oil.

Leloir calls attention to such mixed infections in glandular and skin affections which only heal by antisyphilitic and anti-tuberculous treatment.

Opinions differ on the origin of tuberculides. The theory of their being the products of metabolism and of destruction of the tubercle bacilli which have entered the circulation, the toxin theory of Hallopeau, found followers, especially when Klingmüller succeeded in producing changes similar to tubercles by injecting old tuberculin, free from bacilli and passed through

porous filters, into the skin, and which on further tuberculin injection gave a hyperæmic reaction.

In opposition to the objections of Jadassohn, Pick and Daels, Zieler has demonstrated that tuberculin, free from bacilli and from "splitter" bacilli, can induce genuine tuberculous tissue structure which on further tuberculin injections shows typical focal reaction.

The late effect of the cutaneous and conjunctival tests, in consequence of which lichen and similar tuberculide forms sometimes appear in distant parts, is in favour of the toxin theory.

On the other hand, the association of bacilli in the production of tuberculides has been proved in a number of cases (see p. 247) by their demonstration microscopically, which, by the help of the antiformin method and Gram's colouring succeeds much more frequently than formerly.

The reactive phenomena appearing after the cutaneous test, v. Pirquet's papulæ and the lichen scrofulosorum, which appear occasionally at distant points, and which probably owe their production to the effects of a toxin, are distinguished by their speedy disappearance. As a rule they only last a few days and seldom more than a week.

From this we may suppose that tuberculides are of purely toxic origin, last as a rule but a short time, that the effect of the released materies morbi is soon over, and the changes return to the normal for want of further irritation.

On the other hand, we may suppose that the majority of persistent, often even obstinate tuberculides arise through the association of the bodies and remains of bacilli, the further protracted disintegration of which impresses a permanent character on the tissue formed by them.

The question whether only the dead, or living bacilli also, are the supposed causative agents, and then whether the bacilli are weakened or fully virulent, is much more important both in its clinical and prophylactic bearings.

In the majority of cases we have doubtless to do with dead bacilli which have crumbled away, so to speak, from older disintegrated foci, and which enter the blood passages much more easily than living ones, as shown by numerous negative inoculation experiments.

But the numerous positive results after inoculation into guinea-pigs show that living bacilli may also take part in the formation of tuberculides; still, the fact that we have to do with virulent bacilli for man also is not conclusively proved even by experiments on guinea-pigs, as these are more susceptible to the tubercle bacillus than man, and accordingly it is not proved by

the results obtained by Hildebrandt, who injected the blood of a patient suffering from erythema nodosum into a guinea-pig and obtained a positive result.

Many reasons tell against the complete virulence of these bacilli.

Firstly, the acknowledged benign character of their products, the tuberculides, which would not be the case with virulent bacilli, as we have to do with a great number of children in earliest infancy, when they are most unable to resist virulent affection. The virulent bacilli as a rule are followed by the most serious consequences and do not confine themselves to the formation of insignificant nodules which after a shorter or longer period are absorbed and disappear.

Secondly, the fact that the tuberculides, almost without exception, only appear as accompanying phenomena of mild forms of glandular tuberculosis, of scrofulosis, and sometimes of bone and joint tuberculosis, whilst the fact that acute, florid, highly virulent tuberculous processes, even chronic phthisis itself, are but rarely accompanied by tuberculides, tells against the virulence.

Certainly we do meet with cases in which a person suffering from tuberculides (as Boeck says) "often," many years later, becomes one of the multitude affected with phthisis, who after a time succumbs to tuberculosis.

But this is no proof of the virulence of the bacilli present in tuberculides, for it cannot be proved that the bacilli which cause death are descendants or collaterals of the earlier tuberculide bacilli. We know, not only that there are double infections, but that they are even tolerably frequent, and so in such cases it remains an open question whether a former less virulent infection, perhaps of bovine bacilli, from cervical or mesenteric glands, which was accompanied by tuberculides, was followed by an external, later highly virulent, fatal infection of the lungs. We often find even in the same organ, for example, in the lungs and in the sputum, human and bovine types side by side.

Their lesser virulence is again indicated by their easy dispersal in the body and by the frequent recurrence. For the less virulent the bacillus the slighter is the reaction of tissues at the primary focus, therefore the easier their dispersal and their passage into the blood. We see that in the rabbit when inoculated with the human type the bacilli quickly disperse in the blood through the glands, whereas usually they are retained.

Taken altogether we are led to the supposition that, as far as living bacilli are concerned in the formation of tuberculides, the slight further development and the benign course do not depend

on an increased individual, general or local power of resistance in the person concerned, but in the avirulence of the bacilli.

That which differentiates the tuberculide from the true form of skin tuberculosis is, amongst other things, first, its apparent dispersal without selection over the whole of the body in spite of certain places of predilection, which points to a hæmatogenous origin; secondly, its extraordinary chronic course, often lasting years and decades, its harmless course, and the frequent spontaneous recurrences; thirdly, the frequent lack of bacilli and specific tissue changes, which recall in a measure the lymphoid changes obtained by Bartel, by the inoculation of avirulent bacilli; fourthly, the temporary appearance in symmetrical places, on each side of the body, which in many cases leads us even to think of tuberculo-toxic action on nerve centres; fifthly, the recurrence in stages—in short, a number of conditions which differ from the action of true tubercle bacilli.

How far the bovine bacilli from an older lesion, which are continually ingested by old and young in milk, butter, &c., how far, perhaps, special tuberculous strains participate has not as yet been investigated.

Lewandowski connects the formation of tuberculides with the phenomena of immunity, and believes that the dissemination of a very small quantity of tubercle bacilli when the body contains much antitoxin leads to tuberculides, whilst in dissemination of a moderate quantity of tubercle bacilli where there is but slight antitoxin formation, multiple hæmatogenous lupus is induced. This theory is based and extended on hypotheses which need further confirmation.

There is no question about the fact that we are far from the end of the knowledge which it is possible to obtain on the subject, and I am inclined to think that a further study will give us many valuable hints for the complete understanding of tuberculosis.

B.—LOCAL SYMPTOMS IN THE MUCOUS MEMBRANES.

NOSE.

Pyogenous scrofulosis shows itself in the mucous membranes by frequent catarrh.

The mucous membranes of the nose are often affected as a condition of obstinate, easily recurrent cold in the head (chronic cold in the head), the nose is frequently obstructed, a quantity of mucus or suppurative secretion is discharged (rhinitis chronica purulenta) which irritates the entrance to the nose and the upper

lip, the parts become red and excoriated, followed by swelling and eczema. A quantity of yellowish-green scab is deposited at the entrance of the nose, idle fingers often occupy themselves with removing it, and picking the nose causes new infection.

By the obstruction in the nose the child is forced to breathe through the mouth, and thus infection of the deeper-seated respiratory organs is facilitated. If this condition last long the mucous membrane thickens, the whole nose is permanently swollen, and becomes sensitive to the touch, a state of affairs which is considered peculiarly characteristic of scrofulosis (Pins). Sometimes ulcers are formed, in rare cases the process attacks the perichondrium, the nasal cartilage, the septum nasi and muscles, and leads to deformity of the nasal framework. The extension of the destruction to the ethmoid and perforation of the hard palate has been observed (Henoch and Stoerk), but in such deep-seated cases it may be supposed that we are dealing with tuberculo-scrofulosis or lupus processes and not with pyogenous processes.

Formerly ozæna (rhinitis atrophicans fœtida) was considered almost pathognomonic of scrofulosis. Some (Zaufal) attribute it to an abnormal breadth of the nasal cavity and the faulty removal of the secretion, others (Loevenberg, Rohrer, and M. Hajek) to a specific ozæna coccus. Scrofulosis is said to be distinguished from ordinary ozæna by the fact that in the former the atrophy proceeds more quickly.

MOUTH AND PHARYNX.

In intimate connection with this chronic nasal catarrh and suppuration, perhaps even aided and caused by it, we meet with the well-known growth of the pharyngeal tonsil, the so-called adenoid vegetations. Anatomical proofs are wanting for Erdely's supposition that adenoids are generally congenital (see also Czerny).

Adenoids in a form resembling cones or berries deeply furrowed or spherical, reddish or pale red, sometimes covered with tough greenish-yellow mucus, fill the naso-pharyngeal space entirely or in part, and contract and embarrass the normal respiratory path, and themselves induce further inflammatory processes in the vicinity of the Eustachian tubes, middle-ear, nose or pharynx. The principal well-known consequences are, open mouth, snoring, dull toneless speech, disturbances of hearing, and now and again enuresis nocturna, arrest of physical and mental development (malformation of the palate, Guye's aprosexia).

The tuberculous form of scrofula has less opportunity of making itself noticeable in the nose and naso-pharynx than in

other mucous membranes. The few bacilli with which we have to do in natural infection penetrate, as has been frequently remarked, the more permeable mucous membrane of the child without having propagated immediately on account of their slow growth, and only later find a resting-place. If a bacillus, from special circumstances, should be held back, a sub-epithelial further advance in the extensive meshes of the lymph paths takes place, and by a superficial dissemination lupus occurs, which runs its course without pain, and no special symptoms beyond hypersecretion. The real destruction, the ulcer, is, in the mucous membrane, in all parts of the body, whether nose, mouth, genital organs, or lungs, more a peculiarity of later years, or at least of adult life.

Ozæna is, as a rule, not of tuberculous nature, though in a few cases tubercle bacilli have been demonstrated (Demme, see also p. 12). Volkmann notes the occurrence of an ozæna tuberculosa with genuine tuberculous ulcers, which he distinguishes from the general and more frequent rhinitis.

In many cases adenoid vegetations are of a tuberculous nature, but this condition has been much over-estimated. In fact, in 1,745 cases the tuberculous nature was confirmed in only 4·1 per cent. (see p. 142). On the basis of histological investigations, Simon believes that adenoids have no connection with tuberculosis and scrofulosis (see also Sobernheim and Blitz).

Whilst, according to Roux and Roques, tuberculous neck and bronchial glands were mostly present with adenoids, Nobécourt and Aptekmant found the reaction to tuberculin negative in 57 per cent. The identity of hypertrophy of the pharyngeal tonsil with scrofulosis, which Trautmann recognizes, cannot be considered. Nadoleczny even denies a special frequency of adenoids in scrofulosis and exudative diathesis, but notes at the same time their general great dispersal among boys between 6 and 7 years of age, 94·7 per cent. (in girls 85·7 per cent.); according to Senziak, even the parents exhibit the same affection.

As a phenomenon often appearing in scrofulous patients, we must specially notice in the mouth and pharynx angina, that inflammation of the tonsils, so liable to recurrence, with consequent hypertrophy. Frequently the whole area of the pharynx is in a state of hyperplasia. Contrary to the opinion received by laymen, it must be noted that even highly hypertrophied tonsils cannot be felt from the exterior; what we feel are chiefly lymph glands. The most noticeable symptoms are the nasal tone of the voice, snoring, and sometimes reduced power of hearing.

The occasional demonstration of tubercle bacilli in the palatal tonsils (see pp. 140-142) in no way justifies the conclusion often

drawn from it, that the swollen tonsils are in most cases tuberculously affected.

The teeth of scrofulous persons are very brittle and inclined to caries, a symptom the peculiar bearings of which we have already hinted at above (see p. 142).

Of the milk teeth, especially the upper incisors, Neumann was the first to describe an adherent brown or greenish discoloration of the teeth near the gum, which turned into caries encircling the crown or neck of the tooth. He found scrofulo-tuberculosis is nearly two-thirds of the clinical cases of this circular caries (and tuberculosis *post-mortem* in more than half). When similar adherent greenish layers were found on the remaining teeth three-fourths of the cases were clinically scrofulo-tuberculous.

Moro, amongst others, confirms in general the importance of these symptoms in the tuberculous form, but often met with a negative tuberculin reaction, in genuine circular caries 28 per cent., in partial caries, namely, only on the anterior periphery, 50 per cent. Moro, therefore, considers this symptom more a sign of "lymphatism," though tuberculosis may have helped to induce it.

Some authors (Löri, Cadier, Hajek, Revillout, &c.) mention scrofulous ulcers in the pharynx, and describe their characteristics, flabby granulations, a tendency to speedy dispersal, no surrounding reaction, long duration, and situation on the posterior side wall of the pharynx near the origin of the palato-pharyngeal arch; on healing they may induce partial closing of the naso-pharyngeal wall by cicatricial changes. I have no personal experience in the matter, and it is uncertain how far perhaps tuberculous or syphilitic changes may be concerned. In a succession of manuals by specialists I find these changes are passed over.

Retropharyngeal abscesses, which are often observed as a consequence of scrofulosis, arise from suppuration of the small lymph glands on the anterior part of the cervical vertebræ, or from periostitis, or caries of a neighbouring vertebra. They occur most frequently before the second year. Choking when drinking, stiff carriage of the head, especially in vertebral caries, and nasal voice point to it and demand local examination; it is evidenced on digital examination by a fluctuating protrusion of the posterior pharyngeal wall.

EAR.

A frequent symptom of scrofulosis is chronic suppurating middle ear inflammation, middle ear catarrh, and catarrh in the neighbourhood of the nose or tonsils, sometimes of the ordinary type, sometimes as phenomena consequent upon acute infectious

diseases; scarlet fever, measles, small-pox, influenza, diphtheria, and whooping-cough may be mentioned as the most immediate causes.

On account of the frequency of such agencies, it is difficult to confirm the fact how far such a disease of the middle ear can be looked upon as a symptom of scrofulosis.

In the acute stage of middle ear inflammation the most marked symptoms are boring, throbbing pain in the ear, which is specially felt when clearing the throat, and on any movement of the head, with intervals of painlessness; the inflammation extends to the surrounding parts, and is accompanied by a sense of fulness in the head and deafness. Through the ear speculum we see the evidence of an inflamed hyperæmic membrana tympani; it shows a convex prominence with swelling and œdema of the adjoining cutis. On the summit of the prominence, of the membrane, the threatening perforation appears as a light yellow spot. Out of the small opening spontaneously formed a more or less abundant mucous suppuration, and in carious processes an ichorous secretion mixed with blood, is discharged. Pain, cerebral symptoms and fever, if present, are reduced, or if they continue or return point to the retention of pus, owing to premature closing up of the perforated opening or to inflammatory irritation of the bony walls, to complications with periostitis, ostitis, empyema, caries or necrosis.

In scrofulous persons, especially in those who are debilitated or cachectic, the secretion will often take months to cease. The acuteness of hearing may indeed be restored, but often the process, especially if frequently repeated, turns to chronic suppuration of the middle-ear; when ulceration of the edges of the perforation occurs, considerable defects in the membrana tympani, or growths in the mucous membrane (polypus formation) may ensue. In the aural passages, especially in the cavity of the tympanum, a suppurative secretion may be observed which now and then dries up to a yellowish-green scab, and is accompanied by a fœtid odour. Facial paresis, reduction or loss of power of hearing, dumbness, or in young children deaf mutism may appear as consequences.

The danger of meningitis, a brain abscess, a sinus phlebitis or pyæmia, any of which may appear unexpectedly, is threatened until the middle ear suppuration is completely healed.

When the catarrh of the middle ear is not accompanied by inflammation the violent pain is wanting, complaint is only made of a feeling of fulness in the ear, stuffiness in the head, subjective sensations of hearing, a cracking in the ear when swallowing, and deafness. The membrana tympani is not inflamed or swollen, but

is drawn in, and the exudation may often be seen through it. In the dry form the membrane is often hardly changed, but later exhibits as a consequence an opacity and chalky deposit, a drawing inwards, and atrophy, and during auscultation on catheterizing, instead of the rustling noise heard in moist catarrh we hear a dry, whirring, or harsh blowing sound.

Externally we observe in the ear, especially in connection with eczema of the auricle, otitis externa, with serous purulent discharge, such as follows the introduction of foreign bodies. In the chronic form we get a malodorous viscid pus.

A rare form of otitis externa is caused by the aspergillus fungus, *Mycosis aspergillina* (Schwartze, Wreden, Siebenmann), in which the epithelial *débris* is studded with *Aspergillus niger* or *Fumigatus flavus*, the existence of which is shown by its black and yellow spotted appearance. This form of otitis is consequent, if not necessarily, at least frequently, upon dwelling in damp, mouldy apartments, and the growth of the aspergillus in the ear is, according to Siebenmann, combined with dermatitis (for instance, moist eczema of the external ear), or otitis media, which discharges serum under the same conditions as those in which scrofulosis is found. Thus its etiology has been connected with scrofulosis.

In tuberculo-scrofulous middle ear affections, which are only a small percentage of the total of such complaints, a feeling of stuffiness in the ears occurs first, then subjective sensations of hearing, and now and then considerable deafness. On the other hand, there is no pain, or it is only very slight, so long as it is a purely tuberculous process with which we have to do; only with mixed infection is there violent pain (Moos), and at the same time swiftly advancing disorganization. Painlessness, as well as the existence of multiple perforations in the membrana tympani and speedy destruction of the mucous membrane of the wall of the inner tympanic cavity (Jacobson), must lead to suspicion of tuberculosis, which is to be confirmed by the demonstration of bacilli. In tuberculosis the defects in the tympanum are generally great, and the perforations last a long time.

As serious consequent phenomena we must note caseous degeneration of the mucous membrane, caries, and exfoliation of the ear bones, caries, and necrosis of the adjacent parts of bone of the mastoid process, formation of fistula on this process, destruction of the pyramid, breaking through into the skull cavity, tuberculous meningitis, brain abscess, thrombosis of the petrosal sinus, destruction of the Fallopian canal, paralysis of the facial nerve, erosion of the carotid.

EYE.

On the eyelids we frequently find redness, a discharging eczema with formation of crusts; this process extends along the edge of the lids, which become red, thickened, and peel off in scales (blepharitis); the lids are found to adhere on awaking, being closed with a crust, ulcers are formed, the lashes stick together, and at last fall out. When the eczema is of long duration the edges of the lids become nodular, bare, and often ectropic. Styes (hordeola) are frequent, and appear quickly one after the other.

By a continuous transmission of the process from the eyelids or nose, or in consequence of direct infection by dirty hands, or maybe another catarrhal or eczematous spot, the conjunctiva also becomes affected. It becomes red, fleshy and puffy, and a quantity of muco-purulent secretion is formed (scrofulous blenorrhœa), which flows together with the lachrymal fluid down to the cheeks, and can there induce eczema. On the conjunctival sclera towards the corneal margin we see injected vascular tissue, circumscribed pustulous swellings (conjunctivitis phlyctenulosa), the pustules burst, discharge their opaque contents, and give rise to slight loss of substance.

On the cornea inflammation, and especially phlyctenular processes take place (keratitis phlyctenulosa); small infiltrations on their disintegration leave shallow ulcers, upon the healing of which severe cicatricial opacities and patches occur often connected with fresh vascular formation (pannus phlyctenulosus), consequent conditions which often impair the eyesight and even lead to blindness.

These affections are generally associated with severe irritation, great dislike to light, and reflex closing of the lids; "children go to the darkest corners and bury their heads in a cushion."

Now and then greyish-yellow infiltrations appear, which afterwards suppurate, and may lead to the formation of hypopion, perforating ulcers, prolapsus iridis, synechia, &c.

Keratitis fasciculosa occurs as an infiltration advancing to the centre of the cornea, which later induces a band composed of vessels lying closely against one another.

Phlyctenæ (which also appear in healthy persons) are distinguished in the scrofulous by great frequency, obstinacy, serious consequences, relapse and photophobia of a high degree in proportion to the small local changes. (For the bacterial conditions, see p. 13).

Opinions differ about phlyctenæ as one of the earliest and most frequent symptoms of scrofulosis.

Czerny considers it a symptom of exudative diathesis which often heals by dieting (see Schülz and Vidécky), but Hayshi has demonstrated histologically tubercles with central caseation, in cases in which he could not succeed in proving bacilli, and which in experiments on animals gave negative results. The frequent coincidence with bone and joint tuberculosis, positive tuberculin reaction (Stephenson and Jamieson, &c.), the appearance of phlyctenæ after the cutaneous test, and the successful treatment with tuberculin in many cases (Schülz and Vidécky) point to its tuberculous origin, at least in some of the cases.

Weekers found phlyctenæ in 91 per cent. of persons giving a positive v. Pirquet reaction, in patients with other eye diseases 11 per cent. Igersheimer demonstrated positive cutaneous reaction in 70 per cent. of children suffering from phlyctenæ.

Bruno produced phenomena similar to phlyctenæ by injecting sterilized tubercle bacilli into the vascular system of rabbits. Cohn and Uhthoff consider that tuberculosis may be suspected in those suffering from phlyctenæ, especially adults, when they have never before suffered from the eyes.

In less severe forms of scrofulosis, inflammation of the eyes, affections of the corneal margin, and eczema of the skin which frequently accompanies it, the superficial position of the eruption, the fact of its being easily influenced by external agencies and the more frequent proof of pathogenic bacteria, when compared with other affections, all point to external infection.

Staub considers that severe, obstinate and recurring scrofulous ophthalmia is a paratuberculous expression of latent bronchial tuberculous glands, in the sense given by Neumann, an opinion which may doubtless be correct for many cases. Scrofulous ophthalmia is frequently only a secondary symptom of suppuration in the nose (its neighbouring cavities and the naso-pharynx), and ceases spontaneously when these are cured (Rothholz, &c.).

Affections of the bones, the non-tuberculous nature of which is only indicated by the lack of every other tuberculous symptom, are specially observed at the orbital margin of the lachrymal bone. The external symptoms are œdema of the lids, chemosis, protrusion of the bulb, and in the further course loss of mobility, abscess formation and rupture causing disfiguring ectropion. (For further information, see vol. xxi, ch. iv, pp. 403-406.)

Trachoma has been stated to be connected with scrofula. True, on the ground of his experience, even believes that granules are in most cases only absorbed by scrofulous patients, and only

in such cases unfold their full effect, whilst in healthy persons no complications appear. Other writers (Schmidt, Rimpler) associate severe consequences when scrofulosis is combined with trachoma.

The clinical picture of trachoma may be imitated in tuberculosis of the sclerotic and tuberculous follicles on the conjunctival fold (Rheim, Bongartz, Bach and Heinersdorff).

We cannot properly ascertain how often the tuberculous form of scrofulosis is accompanied by specific tuberculous changes or similar changes in the eye. Thus parenchymatous keratitis, which is sometimes observed in scrofulosis, may be of a tuberculous nature (Bongartz, Michel). The formation of tubercles in the conjunctiva, partly in the form of lupus, has been observed at times (see Cornet, "Die Tuberculose," second edition, p. 332, and the classification of Amiet, Burnet, and Denig).

The tuberculous nature of chalazion has often been demonstrated (H. Wagner, Eangl), but it would be going too far to consider chalazion in every case, or even generally, to be tuberculous.

SYMPTOMS IN THE OTHER MUCOUS MEMBRANES.

Catarrh of the deeper respiratory passages—trachea and bronchi—are more remarkable in scrofulous people by their obstinacy than by their frequency.

Intestinal catarrh is frequently put down to scrofulosis.

The opinion of Escherich, &c., that in scrofulo-tuberculosis catarrh may partly be traced to the discharge of tuberculo toxin may perhaps be justified, though it has not been proved.

We often find in scrofulous girls, even in childhood, catarrh of the vaginal mucous membrane with abundant discharge of a muco-purulent secretion (fluor albus). A large number of these cases in which the gonococcus may be demonstrated depend on gonorrhœal infection by stuprum or other occurrences, and do not come under consideration here. At other times tubercle bacilli are found (Demme), whilst a considerable proportion of cases depend on pus cocci (and not on specific infection) which have been accidentally introduced by "cleansing" with dirty cloths, by intentional irritation, or other accidental circumstances by the children themselves or other persons. Naturally such catarrh happens with girls who are otherwise healthy, as intensive irritation may open a point of entry for bacteria even in the densest epithelium, only then they disappear more quickly than in scrofulous children.

C.—SYMPTOMS IN THE LYMPH GLANDS.

After the scrofulous symptoms at the point of entry, affections of the lymph glands are the most important to be considered.

The tuberculous and pyogenic forms generally produce the same symptoms at the beginning, only as a rule, in the pyogenic form, if virulent germs be the cause, the course is somewhat more speedy. A stationary condition for a long period and caseation are symptoms which are often found only in tuberculous glands.

NECK GLANDS.

Affections of the neck glands are prominent on account of their superficial position and their frequency, especially the submaxillary, sub-auricular, and cervical glands.

The gland becomes harder, and swells so that it can be easily felt, and grows to the size of a pea, bean, hazel nut, or pigeon's egg.

The swelling takes place slowly and imperceptibly without complications, and often without sensible pressure symptoms. On this account for a long time they are not noticed by the patient, and are only discovered accidentally. The skin over the glands is unchanged, can be easily moved and raised in folds. The gland remains without any particular changes for a long time. In this condition it can, especially when not of a tuberculous nature or the bacilli are avirulent, return spontaneously to a healthy condition, that is, if the affection arising from the source of infection (provided such had been discovered) heal, and so the supply of toxin and toxic matter ceases. It will, however, persist, although the original affection may be long healed.

In the meanwhile the neighbouring glands swell, and a chain like a row of beads, which is palpable and even visible, appears, the parts of which grow into large tumours with a nodular surface. From fresh inflammatory processes in the zone from which the affection arises or from unknown causes, softening and suppuration of the glands supervene, they adhere to their surroundings by periadenitic processes, lose their mobility, and surround the anterior part of the neck as a lumpy mass the size of an egg. At times they penetrate the soft tissues and the space between the auditory meatus, the mastoid process, and the posterior margin of the lower jaw, and may cause pressure on the carotids, the jugular vein, air passages, pharynx, and upper part of the œsophagus, and lead to cerebral congestion and to pain.

The fluctuation in the softened glands extends to the surrounding parts, the skin over them adheres, becomes doughy or

œdematous, stretched, shiny and gradually thinner. At last, unless checked by operation, one, or more often several, small openings appear, out of which a purulent or watery fluid resembling sour milk and caseous fragments discharge. The fistulæ which have formed enlarge to ulcers with undermined flaccid margins, and sometimes lead to a sinuous cavity filled with spongy granulations which have been formed from a thickened capsule of the gland. They greatly retard healing; it is only after complete discharge of all caseous matter and dead remains of gland tissue that the secretion dries up, and a bright red, sometimes deeply-sunk scar is formed.

The process drags on for months and years, and continues longer if more glands which have in the meanwhile become affected soften and suppurate. Now and again deep subcutaneous abscesses form which penetrate towards the jugular and the supraclavicular fossæ.

INGUINAL AND AXILLARY GLANDS.

Similar phenomena appear when the inguinal or axillary glands take part in the scrofulous process.

Scrofulous inguinal and axillary glands suppurate in general more rarely than the neck glands; they often remain of moderate size when they swell, for example, owing to neighbouring bone affections. The difference may be owing to the opportunity for pyogenic mixed infections being present much more rarely than in the head, where the frequent skin affections, such as eczema, &c., afford a point of entry for them.

Whilst affections of the neck, and the more rarely attacked inguinal and axillary glands, run their course before our eyes or are at least easily found by palpating, affections of the internal glands (in the chest and abdomen) betray their presence only indirectly, and are only to be discovered by complicated methods of examination. Although they appear not to come much into evidence, they play (at least in the tuberculous form) a far more important part.

BRONCHIAL GLANDS.

It was only at the end of the century before last and at the beginning of the following that more attention was paid to the bronchial glands. Lalouette, Becker, then later Barthez and Rilliet, Guéneau de Mussy, Baréty, Widerhofer, Quain, &c., advanced our knowledge by detailed researches on the symptomatology and pathology of these glands.

They are not to be reached by palpation; at most their

presence is indicated by a chain of glands extending into the adjacent region of the neck, or now and again their presence is rendered probable by an increased feeling of resistance in the infraclavicular region. When they become of large size they prevent the expansion of the thorax, and may cause a constant throwing back of the head (Neumann). The principal symptoms which point to affection of the bronchial glands are caused mechanically by pressure of the glands, which gradually increase in size, on the organs in their vicinity.

Subjectively a feeling of heaviness, of pressure on the sternum, an oppression "as if there were a lump in the chest" sometimes direct pain near the seat of the disease is experienced. There may be also pain between the shoulder-blades, great sensitiveness to pressure on the sternum and the vertebral column, especially on the spinous processes from the second to the seventh dorsal vertebræ. At the same time in the beginning there is often a cough which can be explained by no other physical phenomena.

Even with slight increase in the size of the enlarged gland symptoms of pressure on the nerves are noticed. One of the vagi or its branches becomes compressed (as was known by Wrisberg), and owing to this the pulse is quickened, either persistently or intermittently.

The quickened pulse, which many authors mention as the precursor of phthisis, may, in my opinion, have its cause in such a swelling of the bronchial gland.

Occasionally palpitation of the heart or abnormal beating of the heart (Nagel, &c.) and irregular pulse may appear in consequence of pressure on the arteries.

In this way even dilatation of the heart and death may occur. The compression of sensitive branches of a vagus nerve can lower the reflex activity of the tracheal or bronchial mucous membrane or increase the difficulty of removing any inspired germs or the normal secretion, and facilitate infection by favouring catarrh. In the last of these circumstances we may see the reason for the frequent appearance of pulmonary tuberculosis after certain infectious maladies, such as measles, &c.

Variot mentions paroxysms of pain in the cardiac region three or four times and oftener in the day quite without cause (and often appearing in a manner reminding one of angina pectoris) which lasted an hour, and which was combined with a long fit of hacking coughing, probably caused by compression and stimulation of the vagus nerve, perhaps of the cardiac plexus.

By pressure on the recurrent nerve or its particularly irritable bifurcation, a convulsive cough coming on in short fits, dry and

often very harsh, is produced, very much like whooping-cough, and it may even be attended by vomiting. Often fits of dyspnœa and fits resembling asthma are exhibited with frequent change of symptoms (Barthez and Rilliet, Hérard, &c.).

With paralysis of the recurrent nerve paresis of the laryngeal muscles supplied by it appears, generally on one side, and on the left side, owing to the deeper course of the nerve; in consequence there is hoarseness and aphonia; exceptionally paresis occurs on both sides.

"One can see the child crying, but cannot hear it," says Berghinz, of a case in which both recurrent nerves were embedded in the bronchial glands which were the size of an orange. Further, there may be difficulty of breathing, laryngeal spasms (in one case of Ander's even death).

The pupil of the affected side can become enlarged by involvement of the sympathetic nerve.

Pressure on the trachea and bronchi, which on account of their firmness give way with difficulty, is followed by contraction of the lumen. It declares itself by a gurgling noise during expiration, and often at the end of inspiration by an increased frequency of respiration, by a gulping noise in coughing, by dyspnœa mostly of an inspiratory nature, with stridor, especially during excitement and movement, often increased by the horizontal position, and in the highest stage amounting to orthopnœa.

Under the influence of dyspnœa a rhythmical drawing in of the lower aperture of the thorax may take place in the form of a deep channel in the situation of the false ribs (Guinon).

By pressure the œsophagus is put out of its position, and at times dysphagia supervenes.

By pressure on the arch of the aorta hypertrophy of the heart may be induced; by compression of the superior vena cava œdema in the face, in the neck, or in one or both arms—the cachectic œdema of phthisical patients begins in the lower extremities—cyanosis of the face and lips similar to that in affections of the heart, distension of the veins of the neck and chest (Grober, Allan, &c.), are symptoms which, however, appear but seldom; there is inclination to bleeding at the nose, which has a bad significance as an apparent precursor of phthisis, giddiness, somnolence, bleeding from the arachnoid membrane, according to some authors salivation; these symptoms are very valuable, especially when they occur on one side only.

Pressure on the pulmonary veins causes hyperæmia, congestion, râles, and eventually spitting of blood.

I would also mention inspiratory lowering of the pulse by

pressure on the aorta, and the bruit in the veins when bending the head far back owing to compression of the innominate vein (Goguel).

For changes in the physical condition caused by swelling of the glands, see Diagnosis (p. 242).

We must especially emphasize the extraordinary variation and the intermittent character of the functional and physical symptoms of many swellings of the bronchial glands. They exacerbate suddenly and disappear very quickly, influenced by slight, often unknown causes, atmospheric pressure, and dampness of the air (J. Simon).

The swollen bronchial glands apparently remain a very long time in the same condition. They become most intimately connected with neighbouring parts and surround them on all sides. Even the pleuræ and pericardium may be sympathetically affected by the spread of the inflammatory processes in the glands or by the action of transuded toxin.

The glandular swelling, after existing for a long period and after several remissions and exacerbations, may retrograde, and may heal with shrinking and calcification. Or the glands may become soft, especially under the influence of pyogenic bacteria, suppurate and burst through if their surroundings allow them to do so. If they burst into a bronchus or the trachea the purulent caseous matter is coughed up, and may infect the respiratory passages by suddenly closing the bronchi; they induce severe dyspnœa and frequently cause death.

Meynet, and Poland (who reports a case of bursting at the same time into the œsophagus), Tait, Lundis, Wallis, Loeb (Literature), Gulliver, Biggs, Rolleston, Comba have described the bursting through the trachea and the large bronchi.

The bursting through is, as a rule, preceded for a long time by difficulty of breathing, asthmatic symptoms and stridor caused by the protrusion of the tumour into the wall of the trachea, where Polak in one case observed it with the tracheoscope.

Sometimes with children who are apparently healthy sudden violent cough and severe dyspnœa will occur, and in one such case of Dina's, tracheotomy was resorted to on account of suspected diphtheria, after which, during a severe fit of coughing, a caseated gland was brought up. Sometimes after the first attack of dyspnœa an improvement will be observed, then a renewed attack followed by perforation.

The caseated mass may entirely fill up the lumen of the trachea and lead to death from suffocation, as in a case of Reunert, Koch and others.

In a case of Petersen's, life was preserved by a speedily performed tracheotomy (see also Franz, Polak and Lohrer). Emphysema of the skin may also arise from a rupture into the bronchi (Benda).

A rupture into the vessels, perhaps followed by miliary tuberculosis, occurs less easily, because these, having a less rigid wall, can more easily yield and avoid adhesions. Dittrich mentions a case where a caseated gland settled on the ascending aorta and grew into it. We have many records of cases in which perforation into the œsophagus or a bronchus, and simultaneously into a vessel, took place and there caused fatal bleeding (Ökonomides, Kidd, Michael, Rautenberg, Barry (in a woman aged 71), Widerhofer).

Now and then only small vessels will be eroded by a gland communicating with a bronchus, and then give rise to a perplexing form of hæmoptosis in healthy lungs.

Perforation into the œsophagus seldom takes place. Weichselbaum, Beck and Zenker have each published a case, with consequent tuberculosis of the œsophagus; the three cases were all in elderly persons, or at least adults.

Further cases of bursting through the œsophagus are supplied by Neumann, Poland (in a child aged 1½), Hanot (in a person aged 22), Selenkow (in a person aged 50), Volker (in a boy aged 7), Meyerhoff (trachea and œsophagus). Scarred, retracted, glandular diverticula can form in the œsophagus owing to the strain.

Irruption into the pleura, pericardium, mediastinum often induces pleurisy, pyopneumothorax, or pericarditis. In Koch's case perforation into the pericardium was followed by a streptococcic sepsis.

According to illustrative cases, as far as they are confirmed by *post-mortem* examination, the severe symptoms that arise depend, as a rule, on tuberculous or tuberculo-pyogenic causes (mixed infection), naturally distinct from other malignant growths, such as sarcomatous degenerations. Less severe chronic but transitory swelling of the bronchial glands occur, as it seems, more frequently than we are accustomed to think is the case, for example, in connection with bronchitis, &c., and these symptoms are often erroneously put down to the primary disease.

MESENTERIC GLANDS.

The mesenteric glands, which frequently exhibit inflammatory swellings even in simple intestinal affections, cause few characteristic symptoms in scrofulous inflammation, which is mostly of a tuberculous nature. But they extend, especially when they do

not caseate or calcify, over a very wide range, and can be felt as thickened, hard, uneven masses through the soft, yielding abdominal wall, generally near the navel, though the absence of palpable tumours does not prove that they do not exist. Henoch mentions, for instance, that in a girl aged 5 the tuberculous mass of mesenteric glands, accompanied by simultaneous chronic peritonitis, could not be detected by palpation, although, as the *post-mortem* proved, the mass was the size of a child's head. When mesenteric scrofula (tabes mesenterica) has been of long duration the abdomen is generally distended and bulky, which is rendered more perceptible by the thinness of the body. Sometimes it is accompanied by swelling of the inguinal glands.

Frequently these mesenteric scrofulous patients suffer from indigestion, often accompanied by obstinate diarrhœa, as well as from more or less violent intercurrent abdominal pains; these are often the only symptoms, lasting weeks and months, and sometimes leading to a fixed position with the legs drawn up.

Now and then spasmodic attacks of pain, accompanied by fever and vomiting, appear (Fromm), and, exceptionally, cramp in the calves; the loose connection in which the mesenteric glands stand to the abdominal organs allows of a reciprocal yielding, and thus extensive groups of lymphatic glands may be present without giving rise to symptoms of pressure, as is the case with the bronchial glands. The course is often run without symptoms, for example, a child of seven with advanced tuberculosis of the mesenteric glands only experienced abdominal pains, followed by vomiting with fever and delirium, five days before death (Etsches).

At times they compress the trunks of the vessels, by which, distension of the abdominal veins and even œdema of the lower extremities may be induced.

The glands may heal and disappear, or calcify by absorption of lime salts. Sometimes they grow into the walls of the intestines, soften and perforate either into the lumen of the intestines of the peritoneal cavity, so giving rise to peritonitis. But we may have peritoneal irritation and exudation (perhaps in consequence of transuded bacterial toxin) without perforation. Extension into the mesenteric artery has also been observed (see pp. 221-222).

The considerable disturbances of metabolism which accompany scrofulosis of a tuberculous nature lead to severe wasting, which has given rise to the name tabes, or phthisis mesenterica; in severe cases the further consequences of cachexia are induced, such as amyloid degeneration of the abdominal organs, swelling of the feet, &c.

D.—SYMPTOMS OF BONE AND JOINT AFFECTIONS.

Affections of the bones and joints presuppose a focus already existing in the body (see p. 145).

We have to do, as a rule, with the tuberculous form which naturally appears independently of scrofulosis in the train of tuberculosis of other organs.

Scrofulosis of the bone exhibits itself especially at the epiphysis of the long bones, in the spongy medullary tissue of the end of the joints, and more rarely at the diaphysis; in the short bones, the phalanges of the fingers and toes, and occasionally in the radius, ulna, and fibula (in young persons). Generally about the fifth year a central inflammation begins in the medulla of the affected bone—spina ventosa—which is recognized externally as a distension and spindle-shaped bulging.

The chronic course is accounted for by the near relation of the spongy tissue to the lymph glands.

For the relative frequency in each bone, see p. 135.

A detailed discussion of the symptoms does not lie within the scope of this book. I refer my readers to the surgical manuals dealing with them, and confine myself here to a short sketch.

Foci in the bones often remain localized for years. At times pain is felt, which becomes worse at night and shoots into the neighbouring parts, at other times the pain may disappear or increase in intensity (for example, when there is discharge into the joint); it may confine the patient to bed, and when continuing for a long period, with no perceptible changes in the joints, lead one to suspect a neurosis.

In the further course the affected limb becomes limited in its movements, a feeling of weakness is experienced, and the part becomes stiff and easily tired. In affection of the vertebral column the trunk and head are often held in unnatural positions to take the weight from the spine, and to avoid pain the child grasps chairs and other objects, and later places both hands on the thighs, a position which is typical of the affection. The stiffness of the back is especially noticeable on attempting to pick up objects off the floor.

With the growth of the focus in the bone reactive changes appear in the periosteum, such as thickening, which is recognized on superficial bones by a doughy feeling, and by the pressure of the finger leaving an indentation. At first the skin is normal, later often tense over the affected part of the bone, continual pain and sensitiveness to pressure are felt; these are often confined to

certain points of the epiphysis, and are then of great importance diagnostically; they may be accompanied by slight remittent fever. When the site is superficial a less clear sound is emitted on percussion with the pleximeter over such affected spongy bones (Lücke).

Cold abscesses are formed on the bone, and fistulæ with granulations at the margin, which lead down to the carious bone and which heal with difficulty. The joint is often considerably affected sympathetically, without extension through rupture having taken place in it, clearly owing to transuded toxins.

The foci in the bone have often attained considerable dimensions before extension into the joint takes place.

This extension into the capsule, or through the cartilage into the joint, may take place with acute and often violent pain, accompanied by external signs of inflammation, or it may take a chronic course; in this case the pain is absent often for a long period, in spite of considerable joint changes, or is only felt when there is a weight on the joint or when it is over-exerted. It is often discovered by the child crying out at night, and this may be the first sign of incipient spondylitis or coxitis. Later, pain is felt on palpation, especially at certain points (fixed pain points).

The pains spread through pressure on the nerves, and express themselves by spondylitis in certain regions according as the part concerned is the vertebral column, the occiput, neck, shoulder and arms, the whole back, the region of the kidneys, or as a painful feeling of constriction in the breast or abdomen. Recently such a case was brought before me which for a long time had been treated as an affection of the kidneys. The pains extend to the legs or pass into the sternal region. Later, by the sinking in of the affected vertebral curve, affection of the bladder, paralysis of the arms, or spastic paraplegia of the legs appears. In coxitis pain may be felt for months in a healthy knee, and give rise to unpleasant mistakes as to the seat of the malady.

In other cases of joint affections disturbances of the power of motion take place at an early stage. At first there is only a certain stiffness and awkwardness, especially on rising in the morning or at any beginning of movement; the limb exhibits a certain weakness, the patient loses his certainty in walking, and is inclined to fall. Such a fall is erroneously considered the traumatic beginning of bone tuberculosis, which, as a fact, was already present.

The coxitis shows itself often weeks and months before the appearance of pain by slight limping and dragging of the leg, spondylitis by stiff position of the vertebral column, the child

being quite lively with it. Awkward positions and muscular contractions are formed. The patient seeks to fix the joint in the most convenient and painless manner. In coxitis the thigh is flexed, abducted and rotated outwards, later flexed, adducted and rotated inwards. In joint fungus the knee is held in a half-bent position, whilst in an elbow-joint fungus it takes the middle position, between pronation and supination; with straightening or further movement the pain is often alleviated. An apparent or real lengthening or shortening of a limb takes place; when completely undressed, one sees that in walking the patient lays the weight on the healthy side and stoops towards the healthy side. Walking becomes more difficult; sometimes the limb becomes entirely fixed. Hip-joint affections are accompanied by painful twitching of the muscles, especially at night.

In a number of cases the first symptom is a change of shape in the affected joint, a swelling, either due to peri-articular processes (tumour albus), or to granulations in the joint itself. The buttocks become flat, the gluteal fold disappears, the knee becomes spherical, the elbow spindle-shaped. The swelling becomes more marked as the affected limb becomes atrophied above and below the joint (muscle atrophy). Fluctuation and crepitus are frequently met with, especially in certain positions.

Owing to disease in the bone and relaxation of the capsule spontaneous luxation and subluxation arises.

Frequently the well-known cold abscesses form, usually insidiously. Sometimes they are the first of the symptoms, in other cases they are entirely absent. Their size varies extremely and independently of the extent of the bone lesion, from a few drops to several litres of pus. They are often far advanced before they become noticeable, and partly owing to the law of gravitation, but also, doubtless influenced by the contraction of the muscles, they sink towards the side where they find the least resistance, where the connective tissue is the loosest, or along the course of the vessels and nerves (hence the name wandering abscess) (Hueter).

From the dorsal part of the vertebral column they sink towards the pelvis, along the psoas muscle, and appear on the inner side of the thigh, or they travel from the shoulder-joint along the long head of the biceps to the upper and posterior end of the deltoid, or, starting from the hip-joint, in front of and on the outside of the tensor fasciæ latæ, appear again in the gluteal region or in the pelvis.

If such a wandering abscess burst or be incised it discharges a crumbly, caseous, sometimes thin, pus resembling whey, which

is distinguished by its white colour from the yellow-greenish pus of phlegmonous foci.

Now and again, though seldom in children, a tuberculous hydrops forms, usually chronic, with exacerbation and remission of the discharge, seldom acute. The joint is painful, swells, the skin becomes red, the temperature of the body rises, and the discharge flows within a few hours in a patient apparently healthy (latent tuberculosis). The hydrops may again disappear, leaving a thickened capsule.

In other but rarer cases suppuration takes place inside the joint (cold abscess of the joint), followed by fluctuation and bursting. Or mixed infection shows itself, especially when an external wound exists; severe septic processes may then increase the whole symptom complex.

Often there is not only one bone or joint lesion; several are formed, even four, five, or more, sometimes shortly after one another, sometimes at an interval of years.

Bone and joint affections may run their course without any considerable disturbance or fever, yet when the process is further advanced fever of a remittent character usually appears (hectic fever of König) with low sub-febrile morning and evening temperature, but rising to 38° to 39° due to a chill. I wish here to emphasize that for early and exact knowledge of the fever it is necessary to take the temperature every two hours.

All the affections described are mostly chronic, seldom acute. They may exacerbate, remit, often be at a standstill for a long period, and may even after a long time definitely and spontaneously heal. Abscesses may be again absorbed and disappear, the pain may be reduced, the swelling go down, the secretion from fistulæ dry up, the fistulæ close, the muscles become strong, and the affected limb regains entirely or in part, according to the degree of disturbance, its former mobility. In other cases bony or connective tissue ankyloses may remain (curvature of the spine, Potts' curvature, kyphosis).

Such places are, on account of the changed conditions of circulation, specially adapted, when isolated bacilli at some time or other enter the blood and lymphatic vessels, to retain them, and to reinaugurate the previous processes. Therefore recurrences must by no means depend on reanimation of a few living bacilli, which have remained in the healed lesion, as many authors suppose, but it may just as well be traced to a new batch or fresh infection.

If healing does not take place the tedious processes exhaust the body and lead slowly to amyloid degeneration of the kidneys

(albuminuria), of the liver and spleen (enlargement and hardening), and of the intestine (profuse diarrhœa), to general dropsy and death. Or bacilli are set free, enter the blood passages, and induce according to circumstances either miliary tuberculosis or local tuberculosis in the brain, in other bony parts, &c., and so bring the existence of the individual to a speedy end. Now and again surgical treatment has had fatal consequences, although extensive operation (resection with complete elimination of the diseased parts) has been relatively more successful than small operations on the diseased tissue, such as scraping with a sharp spoon, &c.

E.—GENERAL SYMPTOMS.

Anæmia.—Owing to the long continuation of the scrofulous processes and the continual absorption of poisonous substances, the blood and the body generally is included to a certain degree in the affection, as we have already partly hinted at above. We often observe a high degree of anæmia in the scrofulous in the further course of the disease.

Monti and Berggrün found in a boy of about 6, who was suffering from tuberculous glands, 38 per cent. of hæmoglobin and 3,640,000 red corpuscles and 14,000 white corpuscles. Elze also noticed in scrofulosis that there is generally a reduction of hæmoglobin and red corpuscles, and the former appeared to be more altered than the latter. Besides which, Elze, in eight cases of scrofulosis, instead of the normal proportion of white and red corpuscles, 1 : 500-800 for adults, found proportions of 1 : 11 or 97 or 480, but we must take into consideration that the blood of young children is richer in white corpuscles, and, according to Gundobin, their relative number is about three times as large as in adults. Becker notes the increase of lymphocytes in the scrofulous. The generally reduced number of eosinophiles in the tuberculous increases apparently when the process takes a favourable turn. In surgical tuberculosis in children the eosinophiles were constantly found to be increased, and in inverse ratio to the severity of the affection. See also Rubino, Lanza, and others, and p. 54.

Fever.—Slight feverish attacks appear frequently, at least in the tuberculous form, which, on account of the rarity with which the temperature is usually taken, are easily overlooked (see "Die Tuberculose," second edition, p. 727). The fever as a rule is only slight, because in consequence of the occlusion by the capsules of the glands the production and absorption of the toxins is on the whole less than, for instance, from a tuberculous

lung focus which is in connection with the lymph vessels and lymph spaces in its whole periphery; the more extensive the tuberculous lesions are the more frequently and the higher the temperature rises. With plentiful absorption of toxin, as in caseated bone and joint lesions, fistula, retained pus, &c., hectic fever is reached, often with perspiration.

The anatomical structure of the gland also encourages the pyogenic form, but the important quality of the tubercle bacillus, namely, the power of producing thrombosis in the vessels and thus restricting the dispersal of the toxin, is wanting (see p. 126, and "Die Tuberculose," second edition, p. 682). The appearance of fever depends above all on the greater or less virulence and toxic effect of the pus bacteria in question.

Of earlier writers, Hufeland has devoted a special chapter to fever in the scrofulous, and Virchow has spoken of the tendency to febrile conditions, recalling the febricula of phthisical patients, whilst most authors, with the exception of Birch-Hirschfeld, hardly mention the word fever. H. Neumann has recently, and perfectly rightly, mentioned the frequency of fever temperatures, even if only slight 37·7° to 38·5° (in the rectum), which he found in 62 per cent. of his scrofulous patients, and emphasizes it as an important symptom under certain circumstances, an opinion with which I entirely concur from my own experience. More attention should be paid to the frequent "cold shivers" in the morning and evening and not just put it down to anæmia.

It is often only a slight rise of temperature, once daily to 37·2° to 37·3°—axillary temperature—only to be recognized by taking it every two hours, which indicates tuberculosis of the bronchial and mesenteric glands (see Diagnosis, p. 237).

I should mention that Ludke and Sturm, S. Chaldier and Poncet, Reyher, and others, demonstrated orthostatic albuminuria in tuberculous or scrofulous patients, and Reyher supposes a direct causal connection between the two. Lemoine found it also in five soldiers with all the signs of inherited tuberculosis. See also Benati and Max Wolf.

Nourishment.—The longer and more severe the disease, the more, as a rule, the general nutrition of a scrofulous patient suffers. It exhibits itself chiefly, in spite of excessive hunger, now and then in those suffering from mesenteric scrofulosis, as well as in long-continued bone and joint suppuration. Frequently, however, the appetite is diminished.

Fenwick notes a special form of scrofulous dyspepsia which he observed 42 times in 2,000 cases, and which he considered a neurosis of the intestine. Quite suddenly, in the middle of the

night or immediately after a meal, there is pain in the abdomen, which the patient fancies is in the region of the navel, the pain begins above it and to the right, then extends to the left as well, and has a boring character; it lasts from five minutes to several hours, and is relieved by pressure. The stools are constipated, colourless, offensive, and slimy, and contain a quantity of unchanged matter. Need for evacuation comes on at meal-times, often after the first mouthful, nausea and vomiting are rare. The general health is considerably upset.

In the nervous system, besides the feeling of being easily tired at play or work, and occasional sleeplessness, a certain irritation and instability of temper is observed in many scrofulous persons.

The amyloid degeneration—which we have already mentioned as a consequence of protracted bone and joint suppuration—may also make its appearance in the course of suppuration of the glands only.

F.—THE SCROFULOUS CONSTITUTION.

A malady which lasts so long, and is connected with manifold disturbances, naturally stamps the body externally with a distinct mark of disease.

As long as scrofulosis was traced back to dyscrasia dominating the whole body, the scrofulous constitution, the general bodily peculiarities which are so often observed in the scrofulous were considered precursors of the disease which doomed the individual to scrofulosis.

Even a certain lack of harmony of the external form was put down by Lugol and others to scrofulous constitution, either "the limbs were too long or too short," "the body too small or disproportionally large," "the mouth small or much too large," "the appetite too small or voracious." As perfect harmony in the body is a rarity, it would not be difficult to demonstrate one of these defects in every scrofulous person as a sign of a scrofulous constitution.

In contradiction to Lugol's statement, that every scrofulous child was weakly, and that scrofulosis excluded the attributes of strength and health, Louis has cast doubts on the predominating influence of constitution, and Lebert has questioned the criterion of a weakly constitution. The latter believes that unprejudiced observation has given us no right to look upon a weak constitution as predisposing to scrofulosis, for the experience which apparently supports it was traced back to one-sided opportunities of observation in a children's hospital and on poor children.

Virchow and others note the appearance of scrofulosis in children otherwise healthy.

The fact that scrofulosis, like tuberculosis, often heals in one organ such as the glands, and in another, such as the bones, continues its course, while in the same organ it will heal in one place and extend in another, is incompatible with such a general dyscrasia as a preliminary condition, also with the acceptance of a general diathesis.

A strikingly perceptible sign of scrofulous constitution was believed to have been found in the scrofulous habitus, a sign which was highly valued at the end of the century before last and the beginning of last century. Two primary forms were distinguished, the erethistic and the torpid habitus.

The erethistic form is characterized by a slim build, weak, wasted musculature; little adipose tissue, a soft, tender, pale skin, easily becoming red, the veins are visible as a network of bluish colour, bright moist eyes with wide pupils, silky soft hair, blue-white well-polished teeth, an intelligent, active mind, a lively temperament but easily depressed, and often an early-developed sexual instinct. Many authors see further signs in fair hair and blue eyes (Birch-Hirschfeld), others in dark hair, long dark lashes and dark eyes (Henoch). These are for the fair sex, those phenomena of ephemeral beauty which the artist describes as "beauté du diable," and the country folk, as an apple "with a maggot at the core."

The torpid type is characterized by a heavy build, puffy condition of body, pasty appearance, podgy limbs, with a quantity of spongy, adipose tissue, but without strong musculature, short thick neck, large head, pale complexion, unusually strong massive jaw bone, a swollen, thick broad nose, thick puffy upper lip, stupid expression, with signs of mental dulness and arrested development, phlegmatic temperament, dislike to bodily exercise, and, according to some, having fair hair and blue eyes (see above).

As the greater part of the scrofulous could not, even with the best possible desire, be classed under either of these two heads, a third or "middle type" was introduced.

Critical observation shows us that the scrofulous physiognomy exhibits itself in a great number of the scrofulous, not as a condition of body preceding scrofulosis, but, as Virchow has already noted, as an expression of disease already existing. The clinician, Lebert, who only found this habitus 81 times amongst 537 scrofulous patients, rightly remarks that "it is much less seldom found if the habitus be noted before the diagnosis," in other words, when the judgment is not prejudiced.

Of all these so-called premonitory symptoms, the fine skin might give us a certain clue. But, unfortunately, by combining too many symptoms the worth and importance of single symptoms have been effaced. As for the rest of the signs of the scrofulous habitus, one can easily understand that with extensive swelling of the glands, a compression of the vessels, and consequently a blockage of lymph may be induced, which causes a change in the outward appearance of the patient, and explains the puffy face, &c. It is just as readily understood that scrofulosis is more distributed amongst the poorer classes, because of their crowded dwellings, with increased opportunities of infection, the consequences of poverty, bad dwelling houses and bad nourishment; also a pale complexion and defective bodily development must be oftener found without there being necessarily a causative connection with scrofulosis.

Scrofulosis, especially when of long duration and high degree, has an effect on the bodily and mental powers. Children exhibit a dislike to exercise and do not join their comrades in games which require bodily movement, they often complain of weariness, even on rising in the morning, and they hold themselves badly, which is accounted for by weakness of the spinal muscles. Instead of racing about like other children, they sit down quietly, even when not forced to do so, by reason of the type of their malady—bone and joint disease—and prefer to read or to give themselves up to the pictures of their imagination.

Soltmann, in his further statements respecting his theories already laid down, traces the production of the erethistic and torpid habitus to the concentration and effects of the chemical changes and products of the tubercle bacilli on the blood and lymph systems. Czerny contests the connection of a scrofulous habitus with tuberculous infection, and looks upon it principally as the expression of the exudative diathesis which might be made to disappear by dieting with food containing little fat and no eggs or milk. But the habitus may be influenced and nullified by tuberculin treatment without change of diet (Escherich, Heubner, and others). It is clear that there are more factors which work together as causes.

This, as well as the more frequent association of weakly children with older persons, instead of with companions of their own age, explains the advanced mental development, a certain precociousness, which we find in such children, and a more grave demeanour, which, if the disease runs a favourable course, is often retained during the whole life.

On the other hand, with many children the mental development is retarded by certain forms of scrofulosis, and this is often observed as a consequence of adenoid growths. Doubtless owing to the blocking of the lymph passages, which in brain and nose are connected, the children have difficulty in concentrating their attention on any object (Guye's aprosexia, Bresgen, and Seiler). On this account they give cause for constant complaints from school and fall behind in their studies, unless steps are taken in time.

The fact was noted frequently, especially by older writers, that in the scrofulous the development of the sexual organs was often considerably later than in the normal. I have not remarked whether this is frequently the case, but in scrofulous girls menstruation appears in general later than in the healthy of the same generation, also troubles in menstruation are more frequent.

An unusually early awakening of the sexual instincts is mentioned by some authors (Baumès), by others exactly the opposite is stated.

SECTION IV.

Course and Duration of the Disease.

Scrofulosis almost always runs a chronic course, with many exacerbations and remissions; it is only really comparatively acute in the tuberculous form, perhaps owing to multiple infection. The course is determined by the number and species of the germs which have entered, the intensity of their proliferation and dispersal, by the organs attacked and by the anatomical peculiarities of the individual.

We may in general distinguish four stages of scrofulosis:—

(1) Superficial infection of skin and mucous membranes.

(2) Affections of the glands.

(3) Bone and joint affections.

(4) The various terminations, including amyloid disease.

The single stages play a more or less important part according to the form of the scrofulosis. In the pyogenous we meet, as a rule, with only the first two, in the tuberculous principally with the last three. By the simultaneous existence of various stages and of both forms many combinations arise.

The superficial phenomena of the pyogenous form belong in general to the first years of childhood and the crawling age.

A.—COURSE OF PYOGENOUS SCROFULOSIS.

In the pyogenous form of scrofulosis the local symptoms are most marked at the point of entry, in the skin and mucous membranes, such as eczema, catarrh, &c., for the above-mentioned reasons. The symptoms will often be confined to the same place for a considerable time, or they repeat themselves constantly, or appear now in one place, now in another, in continual changes.

The affections may remain localized at the point of entry and the glands be affected only in this way, so that the diffusible poisons of the bacteria arrive at that point from the tributary area; irritation follows, with consequent swelling, inflammatory

hyperplasia, and even suppuration. These changes in the glands, as well as the affection of the tributary area, are chronic; if the disease heal and the supply from the area traversed by the lymph passages meeting in that gland be thus cut off, then the changes in the glands disappear in a short time (scrofula fugax).

If bacteria enter even into the glands and set up independent processes, these may continue an indefinite time without suppuration after the healing of the surrounding zone, on account of the generally slight virulence of the bacteria in question, and at last may retrograde. If highly virulent bacteria enter at the beginning or later, acute suppurating processes, abscess formation and rupture occur.

We see different combinations; the skin affections may be healed yet the glands remain swollen, or the glands may be healing when a new process establishes itself in the area, or the glands of one part are healthy and the respective tributary area connected with that gland is diseased, or another region diseased and the area in connection with it healthy, and so on, with a multiplicity of variations.

The glands form a more dependable cover for pyogenous bacteria than for tubercle bacilli, perhaps on account of their size, perhaps from other causes. A dissemination from the glands to the bones or other organs, the third stage, is, to say the least, one of the most extraordinarily rare occurrences; still, the possibility should not be denied.

The disturbances in the general health are unimportant, both an account of the slight spread of the process into the interior of the body, and because of the less toxic characters of the bacteria, so that we may rightly term the disease a mild scrofulosis.

B.—COURSE OF TUBERCULOUS SCROFULOSIS.

As regards the course of tuberculous infection, the slower or quicker advance of the processes, and the possibility of spontaneous retrogression, it is very important which type of bacillus, whether human or bovine, has caused the infection. For the present too few researches have been made in this connection to enable us to state the course precisely. The differences are apparently of a more gradual type (see Prognosis, p. 228); the general direction of the course remains the same.

First Stage.—In the tuberculous form, as a rule, we rarely find symptoms at the point of entry. The child's mucous membranes are easily penetrated by isolated bacilli, therefore the first stage, if the infection take place in them, is generally left out. In the skin the bacilli, if they have been able to penetrate, are retained on the spot by the firmer tissue and often so completely

that no second stage is reached. Lupus may exist for a long time without the nearest glands being affected.

These superficial affections are generally extraordinarily chronic.

Haike, on the other hand, notes the sometimes extremely rapid course of tuberculous ear affections in infants. Thus, in a child 5 weeks old, a few days after suppuration had set in, facial paresis was observed, and at the *post-mortem*, which took place three weeks later, the whole of the temporal bone and the labyrinth showed tuberculous changes. Acute miliary tuberculosis can, with exacerbation, lead to death in twenty-four hours with high fever and coma (Lupowski). The natural path for the dispersal of the process from the skin and mucous membranes is by way of the lymph passages to the lymph glands, which apparently always offer a transitory hindrance to the bacilli and so forms the second stage (see p. 122).

The brain may be infected directly by the nasal mucous membrane without the intervention of the glands on account of the connection of the lymph vessels on both sides, so that in such a case death from meningeal tuberculosis follows immediately on the first stage. In rare exceptional cases direct infection of the underlying bones may take place from the skin and mucous membranes through the lymph paths—third stage added to the first.

Second Stage.—Affections of the glands form the recognized second stage of scrofulosis. We see this stage most plainly in the neck glands. As a rule the disease advances but slowly, as the retention of the bacterial poison and also the quantity of lymph cells hinder the development of the bacilli (see p. 125). If the bronchial or mesenteric glands are affected the second stage is often latent for a long period. With continued absorption of the bacterial poison a general weakness comes on insidiously as a want of tone of the whole organism, or appears only in connection with other diseases, such as measles, scarlet fever, &c.

Tuberculo-scrofulous glands of even considerable extent may retrograde even after a duration of months, and the processes of the disease heal completely if no extension to other glands or organs has taken place.

We have seen in cattle that glands which have been affected by human bacilli which are foreign to them, and which have attained to the size of a hen's egg or goose's egg, retrograde to a calcareous focus the size of a peppercorn, therefore it is not remarkable if in children the changes caused by the bovine bacillus, which is almost foreign to them, again disappear entirely or are reduced to chalky foci.

But usually the gland softens sooner or later, spontaneously

or aided by accidental bacteria. It bursts, forms a fistula or an ulcer which secretes for months and years, and only heals after shedding all gangrenous tissue, often leaving a disfiguring scar.

In the meanwhile the protective and filtering power of the glands becomes insufficient, either on account of the advanced process or under the influence of extraneous inflammation, such as measles, &c., or trauma; the bacilli spread further, and the more easily the younger the individual. Owing to centripetal spreading in the direction of the lymph current chains of glands are formed, for example, from the neck into the mediastinum.

In the case observed by Marfan and Oppert, of a child 15 months old which had swelling of the neck glands and "angina," in a few days there was suppuration of numerous neck glands with the formation of a quantity of pus, in which, according to the authors, a great many tubercle bacilli were found as the only inciters of the suppuration.

The pressure of a large mass of glands on the vessels, nerves, trachea, bronchi and œsophagus may give rise to severe consequences, paralysis, dyspnœa, dysphagia, rupture into the trachea, to pulmonary tuberculosis and suffocation; rupture into the vessels may cause fatal hæmorrhage.

Various groups of glands which are not in immediate connection, which do not lie in the same centripetal direction, which even belong to different regions of the body, for example, the bronchial and mesenteric glands, may be affected simultaneously or shortly after each other. It would be wrong to suppose that the affections of the different groups of glands were, as a rule or of necessity, dependent on one another. Such an idea contradicts clinical and experimental work, which teaches that tubercle bacilli not only pass through some glands, and avoiding others settle in the glands lying nearest in continual succession, step by step and not by bounds.

The preponderating majority of such cases depends doubtless on multiple external infection. It cannot be contested that the opportunity for this infection of the individual was given, as his disease shows, by living in an environment rich in bacilli. Why should not bacilli at the same time or at intervals be inspired or have entered the mouth or intestines at some other point in the interior of the body or on the external surface and have infected them?

RETROGRADE DISPERSAL.

Exceptionally, single bacilli become detached from a gland lesion by compression, or some other obstacle, and are turned from their direct centripetal direction and drawn into collateral

and even returning branches, and either alone or in company with migratory cells enter the glands which lie at the side or in the opposite direction of the lymph current.

Those cases point to the possibility of retrograde transference within the lymph passages which, in the case of carcinomatous or sarcomatous degeneration of the bronchial glands, also exhibit metastatic cancerous or sarcomatous foci in the subpleural network of the lymph vessels, whilst in the interior of the lungs, from which the cancer in the lymph vessels might have grown, tumours are wanting (Vogel).

The observations of Heller, who found a cancerous embolus in the branches of the veins of the liver in a case of carcinoma of the cæcum which he had watched, proves that even the venous blood-current, which is expelled much more strongly, may take a reverse direction, at least at times and under certain conditions. A reverse current in the lymph vessels of the head is facilitated by the less development of the valves (Bonamy), therefore it is quite possible that bacilli also in the lymph spaces may be conducted further in a reverse direction.*

In my experiments with animals I have several times been in a position to observe an undoubted reverse infection of the glands. In infection from one side of the navel, besides tuberculosis of the inguinal glands, I have even been able to demonstrate now and then caseation of the further lying peripheral skin glands, but this happened only once in about 4,000 cases which were always thoroughly examined for this very condition of glands, and that in animals which generally exhibit extraordinary facility for the dispersal of bacilli through the lymph passages. At any rate, it is not justifiable to make a rule of an exception. When Neumann supposes for the greater part of cases of scrofula that the neck glands are affected in ascending direction from the bronchial glands, this supposition is entirely without support from facts; it is just as if we should state the paradox, that the normal direction of the lymph current is the reverse direction (see pp. 122-126).

The general health suffers more the more the processes extend, the more tubercle toxin is absorbed, the more loss of substance takes place from open lesions. Increasing pallor, lowering of temperature, loss of strength, betray the severe internal disorganization; with the gradual discharge of all tuberculous matter the disease may be brought to a standstill, to healing, the patient can even develop into a completely strong long-lived individual; but usually a physical inferiority remains

* With regard to this I would refer to the work of Recklinghausen. (See Bibliography.)

for years or for the whole life. In other cases the general exhaustion increases and leads at last to death.

Besides being carried into the nearest lymph glands, the bacilli which have been freed may pass into the blood passages or the organs of the body. Tuberculous meningitis may be induced or complicated pulmonary tuberculosis, the appearance of which so dominates the whole picture that scrofulosis falls into the background, or the bacilli may reach the kidneys, testicles, &c. But frequently the bacilli enter the bones and joints and so introduce the third stage of scrofulosis.

Third Stage.—This can, it seems, also appear primarily, the first stage being passed over, the second (the formation of gland foci) not being demonstrated owing to the hidden position of the bronchial or mesenteric glands.

The general symptoms become more and more evident. The bone lesions may burst outwards, forming fistulæ, which heal with great difficulty, or cold abscesses appear, the vertebræ may partly collapse, and Pott's deformity arise. The joint is attacked and disturbances of mobility take place in varying degrees up to complete fixation and uselessness of the joint.

These processes may take years, and are often accompanied by aggravation or improvement. Even with extensive lesions in the bones and joints a temporary or permanent standstill is possible, but generally with great loss of movement; in spite of treatment the disease frequently advances, and this unfavourable issue introduces to some extent the fourth stage.

Fourth Stage.—The extensive purulent processes cause amyloid degeneration of the abdominal organs, and death occurs after gradual exhaustion and œdema.

Or the bacilli are further disseminated, as in the former stages, and induce brain, lung or general miliary tuberculosis. It is usually accidental pulmonary tuberculosis which brings about with relative frequency the unfavourable end of the sufferings in scrofulosis. It is not always a consequence of bone tuberculosis, but owes its existence more often and more probably to the same focus as bone tuberculosis, namely, the bronchial glands. Or it may have arisen from a new infection, the infectious material for which may have originated with the patient himself by the dissemination of his secretions.

Open glands or bone lesions may, by infection through the wound, lead to serious consequences and even to death.

As the greater part of the scrofulous patients who have died of pulmonary tuberculosis are placed in the lists of mortality under that disease, we have few dependable records even for the genuine tuberculous form, as to how often scrofulosis runs a fatal course,

C.—MIXED INFECTION.

The pictures which we have here represented of the tuberculous and the pyogenous form of scrofulosis are not always so clear, but often appear coincidentally or are mixed, both sorts of bacteria attacking the same region, sometimes the tubercle bacillus first, sometimes the pus cocci.

They may act conjointly and each assist the work of the other. Thus, pus cocci may cause acute or subacute inflammation in a caseous gland which has existed for months, just at the time when the chronic tuberculous lesion was on the point of encysting. The lesion is invaded, irritated, the bacilli mobilized and their dissemination assisted, with all its dangerous consequences.

Very frequently the course of tuberculous glands is influenced by accidental bacteria and suppuration caused by them. v. Brun's researches have demonstrated that in thirty-nine cases of suppurated tuberculous neck lymphomata, in twenty-eight of the cases streptococci co-operated simultaneously (this was demonstrated partly microscopically, partly by plate-cultures). Achard and Ramond observed secondary sporotrichosis in the fistulæ of tuberculous glands.

But mixed infection does not always result in harm to the patient. The inimical species compete against each other, mutually exhaust the nourishment in their narrow zone, injure each other by the products of their changes and decomposition, and often incite the tissues to increased inflammatory reaction. As for the latter case, highly virulent pus-cocci may, if they should enter a gland already undermined by tubercle bacilli, act like a spark in a powder barrel. They cause acute suppuration which expels both intruders, the tubercle bacillus and the pus coccus, with partial or complete destruction of the gland it is true, but to the benefit of the whole organism; thus it happens now and then that the whole of the symptoms of scrofulosis disappear after acute inflammation of the glands with abscess formation and removal of pus and caseous matter.

It will be readily understood, after all these statements, that it is hardly possible to fix a certain time for the duration of scrofulosis. It drags on for months and years, and in the tuberculous form even long after the arrival of puberty; but the non-tuberculous (the pyogenic) form, on the other hand, disappears, for the above-mentioned reasons, on arriving at the age of puberty.

SECTION V.

Prognosis.

THE prognosis of scrofulosis is dependent on its form, its duration, and the social position of the patient, as well as certain external conditions. On the whole, children at the breast are, with respect to scrofulosis, more favourably situated prognostically than those only partly suckled, and much more so than those artificially nourished.

Pyogenic scrofulosis, in which there are no tubercle bacilli, admits of a favourable prognosis; *quoad vitam,* it may be termed mild. Certainly at times it is followed by phenomena which disturb the functions of the body or in other ways indirectly endanger life. For example, disfiguring ectropia are formed, corneal ulcers with considerable restriction of vision, even blindness, restriction of hearing, or breathing through the mouth owing to adenoid growths may cause severe infection of the respiratory passages.

But if such unfortunate consequences are not induced the scrofulous symptoms disappear spontaneously towards or after commencement of puberty, when, as it seems, the permeability of the tissues, and therefore the power of propagation of the bacteria is reduced, the body regains its strength, and the person may for the future enjoy excellent health.

In the tuberculous form of scrofulosis the patient feels himself in a manner on the down path of his existence. One cannot tell whether or when the standstill will come.

Tuberculous skin affections, lupus, &c., although they may be extensive and cause disfiguring disturbances, do not present, as a rule, *quoad vitam,* any great danger when there are no complications. The glands, when only one group is attacked, give hopes that the process may be localized. The more glands attacked, or when several groups are affected, the less is the prospect of recovery, and the more are dangerous complications threatened.

In the third stage, when the bones are reached, the prognosis must be grave. Even should improvement take place the patient still stands on a volcano, is not sure for one moment that a further dispersal of the bacilli will not take place which may perhaps destroy life.

Even if such a sad event should not occur, the long-continued suppuration may undermine the vitality, and lead to the end by amyloid degeneration.

On the other hand, even extensive multiple bone affections can often heal comparatively and only leave more or less considerable functional disturbances to remind the patient later of the troublous times through which he has passed. In tuberculosis of the joints we may reckon that 75 per cent. will heal.

The prognosis depends, too, on age.

With infants even tuberculosis of the bronchial glands runs a swift course, the child becomes thin, dyspnœa appears, and often suffocating symptoms and death ensue.

The older the patient becomes the more will the tuberculous scrofulosis be localized, and the further spread of the bacilli in the body hindered.

A favourable social position which allows of the arrangement of good hygienic conditions and the removal of the child from infectious surroundings decreases the danger of fresh infection and improves the prospect of cure, therefore the state of health of the family has considerable influence, for the more the child is in the companionship of tuberculous persons the greater the danger of constantly repeated infection.

In any case the tuberculous form of scrofulosis, tuberculosis of the glands, skin, and bones takes a milder course with better prospects of return to health than tuberculosis of the internal organs; for this, the so-called genuine typical tuberculosis, is rightly considered to be absolutely fatal in infancy, and during the whole of childhood as extremely unfavourable and much more dangerous than in adults (see Czerny).

Recently we have been much inclined to take a less serious view of tuberculosis in children; the under-current of error in this may be summed up in the sentence: "Our opinions of the prognosis of children's tuberculosis have improved since v. Pirquet's method was introduced"; that means, in other words, nothing more or less than that now we not only include all cases of (internal) tuberculosis which are clinically certain, but also all the doubtful phenomena if they have only been guaranteed by v. Pirquet's reaction; amongst these there will clearly be many which react positively on account of a non-dangerous focus already

healed, a bovine focus, which then gives the harmless pleasure of reacting promptly to every treatment, so leading us to suppose that we may make the note "Standstill and improvement," and it is from such cases as this that Czerny says, "the cases in institutions are recruited, for it is frequently no tuberculosis at all."

If we take all the blank cartridges of tuberculous bovine infection as hitting the mark, naturally the proportion that strike the target in the ball cartridges of human infection is much reduced.

As opposed to the great mortality in the tuberculosis of childhood, we frequently meet with persons who clearly have suffered formerly from scrofulo-tuberculosis—it may be that their disfiguring scars betray it, or that at the time its nature was clearly demonstrated by the bacilli—persons who reach a great age in the enjoyment of perfect health.

Endeavours have been made to explain in various ways this mild course of scrofulo-tuberculosis.

Those authors who attribute to scrofulosis not only partial diathesis within anatomical limits, but a general diathesis comprehending the whole body, will have most difficulty in finding a reason for this, for how will they be able to explain that the mild course, due from their point of view to scrofulous diathesis, suddenly turns to the opposite when the bacilli establish themselves outside the glands, for example, in the lungs? How will they be able to explain that, for instance, in children suffering from pulmonary tuberculosis, scrofulous phenomena suddenly make their appearance with benign glandular course, whilst the pulmonary tuberculosis is hastening the end? Where is the protective, general scrofulous disposition which leads to a benign course?

Moro and others consider the reason of the mildness to be in the irritability of lymphatic tissue which is disposed to scrofulosis, in the violent reaction, which they look upon as an act of self-defence by which the bacilli are hindered in their action. A healthily reactive tissue is without doubt a means of defence, but who will make us believe that this unhealthy, excessive, plentiful lymphatic exudative reaction can be compared with the healthy, strong, normal reaction, and that its effects are of equal value? I have made the comparison in another place that the effect of scrofulous reaction can just as little be placed on the same plane as healthy reaction, as the spongy, limp granulation in a healing wound can be compared with healthy, strong granulation.

Added to all this comes Czerny's assurance that he has put an end to exudative diathesis in the scrofulous (that is to say,

what Moro's "act of self-defence" effects) by his dieting methods, and through them has changed the former scrofulous children "into fine children with tuberculosis." Even if we do not need to take this literally, it appears at least that the improvement in the exudative part of the scrofulosis did not lead to an aggravation of the tuberculosis, and did not change it into the "dreaded" genuine tuberculosis, yet this must have happened if Moro's theory was correct. Thus the theory of Moro does not advance our knowledge.

The difference in the course and prognosis may be rather explained by the difference of localization by contrasting the harmless scrofulosis of the glands with the harmful tuberculosis of the internal organs in childhood; at least here we have a basis of facts.

It is all the same if we seek the cause in the anatomical peculiarities of the surrounding encysted glands, with their small inlets and outlets in opposition to a focus surrounded in its whole periphery by lymph paths and lymph spaces, for example, in the lungs or spleen, by which a dispersal of the processes is favoured from the first, or if we lay the principal stress on the retarding influence of the retained toxins and lymphocytes (mentioned on p. 128), or with Bartel impute to the gland tissue a special quality of checking development and perhaps of immunizing, the fact that the lymph glands advance the tuberculous process less than other organs is hardly to be contested.

In a lesser degree and with a somewhat modified explanation this agrees too for skin and bone. Much is explained by this. But is this the only reason why scrofulo-tuberculosis takes a milder course?

Why does the tuberculous infection remain localized in the glands nearest to the point of entry in only a part of the cases, in the neck, mesenteric and bronchial glands, and frequently "heal spontaneously even under unfavourable circumstances" (Czerny) while in other cases it advances?

Perhaps animal medicine and experiment will give us information. Let us go into the cowsheds of the Imperial Health Bureau.

Why in one of the calves does the tuberculous infection remain localized in the nearest neck gland, the prescapular gland? Why does it induce here a tumour as large as a hen's or goose's egg, as in scrofulosis which retrogrades spontaneously, with or without opening after some months? Why do these calves remain healthy later, whilst other calves get the same glandular processes, which become worse and lead to the death of the animal? Is it

perhaps because the calves are differently disposed and one has exudative tendencies? No. Because they are differently infected, the latter with the bovine bacillus, that of his own species; the others with a foreign species, the human bacillus.

Now we know inversely that the bovine bacillus in man behaves itself similarly to the human bacillus in cattle. We find that, in spite of the numerous opportunities for infection with milk, butter, and cheese from tuberculous animals, that the bovine bacillus is hardly ever present in adults; in children in cases running a severe course it is rarely the cause. On the other hand, in neck glands which necessitate operation we find them in about one-third of the cases, and in minor glandular changes which have hitherto been but little examined we might in all probability find them much oftener.

Koch terms the cases in which the bovine bacillus is said to have caused general and fatal tuberculosis in man as not "free from doubt." Certain doubts seem indeed to be justified, but even if we do not share Koch's point of view, nor completely acknowledge the fatally ending cases in which bovine bacilli were (also?) found, it is clearly a very small number of strains which lead to such an issue in man or in children.

But what is remarkable is the fact that in tuberculosis of bones and joints, which is also frequently noticeable for the benign course it takes, hitherto bovine bacilli have rarely been found, for if these affections had arisen from scrofulous neck and mesenteric glands, the bovine bacilli might be expected to be met with more often. Certainly Krompecher and Zimmermann formerly stated that the chronic course of tuberculosis of the bones did not depend upon the virulence of the bacilli.

It would lead us too far to discuss here the extent to which special conditions, such as infection from the perhaps rarer bovine tuberculous bronchial glands or change in the hitherto little examined material from tuberculosis of the bones (greater age, &c., &c.), and other factors play a part.

For a number of cases, about one-third, it is our fixed opinion, though the researches have really only just begun, that a considerable part of scrofulosis is induced by the bovine bacillus, and that, being a bacillus of a foreign species, is the cause of the milder course.

For the future, in any special case to make the prognosis as sure as possible on all sides, we ought not to fail to find out with which bacillus we are dealing.

For the further question, which is very important for the prognosis, is, how far the primary tuberculous infection in

scrofulosis, whether it be human or bovine species, can influence the later fate of the patient if a fresh tuberculous infection should take place, some authors have endeavoured to bring to light some theories which appear to me to be very far fetched, without for the present being able to support them by proved facts.

We will give a few theories without stating any opinion about them. v. Behring has stated that a tuberculous infection which has been contracted in childhood and later arrested, explains, on the one hand, the proportionately great immunity of most adults to tuberculosis; on the other hand, it explains also the decidedly chronic course which, as a rule, tuberculosis takes in adults. The expected proofs of this theory have not been brought forward.

Other authors lean to the point of view that the first infection chiefly renders the patient more or less immune, but with general individual tendency a scrofulous diathesis arises, so that the first infection is no longer able to protect from the second (Edens).

Hamburger terms tuberculosis a child's disease which nearly every one takes, and which lends a certain immunity to infection.

Hutinel and Lereboullet suppose an early infection of the mediastinal and mesenteric glands. The first infection remains latent, and may either almost immunize or, on the contrary, render the patient more susceptible; the disease becomes manifest in connection with other illness or renewed tuberculous infection. Older children, because they are not affected so frequently as infants, are said to enjoy a certain immunity.

Weber is inclined to believe that a body already infected by human bacilli is more capable of withstanding bovine infection instead of being more susceptible. He bases his theory on the case of two children who were infected by the human bacillus, and who, in spite of drinking milk from a cow with tuberculosis of the udder, on *post-mortem* examination exhibited no lesions of bovine bacilli. But many other children, not the subjects of human tuberculosis, who drink bovine tuberculous milk also do not exhibit bovine bacilli; thus there is no visible foundation for the belief of greater power of resistance in Weber's children.

Burckhardt, on the other hand, relies on experiments on rabbits to confirm whether the incorporation of human bacilli at an early age, when they have not yet induced immunity from bovine tuberculosis, does not favour spontaneous infection with bovine bacilli, or does not cause an already existing infection to burst forth.

The facts that scrofulous persons frequently by taking a second infection are subject to pulmonary tuberculosis, when both diseases appear to merge into each other, that the scrofulous

frequently recover, and yet sooner or later suffer from pulmonary tuberculosis, and again, others often remain healthy throughout their whole life, that both types of bacteria, bovine and human, are very often found living apparently peacefully side by side, and yet working at the destruction of the body, cause us to pause with all these hypotheses before us, for up till now no support which can be accepted, to say nothing of no exact proofs, have been adduced; after all, they are chiefly mere variations of v. Behring's views. It is true the questions of the researches into immunity are combined with great difficulties, for the behaviour of the animal which has been infected with a quantity of weakened or otherwise changed bacilli in the attempt to immunize it affords us no certain conclusion about the conditions which man would show under natural circumstances after infection with a few bacilli.

We have seen, for example, how far we have succeeded with the stamping out of tuberculosis in cattle which years ago promising experiments led us to believe would be achieved, and how short a time the immunizing power remains. In this question we have erred too far from the path of exact research and have fallen into the channels of speculation.

SECTION VI.

Diagnosis.

The decision whether, in certain cases, we have really to do with scrofulosis is not always easy, in spite of often striking symptoms in the beginning. Many processes manifest themselves as tuberculous from the first; most of the symptoms, however, especially those of pyogenous scrofulosis, may appear alone without scrofulosis.

A.—THE PYOGENOUS FORM.

Owing to our hitherto imperfect statistics (see p. 155), we cannot judge how far being descended from parents who at the time of generation were scrofulous or otherwise weakened, influences the transmission of a local or general diathesis, and how far this influence may be diagnostically utilized in the history of the case.

Further processes, such as mapped tongue, milk-scurvy, seborrhœa strofulus may raise the suspicion of scrofulosis, but we must be careful not to be too generous in our conception of scrofulosis, and put down to it every rash and every swollen gland in children.

Nearly all the symptoms which pyogenous scrofulosis presents—eczema, impetigo, chronic rhinitis, ozæna, adenoid growths, otorrhœa, chronic swelling of the lymph glands—are not of themselves characteristic, and appear singly in non-scrofulous persons who are otherwise healthy. But yet they exhibit peculiarities in their course in scrofulous persons which are missed in the healthy, though these peculiarities are only slow in their process, as is always the case in the scrofulous disposition, but which appear to be, as we have already explained, only a higher degree of anatomical characteristics peculiar to childhood.

The differences in the course are the following: those processes have more opportunity of establishing themselves on

account of the more open and wider points of entry, therefore are extraordinarily apt to relapse (recurrence), and similar processes appear simultaneously or following each other (multiplicity), further, owing to the wider lymph passages they can more easily spread, and are more difficult to remove (pertinacity), and can especially invade the lymph glands.

It is only these special signs which justify the conclusion that a focus is due to scrofulosis, and especially the multiplicity of places not directly dependent on each other or at short intervals is of great importance. On the other hand, otorrhœa may depend on eczema of the auricle, nasal catarrh on adenoid growths, without on this account imputing them to scrofulosis.

In this connection the remains of former similar processes may be valuable in diagnosis, for example, ulcers on the cornea, perforation and scars on the membrana tympani, high, narrow, boat-shaped palate with irregular teeth, scars about the glands in the neck, as well as certain consequent symptoms, which are often described in the picture of the scrofulous habitus, the thick puffy nose, the swollen upper lip, with a perpendicular crack in the middle.

Eczema appears in quite healthy persons, is induced by pediculi, for instance, or other causes, but in the scrofulous it is especially frequent and obstinate. But this must not be mistaken for eczema seborrhoicum, which is caused merely by an accumulation of sebaceous matter. We must also keep impetigo contagiosa (pseudo scrofulosis of Chaumier) with its decidedly contagious character distinct.

Many forms of lichen scrofulosorum belong to pyogenous scrofulosis, if they have not a tuberculous basis and growths like tuberculides.

The same may be said of chronic rhinitis which may have been induced by foreign bodies artificially introduced or other causes; this may be of long duration even in healthy persons, but is seldom permanent as in scrofulosis.

Pins lays special weight on the continued and regular swelling of the nose, and a certain sensitiveness to pressure as a sign of scrofulous rhinitis.

Ozæna, whether it is consequent on chronic rhinitis, or is directly induced by certain bacteria, is more frequent in scrofulosis, and in children justifies suspicion of scrofulosis, otorrhœa also when it is of inordinately long duration, and is combined with eczema of the auricle and swelling of the cervical glands.

Swelling of the tonsils, and especially adenoid growths, may in their later symptoms easily assume the semblance of tubercu-

losis, but their speedy disappearance and the lack of all these symptoms after rational treatment and operative removal is against scrofulosis.

I have referred above (see p. 198) to the greenish-brown colouring of the teeth noted by Neumann.

The marked dislike to light in phlyctenular and other affections of the eyes has also been said to be a sign of scrofulosis.

Skin affections in the tributary area of the glands are especially valuable as an indication of the nature of the glandular swelling. (See Topography, p. 130.)

One or two swollen glands in the neck or elsewhere is no sign of scrofulosis. Acute glandular swellings are naturally exempt from such significance as being caused by some infectious irritation near the seat of the swelling; they disappear in a few days or pass off with inflammation, fever, rapid breaking down, and suppuration. There are also a great number of chronic swellings which have nothing to do with scrofulosis, they are more painful, disappear more easily, especially when the exciting cause in the source of the disease is healed.

B.—THE TUBERCULOUS FORM.

(1) Clinical Diagnosis.

The history may give important data for the diagnosis of the tuberculous form. The so-called heredity, that is to say, the existence of the disease in the family, is most significant in tuberculo-scrofulosis, certainly not in the sense used in former times and often also in the present day as indicating that the child was predestined to it, but on account of the opportunities of contagion arising out of it.

The state of health of the parents at the time of the procreation and birth of the child would give us important information for the diagnosis, if only we could accustom ourselves not to dismiss everything with the watchword heredity (see Hereditary Influences, p. 154).

We have not only to notice from the one point of view the state of health of the parents, but also that of the persons with whom the child comes most into contact (relations, servants, playmates), and must in this connection direct our attention to the mode and intensity of the spread of the infectious material. Besides which, we must confirm how far social conditions, certain diseases, measles, &c., or other favouring factors make the diagnosis probable.

Tuberculous scrofulosis exhibits principally a multiplicity of

phenomena in the internal organs of the body and a great pertinacity, the pyogenous form a multiplicity on the surface of the body and frequent recurrence.

The diagnosis of the tuberculous form can be further supported by the demonstration of specific skin diseases—lupus, scrofuloderma, lichen scrofulosorum—the external phenomena of which we described above, whilst for the differential diagnostic signs we must refer to the special section of the work on Skin Diseases.

We must especially refer to lupus of the mucous membrane of the nose in the vestibule of the nose in the anterior angle as one of the most frequent starting-points of lupus of the face, which, on account of its hidden position and its benign course, is frequently overlooked or put down to eczema (Gerber and Senator).

The demonstration of tuberculides, of lichen scrofulosorum, of erythema nodosum, of folliculitis has doubtless high diagnostic significance for scrofulous tuberculosis, as was most emphatically noted by Boeck many years ago.

In tuberculosis of infants there were, according to L. F. Meyer, tuberculides in 50 per cent.; Leopold and Rosentern found the tuberculides described by Hamburger twelve times in thirty cases. But we are not justified in considering these lesions offhand as a sign of general tuberculous infection, for they may arise as the result of a toxin, and especially by dead bacilli of both types, human and bovine.

Now and again tuberculides may be mistaken for syphilitic exanthemata, and the diagnosis can only be confirmed by Wassermann's reaction; the refractory character of antisyphilitic treatment and the local tuberculin reaction establish the diagnosis (Königstein).

A case of Sergent shows what difficulties now and then present themselves in diagnosis. A woman who was declared to be tuberculous seven years after her marriage, and who had a series of skin, gland, bone and joint affections, turned out to be syphilitic, and was cured by antisyphilitic treatment.

The rest of the symptoms in the skin, eczema, impetigo—and in the mucous membranes, catarrh, ozæna, rhinitis, phlyctenæ—owe their origin perhaps to the same scrofulous tendency, but are not connected directly with tuberculous affections. If bacilli are present, as in some cases of eczema, ozæna, and adenoid growths has been demonstrated (see pp. 11, 12 and 141), they denote a second infection; the proof of this is important in so far as they also confirm the character of the accompanying glandular swelling.

Otorrhœa, too, need not depend on tuberculosis, although it often owes its origin to it. This is shown by the presence of tubercle bacilli in the secretion of the ear, and pointed to by its insidious painless occurrence, and especially by the accompanying caries of the petrosal bone. Also the (generally caseated) glands of the mastoid are in the pyogenic form not so frequently met with.

Tuberculosis of the Glands.—The diagnosis is considerably more difficult when, as is so frequently the case, in the tuberculous form there are no specific symptoms at the point of entry, and we have only the swelling of the glands as guides, these having few signs which characterize them as specifically tuberculous.

The fewer the superficial affections, of course with the exception of specific lupus, the more probable is it that the swelling of the glands is of a tuberculous nature.

Thus we can understand the notion of older authors. Hufeland, for example, greeted the phenomena of scaly eruptions, discharging ears and eyes as favourable signs, considering them a diversion protecting from internal scrofulosis.

As long as the gland is closed the slow, painless course, which may remain stationary for months or years at the same stage of development, as well as the presence of large masses of glands or the absence of radiating hypertrophic scars as signs of processes (fistulæ) which have already healed, all point to tuberculosis.

The diagnosis is relatively easy in the case of the neck glands which have burst, where we can demonstrate tubercle bacilli microscopically in the pus, or by inoculation into animals which, on account of the small number of bacilli, is more reliable.

But without this confirmation a thinner fluid secretion mixed with caseous fragments, the unusually long standing, and the formation of fistulæ are in favour of tuberculosis, whilst thick yellow pus, acute course with prominent inflammatory symptoms, and a speedy scarring rather indicate a different origin.

Tuberculosis of the Bronchial Glands.—Demonstrable swellings of the bronchial glands depend most on tuberculosis, for if they swell from other causes—Geffrier, for example, has noted such cases—experience has proved that they seldom arrive at so great a size as to induce characteristic disturbances.

General symptoms for which no other reason can be demonstrated often point to scrofulosis of the bronchial and mediastinal glands. Such symptoms are loss of weight, loss of appetite, often dyspeptic derangements, easily becoming tired, and "feeling limp," especially in the morning. We are often seduced by a pale face to content ourselves with the diagnosis "anæmia,"

although the state of the blood gives no ground for this dictum. A correct record of the temperature generally suffices to show the real state of things. In this case (see "Die Tuberculose," second edition, p. 729) I must especially emphasize the fact that only by a record every two hours is it possible to confirm slight increases of temperature. I have seen numerous cases of pulmonary and glandular tuberculosis which, although accompanied by ambiguous general symptoms, escaped a certain diagnosis for months, only because the practitioners had been contented with taking the temperature two or three times daily, and were deceived by its being apparently normal, whilst on the first day by consistent record every two hours I confirmed an increase of temperature of 37·2° to 37·3° in the armpit, and of over 37·5° in the rectum, with occasional transitory slight feeling of chill, and by this means severe affection of lungs and glands was demonstrated. Many are still under the delusion that fever only begins over 37·7° (rectum), and thus miss the best time for rational treatment.

Avellis has found in children from 1 to 8 years of age an evening temperature of 38·2° in the rectum for months together without tonsillar enlargement or physical examination giving any clue. Suspicion of tuberculosis has kept children for months in bed "to no purpose." Avellis attributes the cause of local rise of temperature in the rectum to anaerobic bacteria, which increase the temperature locally, as the temperature of the armpit is 1° to 1·2° lower.

The bronchial and mediastinal glands point more clearly to infection. They cause a convulsive, reflex, rough, dry cough, coming on by fits and starts, lasting a short time, but frequently recurring, resembling whooping cough, though less seldom accompanied by vomiting and wheezing.

The attacks resembling pertussis, which frequently occur after swelling of the bronchial glands, come on, as J. Simon notes, more in the morning and evening or after exertion, and are less frequent at night. The cough shows great variations in intensity. In whooping cough, on the contrary, the attacks are more rhythmic, the expiration forced and jerky, the inspiration gasping or wheezy. This condition returns after every five or six attacks of coughing, and finishes with mucous expectoration. The attacks are especially frequent at night.

Other indications are hoarseness (chiefly posterior paresis, Breeke), even complete aphonia, now and then a wheezy voice, followed by frequent catarrh, which is favoured by the reduced reflex activity of the respiratory mucous membrane, in consequence of compression of the sensitive branches of the vagus. Hyper-

plasia of the pharyngeal vault, swelling of the neck glands and other scrofulous phenomena, palpitation, quickening of the pulse, and variation of the pulse, now and then enlargement of the pupil on the affected side, which for the same reason can also be mentioned as an early symptom of pulmonary tuberculosis (Wolfer and others). Enlargement of the pupil may be artificially induced, according to Grover in mediastinal tumours, if it did not exist before, by pressure after deep inspiration, whilst in healthy persons the pupil would diminish.

Further signs are œdema of one side of the face (O. Müller), enlargement of the veins on one side of the neck, at the upper part of the chest, at the back of the neck, often only small stellate radiations, rarely enlargement of the temporal vein of the same side (Siracoff), sometimes bluish colouring of the face and lips, nose bleeding similar to what is seen in persons suffering from heart disease; later, increased frequency of breathing, asthmatic attacks, dysphagia, and sometimes enlargement of the spleen.

A child aged $1\frac{3}{4}$ exhibited purely expiratory dyspnœa under the guise of asthma, accompanied by fever. It became thin, and gave a positive tuberculin reaction; other signs such as Röntgen shadows were wanting; the *post-mortem* examination showed compression of the trachea in the form of a slit due to tuberculous bronchial glands (Eckert).

A feeling of pressure over the sternum, or painful sensitiveness to pressure and tapping on the sternum, or between the shoulder-blades and on the vertebral column, especially on the spinal processes of the second to seventh dorsal vertebræ (Neisser, of Stettin, and Petruschky) are frequent characteristics. This spinalgesia was found in 13 per cent. of school children in Dantzig.

In infants at first nasal snuffling is exhibited, and later expiratory gurgling, with a hissing noise due to compression of the chief bronchus with expiratory dyspnœa, especially when crying or coughing, which, according to Schick and Sluka when combined with positive reaction and the Röntgen signs, is sufficient to establish a certain diagnosis (see Escherich, Variot and Finkelstein).

Physical examination is of great importance. Over the apices of the lungs, on the right, in front and behind, prolonged exaggerated expiration is found, which posteriorly and in the right suprascapular fossa often shows a decided bronchial character, and from the second to fifth dorsal vertebræ (at the place where there is usually vesicular breathing) a loud blowing sound, often even amphoric, is audible. It is best to let the children

breathe with closed mouth during auscultation in order not to be deceived by their gasping.

H. Neumann has especially remarked the great value of this abnormal breath sound at the apex of the lung in enabling us to differentiate it from phthisis of the lungs, in which it is not present, and which is not accompanied by diminished resonance nor by râles, although this abnormal breathing at the apex has frequently given rise to an erroneous impression of pulmonary phthisis, on account of which children are "taken into institutions, treated and cured."

Steiner and Neureuther, Widerhofer and others have also emphasized the importance of this, and Widerhofer especially, when it is met with on the left side. I can concur in this from my own experience. But Henoch, Gerhardt and Bacinsky do not attach much importance to it.

Below the clavicle and at the back in the central and lower parts breathing and fremitus are weakened by pressure on the chief bronchus. When the mediastinal glands are affected we hear a dulness in front, above and near the sternum irregularly in the first and second intercostal spaces, over the parasternal line on one or both sides, not extending very far, and getting less marked lower down.

In the back a dulness is often perceived on the right and left, near the vertebral column, between the spine and angle of the scapula (Escherich and Kramer), and an interscapular weakening of the breath sounds, also a loss of vocal fremitus, or there may be abnormal resonance in many places (Allan). The weakening over the sternum and on both sides of the vertebral column may perhaps be caused by a thymus gland, or struma retrosternalis; it may lead to mistakes, especially in the first two years of life, till the thymus has atrophied. Besides all this, slight differences of sound may be caused by scoliosis, even when of moderate extent.

Percussion of the vertebral column is very important, a point emphasized by de la Camp. In the group of glands lying at the bifurcation of the trachea a noticeable relative deadening and an increased feeling of resistance on the fifth and sixth spinal processes of the dorsal vertebræ is remarked, and can be best heard in a sitting posture, when the trunk leans slightly forward and the shoulders are kept loose (see also Piorry, Fr. v. Koranyi, de la Camp, Nagel, Michalowicz, Finkelstein, Cozzolino, and others).

As an early symptom d'Espine has mentioned bronchophony in the region of the seventh cervical and first dorsal vertebræ, which, when it lasts in an unchanged condition for several months,

leads us to conclude the tuberculous nature of the glandular swelling.

The phenomenon observed by Eustace Smith is a very valuable means of assistance, namely, a systolic murmur, or a continued humming above the manubrium sterni, which is perceived when the head is thrown far back, and is caused by the pressure of the groups of glands on the veins in the chest (Neumann, Shaw, and Laird).

Neisser's palpation with the sound may also render service in diagnosis. He made the bronchial glands which lie on the œsophagus accessible by introducing into patients who had taken no food for some hours before, to the depth of about 30 cm., a thin soft sound which was armed with an india-rubber teat, and which was tightly bound above and below the fenestrum; by injecting air with an ear syringe a small bladder filled with air is raised at the fenestrum of the sound; by withdrawing the probe and by repeatedly inflating the whole region can be palpated. In forty-eight cases which reacted to tuberculin, but were without other signs of tuberculosis, Neisser found that forty-two experienced pain, whilst amongst 250 healthy persons there was complete freedom from pain. But it is a remarkable fact that after one or two years and without any special treatment there was no further sign of tuberculosis, so we must admit the possibility that he had to do with cases of inactive foci.

Sometimes by means of tracheo-bronchoscopy the bulging of an enlarged gland lying near the trachea or bronchi may be recognized, its course may be followed, and its point of rupture afterwards established (Pollak and Erdely).

Chiari by bronchoscopy was led to suspect primary carcinoma of a chief bronchus, whilst the *post-mortem* showed a tuberculous tumour of the lymphatic glands which had traversed the bronchus.

The Röntgen rays have proved of great value in diagnosis in cases where, in spite of severe tuberculosis of the bronchial glands, clinical symptoms were absent, for instance, in a case of Variot, Heisler and Schall, and others; frequently the shadow is demonstrated lying sharply defined on both sides of the hilum. The condition revealed by the radioscope is especially valuable as an early sign (Barret relates 1,000 instances); it is very dependent on the condition of the gland; normal glands cannot be recognized, the softened gland occasionally, and the caseated or calcified gland, as a rule, throws a very sharply defined shadow, but practice is necessary, together with experience and cautious judgment, to avoid false conclusions. The glands lying near the hilum and the

intra-pulmonary glands can be observed by posterior Röntgen examination, though often still better by anterior examination, and on the right side better than on the left; the other glands, hidden by the shadow of the sternum and vertebral column, can best be seen by lateral and oblique direction of the rays. Examination by the photographic plate is preferable to examination by the screen. A negative result in examination by the rays is, as we can understand by what has already been said, not a proof that swelling or tuberculosis of the bronchial glands does not exist (see Barret, Escherich, Köhler, Josserand and Roux, Cozzolino, Nagel, Pierry and Jacques, Allan, Feer, Pfaundler and Laureati).

The lateral thoracic lymphatic glands, those which lie in the fourth and fifth intercostal spaces, between the anterior and posterior axillary line, and which communicate with the intra-thoracic glands, also merit consideration. At times they swell visibly and palpably, especially in infants, but also in adults (Zebrowski) when inflammatory processes arise in the lungs and bronchial glands, and especially in tuberculosis, sometimes also in syphilis (Hochsinger).

I will also mention that Noegerath and Salle, in a number of cases of bronchial gland and pulmonary tuberculosis, demonstrated the presence of Head's zone of sensibility, which proves itself of value in diagnosis.

For further particulars of tuberculosis of the bronchial glands see Breeke, Finkelstein, French, Guinon, Hecker, Michalowicz, O. Müller, Nagel, Pierry and Jacques, Schick, Sluka, Stoll, Thiemann, and Zumsteeg.

The mistaking for other sorts of degenerated glands or mediastinal tumours may be avoided by taking the whole of the symptoms into consideration. The demonstration of simultaneous swollen mesenteric glands (see p. 208) affords the best support for the acceptance of a tuberculous character. For the differential diagnosis, see also end of the chapter.

The mesenteric glands frequently run their course without pressure symptoms or functional disturbances. Their presence is indicated, therefore, for a long period only by general symptoms and increase of temperature (temperature should be taken every two hours, see above). In other cases an extension of the abdominal venous plexus, and long-continued, and at times spasmodic, pains in the abdomen occur; sometimes also there are cramp-like pains in the thigh, the abdomen becomes round and prominent, and rises to a point at the navel, together with obstinate diarrhœa. The mesenteric glands become palpable only when they have attained a certain size. But even then they often

escape observation, being covered by the intestines and abdominal wall, or when the abdomen is soft they may at times be demonstrated, or be accidentally discovered as movable tumours, though sometimes fixed and at times very sensitive to touch, especially in the region of the navel.

They may be easily differentiated from the scybala resulting from obstinate constipation and which lie more in the iliac region by a laxative which causes them to disappear. A differentiation from peritonitis, stenosis, or a kink of the intestine must be taken into consideration. Katzenstein found in an operation a group of tuberculous glands on the vena cava which at first had appeared to be a tumour in the stomach. Often a chronic swelling of the spleen can be demonstrated (see also Hecker and Trumpf, Hecht, Tlantenga and Thilmann).

Should the tuberculous form of scrofulosis have already reached the third stage fungous bone and joint affections are present, and there will be less doubt as to the nature of the case.

At first these affections of the bony skeleton may give rise to many errors in diagnosis. Pain in the knee, which often long precedes coxitis, easily misleads, especially when the first stage in the region of the joint has been overlooked, and when the second stage, that of the glands, has remained latent. The peculiar position when attempting to raise an object from the ground, lancinating pains in the legs and the above-mentioned signs (see p. 210) point to a spondylitis.

In addition the Röntgen rays afford us extremely valuable information as to the nature and extent of bone affections.

Garrod recommends auscultation of the large joints during slight stretching and flexion movements, in order to help to form an early diagnosis between tuberculosis and rheumatism by the sounds heard. An early symptom in bone and joint tuberculosis is regional plastic œdema of the skin over or very near to the tuberculous lesion, supposed to be due to congestion or toxic effects (Werndorff).

It is not the place here to go into the differential diagnosis of fungous and other affections in bones and joints, and I refer my readers to surgical handbooks.

One is more easily deceived when apparently healthy individuals are attacked, in whom, according to former notions, tuberculosis would never have been suspected from their appearance and family history. But usually the general health has suffered considerably owing to the long existence of the affection of the glands (whether it had been latent or manifest) preceding the evidence of tuberculosis without being able to find any other

explanation of this loss of health. Paleness, loss of weight, or insufficient increase of weight and functional disturbances point to severe derangement of the general organism. Especially—and we cannot emphasize this enough—the greatest attention must be paid to the temperature (see p. 238). We must never neglect, for even one day, to know the exact state of the temperature of the body by taking it every two hours (see Cornet, "Die Tuberculose," second edition, p. 729).

Clinical Differential Diagnosis.

Scrofulous lymphomata differ from other sorts of lymphomata in the following manner: they grow gradually to large tumours and in their later course merge into each other by periadenitic irritation, and cannot then be differentiated by palpation from a mass of single glands. According to their successive production and their different characters they exhibit in places variable resistance, either becoming hard, or soft and fluctuating. In the places which have softened and are nearly breaking the skin is especially adherent.

Leucæmic lymphomata form tumours which are sometimes the size of the fist; they begin in the neck and often involve the whole of the lymph glands of the body; as a rule the skin is not adherent, even when the tumours reach the size of a child's head it will still form a fold. Errors in diagnosis may be prevented by examination of the blood, which exhibits a very great increase of leucocytes.

In the pseudoleucæmic form we see enormously enlarged groups of glands in large non-adherent masses, which are often simultaneously affected, are easily movable and show no inclination to degeneration. They offer a uniform resistance to the finger on palpation. An increase of mononuclear leucocytes with the normal total of leucocytes points to pseudoleucæmia, an increase of polynuclears to tuberculosis (de Renzi). Now and then we see a combination of pseudoleucæmia with tuberculosis of the lymph glands, as shown by the cases of Askanazy, Waetzoldt, Weishaupt, Cordua and Müller. (See also Falkenheim, Sternberg, Graetz, Kirchner, Lichtenstein, Hoffmann, Zuppinger and others.)

v. Bergmann mentions the possibility of mistaking scrofulous neck glands for atheromatous cysts, but the fact that the latter do not appear in childhood, and that if they appear on the cheek they grow closely into the skin without leaving a trace of inflammation, prevents this error. We need hardly take into consideration mistaking a branchial cyst, which invariably lies between the

mastoid process and the hyoid bone, and which arches the lower part of the mouth and is never connected with skin; or a partial hypertrophy of the hyoid gland; the latter is easily recognized by its rising and falling with the movements of swallowing (v. Bergmann).

For the distinction of scrofulosis from syphilis, the history, the favourite sites for its appearance, the special signs of one or other disease and the Wassermann reaction assist us in forming an opinion. Moreover, we must remember that often the two diseases co-exist.

(2) Bacteriological Diagnosis.

Proof of the Tubercle Bacillus.—Whenever it is possible an exact diagnosis should be based on the demonstration of the tubercle bacillus either by the usual Ziehl-Neelson staining process or by inoculation into guinea-pigs (see Cornet, "Die Tuberculose," second edition, p. 715).

The introduction of antiformin by Uhlenhuth in examination for tubercle bacilli was of great importance in the practical diagnosis of tuberculosis.

Antiformin, a mixture of eau de Javelle (liq. sod. hypochlor.) with a free alkali (1 litre for 50 pfennigs—Osk. Kuhn, Berlin, Dirksenstrasse) was at first only used in breweries for cleaning the pipes, on account of its property of dissolving mucilage, but was shown by Uhlenhuth and Xylander to have the quality of disintegrating (in a solution of 2 to 5 per cent.) most bacteria, the bacilli of cholera and typhus, staphylococci and streptococci with very few exceptions (such as anthrax spores) in at least 2½ to 5 minutes, and in watery solutions to kill them after some minutes, also to dissolve mucus, hair, silk, and horny substances without leaving a trace behind. Wax and wool are not dissolved by it nor tubercle bacilli, and the acid-fast bacilli are refractory with concentrated solutions; even in a solution of 15 to 20 per cent. their vitality is not perceptibly altered.

Thus a means was discovered of freeing sputum and other tuberculous material, parts of organs and fæces from the so-called accompanying bacteria and of rendering them suitable for microscopic examination or experiments on guinea-pigs and for the especially difficult cultivation of bacilli from sputum (Uhlenhuth and Xylander).

Twenty to thirty c.c. sputum and 15 c.c. pure antiformin are made up to 100 c.c., so that a 15 per cent. antiformin sputum solution results; after two to five hours the tiny particles are picked out or centrifugalized and thoroughly washed in a solution

of sterilized physiological salt solution and the little flakes inoculated into glycerine serum or examined as they are (Uhlenhuth and Kersten).

Or sputum is mixed with the same volume of water, antiformin is then added, so that a 25 per cent. solution of sputum water and antiformin is obtained, and then it is well shaken to a froth. If the solution is of a brownish colour a small quantity of antiformin must be added until a slightly yellowish colour is obtained, it must then stand, and after four to five hours the adherent flakes must be removed by shaking, a smear of the sediment is examined, after an addition of sputum or albumin water (1 in 10) to make it more consistent (Görres). The process is more speedy at a high temperature—about 60° C. With a strong electric centrifuge the segregation can be considerably hastened.

Besides avoiding disturbances from other bacteria and from particles of tissue, the chief advantage of this method is, that by the use of antiformin large quantities of expectorated matter may be concentrated in a very small volume; for example, the quantity of sputum ejected in one day may be so concentrated as to lie on the cover-glass of a microscope slide.

The antiformin method has proved itself of value by numerous tests (Krüger, Hall, Münch, Hoffmann, Finkelstein, Frankenburger and others). As a source of error, Beitzke calls attention to the presence of acid-fast bacilli in the water from the main; Bren has found them in distilled water; Schern and Dold found, without exception, acid-fast and alkali-fast bacilli which could not be distinguished from tubercle bacilli in pipes through which water had run for a long time.

Haserodt combined the antiformin method with that introduced by Lange and Nitsche, viz., ligroin admixture, a method which has also proved of great value, especially when no good centrifuge is at hand (v. Scheven, Skutetzky, Herzfeld, and Münch); Bernhardt also mentions a similar antiformin-ligroin method.

The antiformin method modified by Lorenz, by boiling, is very simple and to the purpose; 2 to 10 c.c. sputum are shaken up with two or three times the quantity of 15 per cent. antiformin for five minutes, till it becomes a homogeneous mass, which is then boiled in a test-tube and centrifugalized for fifteen minutes, the whole proceeding taking twenty to thirty minutes.

The sediment forms fairly well, larger quantities of sputum are first treated by the older antiformin method. Löffler boils the sputum and antiformin mixture, and then agitates with chloro-

form-alcohol (10 grammes : 1·5 grammes chloroform-alcohol, 10/90). (See Fabrici, Hüne, Koslow, Schulte, Frank, Seemann, Silvestri, Weihrauch and others.)

A "double method" for the concentration of the tubercle bacillus, described by Ellermann and Erlandsen, is autodigestion of the sputum,* centrifugalizing, boiling with 0·25 per cent. sodium hydrate solution, and again centrifugalizing; this certainly is attended with good results, but it takes forty-eight hours, causes an offensive smell, and is too troublesome for practical use.

Other improved methods, *e.g.*, that of Zahn, using calcium chloride, recommended by Mende, in conjunction with antiformin, have been but little adopted.

Much's Granules.

Much made the assertion that in tuberculous tissue, especially when of bovine origin and in caseated glands, where it is often not possible, according to Ziehl, to demonstrate bacilli, a form of tubercle-virus is present which can be stained by Gram's method, which exhibits itself as blue-black granules, either isolated or in groups, or as granulated bacilli, which are virulent (Much's granular form).

Much distinguishes: (1) Acid-fast bacilli, which can be stained by Ziehl's method; (2) non-acid-fast bacilli; (3) granular form; the two latter can be stained by Gram's method.

Gram's method modified by Much is suitable for exhibiting them as follows:—

(1) A thin layer of the material laid on an object-glass is stained with methyl violet B.N. (10 c.c. of an alcoholic solution in 100 c.c. of a 2 per cent. aqueous solution of carbolic acid) either kept twenty-four or forty-eight hours at 37° or boiled over a flame.

(2) Place in a solution of potassium iodide one, five, or ten minutes (up to fifteen minutes according to Wirths).

(3) Wash with water.

(4) Place in 5 per cent. nitric acid solution for one minute.

(5) Place in 3 per cent. hydrochloric acid solution for ten seconds.

(6) Decolorize in a mixture of acetone and alcohol, equal parts, shaking continually.

(7) Thoroughly wash with water.

These researches were confirmed by Wirths, Weiss, Deycke,

* With half a volume of 0·6 per cent. sodium carbonate solution, at 37°, for 24 hours.

Wolff, Wehrli and Knoll, Boas and Ditlcosen (in a case of lupus) and others, and Ziehl's method was declared, apparently not without justification, to be insufficient, and in case of negative results a supplementary test by Much's method was recommended.

Opinions differ as to the nature of the granules. Much considers them to be a vegetable form, Wirths thinks they are the most virulent form of bacilli hitherto known, Schottmüller, Weiss, Fontes and others express the same opinion. Schulz considers them to be a resistant form derived from the noxious influence of immune bodies, which remain for years in the system, and with favourable opportunity may again produce tuberculosis. Here we see another opportunity of adopting the most far-reaching, speculative decisions upon latency, without any security for the foundation. Knoll looks upon them as spores, but Liebermeister will not accept this.

The probability is that we have to do with products of disintegration. v. Behring has also expressed this opinion by supposing them to be engendered bacteriologically. Geipel, too, accepts their degenerative nature.

Spengler claims that these granules of Much are identical with the "splinter" bacilli mentioned by him, as does also Fuchs-Wolfring, while Much, Wirths and Liebermeister contest this identity.

The appearance of such granules in tuberculosis has been known for some time (see Cornet, "Die Tuberculose," second edition, p. 24).

As other granules of bacilli as well as cocci stain in the same way by Gram's method, a conclusive proof of Much's granules is impossible in all cases where other bacteria cannot be completely excluded, as, for example, in the sputum. Therefore the claim that when granules are found this alone allows of a diagnosis of tuberculosis is all the more hazardous, because with the modified Gram's method (Schottmüller) unavoidable residue of staining material and such like may easily give rise to mistakes.

According to the most recent researches of Bittrolff and Momose, of the Kossel Institution, all these findings with the far-reaching conclusions (Schulz and others) come dangerously near to being upset, for according to them no different form is revealed by Much's method than by Ziehl's method, provided the effect of the staining material is continued for the same length of time (twenty-four hours). Further, when by Ziehl's method the result is negative nothing is to be discovered by Much's method, and the isolated granules which appear in a few cases always exhibit acid-fast constituents on restaining by Weiss's or Ziehl's method.

The method of Müller-Jochmann and Kolaczek to distinguish tuberculous pus from other pus on the serum plate or by Millon's reagent is not very applicable, on account of the frequent mixed infection in the pus of scrofulous glands.

Endeavours have been made to ensure the diagnosis of tuberculosis by opsonic determination, but, to say nothing of the troublesomeness of the method which at present excludes its application in practice, it appears that the results are not so clear that they can be considered valuable diagnostically. According to Helmholz, exudative children have a normal or increased opsonic index, lymphatic and scrofulous children a low index (see also Baecker and Laub, Noeggerath, Köhlisch, v. Torday and others).

The same may be said of agglutination tests, according to Arloing's or Koch's method.

Salge, in 82 children, amongst which were 71 infants, had positive serum reaction in 20 cases, and in a few instances this was anatomically confirmed, in others not. Schkarin found :—

(1) Positive agglutination in 6 out of 24 children with symptoms of exudative diathesis (25 per cent.).

(2) Positive serum reaction in 25 out of 41 children with scrofulosis (62·5 per cent.).

(3) Fifteen out of 19 cases of tuberculosis proved clinically with tuberculous bones, &c. (78·9 per cent.).

(4) Amongst 14 children without tuberculosis clinically 3 were positive (21 per cent.).

Noeggerath obtained agglutination much more rarely and considers Schkarin's findings to be due to faults in experiments (see Cornet, "Die Tuberculose," second edition, pp. 720-724, as well as the abundant literature on the subject, of which I will only mention a few works: Comby, Paganelli, Miglio, Brion, Ribas, Kinghorn and Terichell, Thomesco and Graçoski, Cozzolino, Greco, Calmette, Gescheit, Courmont, Ferré and Saliger).

For the present the fixation of the complement, the serum deficiency (owing to fatty covering of the bacilli), or Calmette's snake poison reaction, are not applicable for diagnosis.

The viscosity of the blood gives no consistent results in tuberculosis. According to Hess, this is more marked in scrofulo-tuberculosis. It is found to be highly valuable in miliary tuberculosis and in tuberculous bronchitis.

To hasten the result in inoculation subcutaneously in the region of the groins of guinea-pigs, Bloch has at the same time crushed the respective inguinal glands, which may be felt between the fingers in the fold of the groin, and was able after about ten to fourteen days to demonstrate a considerable quantity of

bacilli. Ivannovics and Kapsammer, Wolff-Eisner and others confirm this result (see also Arth and Weber). Schern and Dold by combining Bloch's method with the antiformin method have simplified and hastened the proof of their existence.

Tuberculin Diagnosis—Allergie Reaction.

The question of the tuberculous nature appeared to be in a few cases easily solved when v. Pirquet introduced his well-known cutaneous or allergie test, and Wolff-Eisner the conjunctival reaction in the diagnosis of tuberculosis. Both discoveries made a great sensation on account of their simple and easy mode of application, and hundreds of publications and thousands of tests followed, the results of which did not entirely fulfil the great hope which had been built on them, but still they threw important accidental lights on the question of tuberculosis and scrofulosis.

The significance of allergie reaction and the too great importance which has often been attached to it, and the erroneous conclusions which have been drawn from it respecting scrofulosis, make it necessary to go into it thoroughly.

v. Pirquet started with the premise that an organism which has gone through an infection changes its power of reaction to the same causative agent; this change, the so-called allergie reaction, is seen most clearly when the extract is inoculated into the skin.

Everyone who is capable of reaction responds to an infection by the formation of antibodies, the immune or, more properly, the over-sensitive person, who is or who has been under the influence of the same infection, reacts to a slighter irritation than the healthy person.

According to v. Pirquet and Wassermann the reaction itself is explained by the conjunction of the anti-materials formed in the body (reaction materials according to Wolff-Eisner) with the tuberculin which has been introduced (v. Pirquet and Wassermann). Up to this point the tissue cells are accustomed to create antibodies under the influence of infection; these are formed more rapidly and intensively from the action of the fresh infection, as the body, according to this, possesses a greater and to a certain degree a more educated power of resistance than in the beginning of the illness, and in advanced cases, by reason of successful combating, so the reaction will be the more powerful according to the more intensive formation of anti-materials; with the reduction of the power of resistance, the more the disease advances towards a fatal ending the more will the formation of

anti-material, the reaction, become weaker and at last disappear entirely.

In this sense slight reaction marks unfavourable cases as far as prognosis is concerned. The hypersensitiveness is analogous to that which occurs in animals into which a serum has been injected against injection of the same serum.

The hypersensitiveness is referred to the effect of lysin which sets free the bacteria which have been introduced, and makes them innocuous in small quantities under the phenomena of hypersensitive reaction, whilst with enlarged quantities poisoning takes place rapidly owing to the toxin becoming freed. According to this the non-tuberculous person does not react because he has no lysin which can set the poison free from the *débris* of the bacilli quickly enough (Wolff-Eisner and others). These hypersensitive reactions are not only found in the tuberculous, according to v. Pirquet, but similarly, owing to the same toxin, also in leprosy, glanders, small-pox, &c. (Lemoire, Parturier and others).

When only later inoculations become positive we may suppose, according to v. Pirquet, that there were no antibodies (to tuberculosis), and that their formation was only demonstrated after repeated inoculations.

By repeated inoculation, antibodies and reaction may be induced even in healthy persons.

The observation that rubbing in tuberculin on one side of the body will sometimes produce redness on the other side, often exactly symmetrically, and that nodules will appear even in places far distant which had not come into contact with the tuberculin, leads us to suspect the co-operation of nervous influences.

Moro considers from this that the percutaneous tuberculin reaction is a vasomotor phenomenon depending on strong irritation of the vasodilator tracts, an angioneurotic inflammation, and refers to the intimate connection of tuberculosis with the nervous system, especially with the sympathetic nervous system (*e.g.*, neuritis, chronic rheumatism, hectic flushes, perspiration, nervous disturbance of the stomach and intestines, and disturbances of menstruation, &c.). But it would lead us too far to go further into these theories.

Method of the Proof of Allergie.

v. Pirquet's Cutaneous Method.—The inner side of the forearm is carefully cleansed with ether, then, at a distance of from 6 to 10 cm., place a drop of 25 per cent. old tuberculin (alt tuberculin Koch, and 5 per cent. carbol-glycerine, of each 1·0, and 0·8 per cent. physiological salt solution 2·0), then scarify

on the stretched skin between the two drops with a v. Pirquet's chisel-shaped inoculating needle or a fine lancet as a place of control, and in the drops themselves; finally a piece of wool is laid over, or the scarifications are simply left to dry.

In about five to twenty hours after inoculation, rarely later, bright red, nodular palpable papules of from 3 to 20 mm. in diameter appear in tuberculous persons, now and then streaks of red lines radiate from the place of inoculation. Round the papule there may be a red circle, and in the centre of the papule a small blister. The patient only experiences slight pain or itching, the reaction is apparently purely local; general reaction, fever, as well as focal reaction are as a rule absent, but are sometimes observed (v. Pirquet, Feer, and Bayewsky).

In a few rare cases phlyctenæ have appeared. The complete harmlessness of the method allows of its application even with fever. Reaction phenomena are sometimes delayed for five days (late reaction); after from five to ten days the papules disappear altogether.

v. Pirquet applies the term torpid to a reaction appearing late; now and then a positive reaction only takes place after a second test, which, according to Feer, should not be made before the eighth day at the earliest, and especially in cases in which there is no clinical evidence of tuberculosis, but it is only demonstrated *post-mortem* as a secondary condition.

The degree of the reaction is no guide to the extent of the tuberculous process, it is rather the reverse, proportionate to the multiplicity of the foci and the bacillary dissemination (Soltmann). For example, in the cutaneous test the greatest reaction is found in tuberculous skin lesions which are generally much greater than those observed in pulmonary tuberculosis and are especially weak in the atrophic skin of the cachectic (Pfaundler, Moro and Doganoff, Eppenheim, Bandler and Kreibich, Doutrelepont and Mainini). Pure undiluted tuberculin may be used with equal success.

By simultaneous application of various concentrations, from 1 to 50 per cent., Erlandsen and Ellermann sought to fix that concentration which would establish the limit which just gave demonstrable traces of reaction (tuberculin standard of the organism), the measure of the reactive power of the body. The cutaneous tests with 5 to 10 per cent. prove to be of equal value with the conjunctival test and injection; according to Götsche and Petersen the 1 per cent. solution in adults generally indicated only active tuberculosis, Mirauer considers the graduated method practicable, Lossen and Möller consider it uncertain.

Histological examination of excised papules shows nodular massing of epithelioid cells, partly surrounded by a zone of round cells, the typical giant cells of Langhans, and distended capillaries; the picture of typical tubercles without caseation, changes such as are caused by toxins and by material capable of diffusion given off by the tubercle bacilli (Zieler *v.* Wolff-Eisner, Bandler and Kreibich, Pick, Daels, Aronade and Falk).

Modification of v. Pirquet's Method.

Intimate contact with the uninjured skin by tuberculin or dead bacilli with friction suffices to cause cutaneous reaction (Lignières and Berger, Naegeli-Akerblom and Vernier) or pressure (Siegert and Barabaschi).

Ointment Reaction.—Moro (and Senger independently) produced reaction by friction with a tuberculin ointment on the uninjured skin.

Method of Using Moro's Ointment.—A portion of tuberculin ointment,* the size of a pea (tuberculin with equal part of anhydrous lanoline, the latter to be warmed to 20° to 30° before mixing) is rubbed for half to five minutes on the abdomen or chest over a place 5 cm. square, which is then left uncovered for ten minutes; a protective bandage is unnecessary; this method has the advantage of remarkable simplicity and of not attracting the attention of nervous patients; the ointment has the advantage of keeping for months in an ice-chest.

Moro has obtained a similar result with a loosely-adhering tuberculin plaster; Piesen recommends a 50 per cent. tuberculin-glycerine.

The ointment reaction declares itself either as:—

(1) Weak; after 24 to 28 hours (seldom later) 2 to 10 distinct reddened nodules appear of 1 to $2\frac{3}{4}$ mm. diameter, which disappear after a few days without itching.

(2) Medium; in the course of 24 hours many (up to a hundred or more) nodules, of 3 mm. diameter, spring up and remain for several days with slight itching.

(3) Severe; after a few hours 100 and more nodules appear of 5 to 8 mm. diameter with itching and exudation, and spread over the adjacent skin. After a few days the papular efflorescences dry up, scale off, and after a couple of weeks leave behind a brownish pigment.

On the site of reaction a typical lichen scrofulosorum has

* To be had in small tubes of 7 grammes for 20 reactions from the Crown Pharmacy, Munich.

several times appeared subsequently, at other times a transitory general exanthem or an erythema nodosum; but once long-standing lichen scrofulosorum disappeared leaving no trace.

Symmetrical reaction on the opposite side and disseminated distant reaction has been mentioned above (p. 251) (Moro and Bullinger); now and then, especially with the atrophic skin of older persons suspected of tuberculosis, positive reaction is only obtained after two severe frictions.

Further Modifications of Allergie Reaction

Buschke and Kuttner laid on the skin a cantharides plaster $\frac{1}{2}$ cm. square, and injected into the resulting blister 25 per cent. old tuberculin; the results, according to their statements, are more exact than by v. Pirquet's method.

Intradermic Reaction.—Moussu and Mantoux injected into the skin a drop of tuberculin solution 1 :5000 ($=\frac{1}{100}$mg.), and with children who did not react to this 1 :100. Most of the children exhibited redness and some infiltration after this, which reached its maximum about forty-eight hours later, and after a further forty-eight hours disappeared, whilst the true intradermic reaction only appears on the second day. This method is recommended by Mac de Lepinay, Bondi and others as rather preferable to the cutaneous test.

Römer employed it in animals which, on account of reduced skin absorption (?), were often insusceptible to the cutaneous test, and found the results equal in value to subcutaneous injection (Römer and Joseph, Kraus and Volk).

Tedeschi preferred the injection (of $\frac{1}{100}$ mg.) into the skin of the horizontal portion of the auricle. Monti objects to this auricular test because it induces deformity and swelling of the glands.

Streak Reaction.—Epstein and Escherich had already observed in the nineties that after tuberculin injections in the tuberculous a characteristic inflammation appeared at the site of injection. From this observation Reuschel and Hamburger recently further improved the method of streak reaction: 0·1 to 0·2 or even 1 mg. is injected into the upper arm, being doses which, two or three days after the cutaneous reaction, and before tuberculin sensibility is increased, can generally be borne without fever. As a reaction after twenty-four hours, not only the usual pink or livid circle is exhibited, but in tuberculous persons a circumscribed inflammation starting from the subcutaneous tissue, with œdema and pain on being touched, which continues four to five days. By

this method active foci are confirmed when the cutaneous test fails (see also Schick, Grüner and others).

The observation of Arvonade and Falk is worth mentioning. If not less than twelve hours after a v. Pirquet inoculation a tourniquet or a suction apparatus be placed on the inoculated arm, after a few minutes to a quarter of an hour small hæmorrhages occur on the reacting papules, and partly also in places which had not reacted before, but none appear on the site of control. Ointment and streak reactions (see below) behave in the same way. The hæmorrhages are valuable also in cases of doubtful reaction, and will appear six weeks after the inoculation.

Wolff-Eisner's Conjunctival (Ophthalmic) Reaction.—Immediately following on v. Pirquet's demonstration of his cutaneous test in the Berlin Medical Society, Wolff-Eisner communicated his conjunctival test. His method is as follows: A drop of sterile $\frac{1}{2}$ to 1 per cent. solution of old tuberculin (the best is "tuberculin for ophthalmic reaction Ruete-Enoch") is introduced into the inner angle of the eye whilst the patient looks up.

By drawing down the lower lid the solution is prevented from being forced out by the closing of the lids. The result takes place after twelve, twenty, or forty hours.

Following the example of Moro, Wolff-Eisner recommends a 1 to 2 per cent. tuberculin vaseline for the ophthalmic test instead of the fluid tuberculin.

Conjunctival reaction shows itself after three or four hours, sometimes only after fifteen hours, and even after twenty-four hours, by slight redness and injection of the under lid, with swelling of the lachrymal caruncle, and there is enlargement of the pupil which may also occur in non-reacting patients.

In more severe reaction swelling of the follicles and a flow of tears appear; the ocular conjunctiva and the sclerotic are also affected, or a fibrinous or suppurative secretion is seen, with œdema of the lid and ecchymosis; subjectively the reaction shows itself by the sensation of a foreign body or a slightly stretched feeling, heat in the eye, itching and pain.

A general reaction is only exceptionally observed (Andeoud, Schröder, Kaufmann).

When, with suspicion of tuberculosis, the conjunctival test gives a negative result, a repetition of the test twenty-four hours later (according to Wolff-Eisner), or four days (according to Erlandsen) should be undertaken with 2 per cent. tuberculin in the other eye, and at the same time supplemented by a cutaneous or streak test; this has then frequently led to positive results (Wolff-Eisner and Brandenstein, Eyre, Wedd and Hertz, Baldwin

and Lacke). The conjunctival reaction was first confirmed on tuberculous cattle by Vallée, but he warned against its use on man on account of the severe eye symptoms; it was then re-tested by Calmette, and therefore sometimes described wrongly as Calmette's reaction, then by Letulle, Dufour and Comby and Jean Lepine, and in Germany first re-tested by Citron, Eppenheim, Schenk and Seiffert, Kohn, Fr. Levy and others, whereupon a deluge of researches were made respecting the utility of the method.

Unfortunately, it is not so harmless as one might believe from Wolff-Eisner, Schenk and Seiffert, Clark, Umber and others. Corresponding with Vallée's experiments on animals after the eye test, severe and serious eye changes were soon observed in man also, which continued for months, and often resembled the phenomena which frequently appear in scrofulous persons. There occurred very severe keratitis (Barbier), corneal opacity, acute blennorrhœa, with chemosis (Plehn), eczematous conjunctivitis (Damask), formation of ulcers (Butler), permanent disturbance of vision (Polland), ten to twenty days later, superficial corneal ulceration (Lapersonne), (see also Pfaundler, Feer, Trousseau, Wiens and Günther, Eppenheim, Klieneberger, Buch, Boral, Seligmann, Schrumpf, Satterlee Woodcock, Siegenbeck van Heukelom, Collin, Danielopulo).

A repetition in the same eye (Eppenheim, Schenk and Seiffert and others) is to be avoided on account of increased irritative symptoms (Stadelmann, Klieneberger and Plehn) which occur even in healthy subjects, not to mention the unreliability, for if repeated within eight weeks (Goebel) we get positive results even with clinically unsuspected persons (78 per cent.) (Klieneberger, S. Cohn, F. Levy, Micheli, Bing, Goebel).

The severe injury may be due partly to the employment of stale, chemically changed solutions (Schenk, Steindorff, Fabian and Knopf) or too strong preparations, especially the Höchster preparation (Wiens and Günther, Krause and Hertel, Treupel, Citron and others), but also to Calmette's solution (Goerlich).

Still the fault of the injury to the eye does not lie in the preparation alone, as sometimes even with the employment of the innocuous 1 per cent. old tuberculin seriously severe reaction occurs (Collin and others), therefore the conjunctival test must be absolutely avoided, not only in tuberculous (scrofulous) eye diseases which may easily be intensified, but also in all other affections, even in simple irritative condition of the other eye (Adam, Citron, Eisen, Siegrist and others).

Reaction in other Mucous Membranes.—Lafitte, Dupont and

Moulinier have introduced a 1 per cent. Calmette's solution by means of wadding into the septum nasi and observed exudation. Pollaci induced reaction in the mucous membrane of the mouth, Oppenheim in the urethra. Winkler mentions skin reaction after electrolytic introduction of old tuberculin, and Salo observed fever amounting to 38·5° C. in tuberculous patients on internal administration of ·001 c.c. old tuberculin, whilst, according to Pfeiffer and Seyacker, the internal tuberculin preparations usually sold produce no fever even in large doses. Hell obtained similar results.

Results of Allergie Reaction.—After thousands of tests it has been confirmed that, as a rule, positive reaction takes place by the methods mentioned in cases clinically proved to be tuberculosis.

As all the methods based on allergie do not differ in principle, the hypotheses and results are the same for the one as the other, and the differences are more quantitative than qualitative.

The specific character of the reaction is contested by the statement that positive reaction also occurs in other diseases that form vaso-dilator toxins (see Arloing, Purjesz, Entz, Naegeli-Ackerblom and Vernier, Tezner and Schmidt-Nothmann), but even if the strictly specific character suffers a certain restriction, yet there is a difference between that apparent reaction and genuine tuberculin reaction, which hardly allows the specific nature of the latter to be contested.

A.—Clinical Tuberculosis.—v. Pirquet found conformity in 200 cases which were proved by *post-mortem*, 64 with positive reaction, and 109 with negative reaction. Amongst Feer's 344 cases, of 25 with clinical tuberculosis, 24 reacted positively; of 28 suspected cases 14 were positive; of 291 not suspected cases 27 (9 per cent.) were positive; of 112 infants, 3 were positive (confirmed by autopsy) (see Kreibich, Engel and Bauer, Schleisner, Goebel and Peschorner (769 cases) and others).

Positive reaction in tuberculosis is unanimously confirmed with but few exceptions.

Negative Reaction in Tuberculous Persons.—Negative reaction, in spite of demonstrated tuberculosis, is observed in very advanced cases, in miliary tuberculosis (Kietz, Goebel negative, Aronade and Falk positive), in persons who have shortly before undergone tuberculin treatment and have had a large quantity of tuberculin, in cachectic and carcinomatous patients (Rolly) when the power of resistance is paralysed, and antibodies are not formed in sufficient quantities.

The behaviour in measles is very important. One or two

days before the appearance of the exanthem of measles even tuberculous children lose the power of reacting for about a week, and that so regularly that positive reaction would point diagnostically against measles (Preisich, v. Pirquet and others). Susceptibility to tuberculin is, according to Gruner, reduced nearly 1,000 times, but is restored on a rapidly increasing scale at about the eighth day after the outbreak of the exanthem. It has been sought to prove in this phenomenon the defencelessness of a patient suffering from measles against the poison of tubercle bacilli, and an analogy to the reduction of vaccine streak reaction (Hamburger and Schey), a reduction of the "energy" of the body which, as a sort of antibody, brings about the reaction between tuberculin and the cells which, owing to the measles, is cut off (v. Pirquet).

Reaction frequently proves negative in the incubation stage of scarlet fever (Brandenberg). In forty-six scarlet fever patients only eight reacted positively in the exanthematous stage, but twenty-six of the negative cases gave positive results when convalescent.

On the other hand, reaction papules which have disappeared for weeks may again appear with an outbreak of the rash of scarlet fever or measles (Heim and John-Schick).

In thirty-three cases, in the fever stage of croupous pneumonia, fifteen showed a positive reaction, eighteen a negative reaction. But of the latter eleven when convalescent showed a positive reaction (Rolly).

In acute serous pleurisy Barbieri found the cutaneous reaction almost always negative.

The ointment and cutaneous reaction was also positive in a series of cases in which there was no suspicion of tuberculosis, but in which purpura, epilepsy, chorea, herpes, or hysteria were present. "Absolute reliability" (Germonig, of Trieste, and others) is not obtained by this method.

In typhus, in spite of there being no tuberculosis (as shown by autopsy), reaction is not rarely positive (Bourget, S. Cohn, Krokiewicz, Calmette, Fabian and Knopf, Nestor and Barbuneanu), and tuberculous patients react interchangeably to typhus and extract of *Bacillus coli communis* (Krauss, Lusenberger, and Russ), but the course of this reaction is much more speedy and violent than in the purely tuberculous (Cohn; see also Chantemesse, Blum and Schlippe).

In syphilitics who were free from tuberculosis, Nicolaus, Favre and Charlet generally found distinct positive reaction.

In acute articular rheumatism a positive reaction is found relatively often (Schenk and Seiffert, Cohn and Krokiewicz, in

50 per cent.); Fabian and Knopf, on the contrary, always found it negative.

B.—Clinical Suspects.—In persons who are suspected of tuberculosis the cutaneous reaction very frequently gives positive results, which have been confirmed by the later course of the disease or by *post-mortem* examination.

C.—Clinically Free from Tuberculosis.—Lastly, in those persons who, clinically, give no sign of tuberculosis, cutaneous reaction, as a rule, is wanting in infancy and early childhood; almost complete agreement exists between the reaction and the clinical findings or the *post-mortem* result.

Corresponding to the rarity of tuberculosis in the first six months of life, at this age in all tests reaction is rarely positive; with increase of age in the person examined, a positive reaction is observed with increasing frequency without any definite clinical causation.

Positive results[1] were obtained by :—

v. Pirquet in Vienna.

1 year	7 per cent.
1 to 2 years	24 ,,
2 to 4 ,, ...	37 ,,
4 to 6 ,, ...	53 ,,
6 to 9 ,, ...	57 ,,
10 to 14 ,, ...	68 ,,

Engel and Bauer in Düsseldorf.

3 to 4 years	16·5 per cent. positive v. Pirquet
5 to 6 ,, ...	16·6 ,,
7 to 8 ,, ...	30·2 ,,
9 to 10 ,, ...	49 ,,
11 to 12 ,, ...	35 ,,
13 to 14 ,, ...	53 ,,

Nothmann.

3 to 5 years	47 per cent. positive v. Pirquet
6 to 7 ,, ...	56 ,,
8 to 9 ,, ...	70·7 ,,
10 to 11 ,, ...	81 ,,
12 to 14 ,, ...	84·5 ,,

The supposition is, that in cases wherever clinical symptoms are lacking, and where the positive reaction did not appear at the first time of observation, the positive reaction was caused by tuberculosis, either latent or inactive, or which has become arrested.

[1] Mantoux and Lemaire found amongst poor children who reacted to tuberculin 16 per cent. in 1 to 2 years of age, 51 per cent. in 2 to 4, 66 per cent. in 3 to 4, and 84 per cent. in 7 to 15 years of age.

This is very frequently confirmed by the *post-mortem* findings. In many cases, however, of positive reaction autopsy shows no trace of tuberculosis, and it is then a question whether small tuberculous lesions have been overlooked in examination, or whether former tuberculosis has completely healed, leaving no visible trace, as in variola (Knöpfelmacher and others), where it has been observed that the signs of allergie have been for a long time suppressed, or whether the cutaneous reaction (see above) can under certain circumstances occur without tuberculous antecedents.

In any case, the cutaneous test is an extraordinarily delicate test, capable of indicating not only active, but also completely inactive foci, those produced either by the bovine bacilli (a species foreign to the body), which, as a rule, are advancing to their spontaneous involution, or foci, whether of bovine or human origin, which are already calcified or completely healed. But practical utility suffers a severe loss from this fact, as, although inactive foci certainly interest us from the point of view of morbid anatomy, they only to a certain degree engage our clinical interest, and in no way indicate the lines of treatment.

As such clinically unimportant foci appear much more frequently with advancing years, and always oftener in adults, a cutaneous reaction is almost valueless for adults and even for later youth, but retains its importance for early childhood, and also for the scrofulous in a certain sense.

Moro's ointment is somewhat less sensitive than v. Pirquet's method, but at the same time it also shows inactive foci, and is therefore of little value for adults (Emmerich and others). With children it indicates active foci, with perhaps more probability (Moro and Doganoff, Lignières and Berger, Lantier, Naegeli-Akerblom and Vernier, Kanitz and others; Wetzell has 221 cases), but it tells us nothing of the origin of the bacillus or its virulence.

Monti's comparative researches on 300 children gave results as follows :—

	According to Moro	According to v. Pirquet
In certain tuberculosis ...	88 per cent.	... 98 per cent. positive reaction
Persons suspected of tuberculosis ...	65 ,,	... 78 ,,
Apparently free from tuberculosis ...	34 ,,	... 44 ,,

Emmerich found that of clinically non-suspected persons, according to Moro 32 per cent., and according to v. Pirquet 79 per cent. reacted.

Conjunctival reaction has proved itself less sensitive than the v. Pirquet's method.

Morelli found amongst 300 adults in :—

	According to Pirquet	According to Wolff-Eisner
114 persons with pulmonary tuberculosis	... 98 per cent. positive reaction	86 per cent.
22 persons with other forms of tuberculosis	... 72 ,,	63 ,,
68 tuberculous suspects	... 49 ,,	47 ,,
96 tuberculous non-suspects	21 ,,	11 ,,

A compilation of Schröder and Kaufmann gave, inclusive of the severest cases, positive reactions in 85·5 per cent. amongst 971 tuberculous persons; 51·4 per cent. amongst 284 suspects; 12·7 per cent. amongst 627 persons clinically not tuberculous, and Calmette mentions over 14,000 observations by clinicians of all countries, according to whom 92 per cent. in advanced tuberculous patients, and 61 per cent. of suspects, and 18 per cent. of apparently non-tuberculous gave a positive result.

Wolff-Eisner's statement that his method only revealed active foci, that healed lesions were revealed by late reaction, and the inactive only by repetition has, unfortunately, not been confirmed.

The following examples prove how far opinions differ respecting the conjunctival test :—

Some authors recommend it, emphasize its great importance and reliability (Schenk and Seiffert, Schubert, Boyd, Malmstrom, Megias (120 cases), Parker, Bjelilowski, Pons y Marquez), or they praise its value for the period of childhood (Comby, Feer, Siegenbeck van Heukelom), or they note its value for special regions, for affections of the ears and larynx (Wilzcur), or for skin affections (Sequeira).

On the other hand, some authors object to its very restricted reliability (Wiens and Günther (409 cases), Fehsenfeld, Tice, Köhler and Burg).

Lastly, many authors object to it entirely, or at least warn against its employment (Möller, Collin, Purjesz, Daniels, Schlossmann and others).

Siegrist considers it of little value for the eye specialist, and dangerous for persons suffering from affections of the eyes; Zöppritz denies its value for discharging and open tuberculosis.

According to Calmette, Calzolani, Lurie-Lüdke, Fabian and Knopf, the positive result points with certainty or probability to fresh tuberculosis, excepting in typhus fever (Damask), to active tuberculosis according to Tobiescu, whilst Coderque does not accept positive reaction as a sign of active tuberculosis, for foci

which have run their course react positively, and Baldwin only considers it conclusive when reaction appears speedily with small doses.

Negative reaction naturally does not exclude tuberculosis, with the exceptions already mentioned under the head of cutaneous reaction, but makes it otherwise improbable (Calmette, Fabian and Knopf, M. Elsässer and Lüdke, Hörmann, Schröder and Kaufmann, and Medowikoff); from other quarters negative reaction is denied any importance at all.

As to the general applicability of the allergie test, we come to the conclusion that it has no absolute reliability, but is of value as a means of supporting the diagnosis, that the positive cutaneous test is capable of proving with the greatest trustworthiness a tuberculous focus of any sort, active, inactive or healed, of human or bovine nature, with the above-mentioned limitations, but that its diagnostic value, as v. Pirquet himself has stated, is limited to the early years of childhood (according to Calmette to the first three years, to Brückner to the fifth year, to Goebel to the twelfth year). The younger the child, the nearer it is to infancy the more reliable is the cutaneous test; according to general opinion (Feer, Brüning, Goebel, Brückner and others), it appears to be specially valuable in infants when tuberculosis is concealed under the appearance of atrophy, because at this age inactive foci practically never appear.

A negative result in older children and adults (more important than the positive result (Feer and Makowski) excludes with all probability the presence of tuberculosis unless we have to do with advanced tuberculosis, miliary tuberculosis with preceding tuberculin treatment, with marasmic and cachectic persons, or with a patient suffering from measles, especially in cases in which it is repeated with the above-mentioned limitations (J. Beck in 808 cases, and amongst adults, Goebel; see also Filipkiewicz, Brüning, Ferrand and Lemaire, Kaurin, Bartholdy and Termin, Abrami and Burnett, Rolly, Korczewski, Korczynski and Bylina, Brückner, Poten and Griemert). If the cutaneous tests prove negative it must be repeated after eight days, or the streak test must be tried.

The ointment, conjunctival and streak tests are equal in value to v. Pirquet's test, and have apparently the advantage that they do not indicate inactive foci to the extent of the latter; we must, however, object to the conjunctival test, since a number of severe injuries have been observed from it (see Heinemann, Emmerich, Bullinger, Wideroë [186 cases], Weil, Chlumsky and others).

The very interesting phenomenon has occurred in these

allergie tests that subsequent subcutaneous injections lead to a pronounced reinflammation of the old sites of injection in the skin and conjunctiva even when the symptoms have all disappeared, and the test took place weeks and even months before (in one case of Catoir five months). This revival occurs also in cases in which the result of the former inoculation was doubtful, even negative.

As it also occurs in cases in which tuberculin injection induces no fever, it is clear that the hypersensitive focus which has been created for a long time is locally circumscribed (Citron, Cohn, Baginsky, Levy, Caan, Lenhartz, Feer, Bing, Collin, Goebel, Blum and Schlippe).

Subcutaneous Tuberculin Test.

In doubtful cases one can always return to the subcutaneous tuberculin test, but this cannot be used in patients suffering from fever, and in weakly patients it is hardly applicable on account of the fever produced by it.

One must first assure oneself of the normal temperature by recording it every two hours for three days; then late in the evening a first injection of $\frac{1}{2}$ to 1 mg. is given. Reaction may be expected after eight to sixteen hours, and shows itself by fever, that is, an increase of at least 0·5°, prostration, and perhaps a focal reaction. The two hourly record must of course be continued during the time of observation. If no reaction follow, one injection of 3 mg. is given on the fourth day, should the result be still negative, 5 to 6 mg. is given on the seventh or eighth day. If reaction is still wanting in all probability tuberculosis is not present. Children under 10 are given 0·2—0·5—1·5 mg.; under 5 years 0·1—0·3—0·6—1·5 mg.; for delicate persons the initial dose is 0·1 mg., and for delicate children 0·05 mg.

For prognosis in general, for reasons already given, a severe cutaneous reaction is considered of more favourable import than a weaker and slower reaction (Levy and others). In pronounced tuberculosis negative reaction is considered an unfavourable sign (Wetzel and Wilson and others), and often signifies an aggravation of the disease, if some time before reaction were positive (Bartholdi and Ternim, Korczewsky, Korczynski and Bylina, and Comby).

Lapschin, Fabian and Knopf attribute a certain prognostic value to reaction, but in other quarters little value is attached to it, and at times it has been contended that the quantity of antibodies is in no proportion to the severity of the disease (Calmette), and that severe sufferers—for example, thirteen out of nineteen

post-mortem cases—had reacted positively to one inoculation with 1 per cent. tuberculin (Aistermann, Nöggerath; see also Burckhardt, Roepke, Hans, Baldwin, Ziegler [600 patients]).

In general we cannot attach much value to the prognostic reliability, and Wolff-Eisner's supposition that the prognostic value of the conjunctival reaction is higher than the diagnostic value appears not to be justified.

Allergie Reaction in the Scrofulous.—Reaction appears after the most various methods, especially regularly and severely marked in children, often with the formation of crusts and scabs, more particularly in scrofulosis, and bone and joint tuberculosis (Citron, Feer, Goebel). Thus among seventeen children with bone tuberculosis sixteen showed a positive reaction, and in fifty-four suffering from bone and joint tuberculosis, fifty-three showed a positive reaction, yet Chlumsky (who investigated 150 cases) in twenty-four assured cases of surgical tuberculosis only had positive results fourteen times (see also Brüning, Monti, Wilms). The more violent the reaction the more it points to the scrofulous character of the tuberculosis. These decided skin reactions have led to the belief in a specific hypersensibility of the skin in tuberculosis of the skin and scrofulosis (Moro, Oppenheim, Bandler and Kreibich). In scrofulosis papules often appear 10 to 20 mm. in diameter, which become gradually pale, and may be long recognized as pigmented spots (Engel and Bauer). The production of nodules resembling lichen has been mentioned elsewhere (Reuschel, Zieler, Oppenheim). The reaction may take the exact appearance of tuberculides. Now and then, after seven, eight, or more days, when one has begun to think the inoculation would have a negative result, phlyctenæ of the cornea, or a sort of folliculitis (small, round, raised papules) appear, of bright-red colour, with a central depression (Engel and Bauer, Pfaundler, Moro, Doganoff).

It is remarkable that v. Pirquet demonstrated in a child, which reacted positively but which on autopsy was proved to be tuberculous, a decided status lymphaticus, which led him to suppose some connection between the status lymphaticus and tuberculosis. But in a similar case of Engel and Bauer the status lymphaticus was wanting.

The observation of Wolff-Eisner and Brandenstein that the erethistic form of scrofulosis shows a positive, and the torpid form a negative, reaction has not been confirmed.

The reaction symptoms which are more severe in scrofulosis may, in the eye, readily have grave import. Mongour and Brandeis observed suppurative conjunctivitis after the conjunctival

test, Levy twice observed suppurative inflammation of the eye, and Lapardt severe corneal infiltration in lupus of the face. Siegert notes in his lupus patients the relatively slow reaction as compared with those suffering from internal tuberculosis. Now and again phlyctenæ appear, and more severe affections as well as aggravation of ophthalmic processes already existing in scrofulous patients, even with 1 per cent. old tuberculin.

We therefore consider the conjunctival test—which we never employ on account of the danger connected with it—relatively contra-indicated, and we employ either v. Pirquet's, the ointment or streak reaction, which at times gives us very valuable indications, especially in connection with other means of diagnosis. If the reaction be negative, or disappear rapidly, so that it cannot be considered entirely conclusive, the test is to be repeated, as already mentioned, after eight days in the same form, or as a streak test. In fresh or recently healed eye affections even the percutaneous test is only to be employed with great reserve (see Brückner).

I have recourse to subcutaneous injections for diagnostic purposes only in exceptional cases, as they have a complete equivalent in percutaneous tests. Although small doses are almost innocuous, in the larger doses which are necessary to produce reaction, an injury, though rare, is not entirely excluded, and such injury generally escapes observation, as it only manifests itself some months later owing to the slow growth of the tubercle bacillus. On account of the frequent close symptomatic connection between tuberculosis or scrofulosis and syphilis, it would be advisable in a case of a negative result of the tuberculin test to test for the other affection by Wassermann's reaction. Thus Hertz and Thomsen in 228 scrofulous children had 192 positive v. Pirquet reactions; of the remaining thirty-six, eight showed Wassermann's reaction (see also Marshall and others).

Differentiation of the Human and Bovine Bacillus.

The extremely important decision as to whether in certain cases we are dealing with human or bovine tubercle bacilli is for the present surrounded with considerable difficulties, and practically cannot be carried out.

Just as the fact derived from the history of the case, that about the time of the infection raw milk and milk products from tuberculous cows had been consumed, can, when dealing with tuberculosis of the digestive organs and neck glands, give a certain clue, so the demonstration of tuberculous persons living in close

proximity to the patient or child may give a certain hint, but beyond this no great value can be placed on the history.

Macroscopically no difference can be demonstrated in the organs examined. Microscopically also the differences are not decisive.

Benda remarked in most cases of bovine tuberculosis the lack of giant cells and a greater quantity of the tubercle bacilli, the confirmation of which in the pus of the gland (in a smear preparation) is easier than in human tuberculosis.

Besides which, the human type exhibits morphologically a longer and more slender shape, the same thickness at both ends, and absorbs staining matter regularly; the bovine type has a shorter shape like oval cocci, the larger ones are more extended and many are club-shaped (similar to the bacilli of diphtheria), the one end better coloured, and thickened like a button. These differences can only be clearly distinguished in fresh cultures, prepared in exactly the same manner (Kossel).

A decision as to the etiological connection of any affection with human or bovine tuberculosis can only be arrived at by bacteriological tests and experiments on animals.

Kossel, Weber, and their collaborators, Heuss, Oehlecker, Taute and others have, with the co-operation of Robert Koch, worked out an exact method of differentiation which, it is true, is troublesome in practice and exacting in its conditions, but is adapted to avoid all the numerous rocks of error in experiments on which the reliability of the greater part of such experiments suffer shipwreck. The proceeding is based on cultural signs, on subcutaneous inoculation experiments on rabbits, and in doubtful cases on cattle. The sterling works of Hans Burckhardt contain very exact accounts of the differentiation in culture, and in experiments on animals, as well as valuable hints as to how such experiments may be exactly and economically carried out.

These experiments are easily subject to errors. Koch attributes the contradictory results of other investigators, and also those in his own statements, to not paying attention to sources of error, and has drawn up a series of maxims in order to avoid them.

To obtain a result free from all objection, the animals chosen for experiment must be without idiopathic tuberculosis. To avoid mistakes, a large number of animals must be used. The danger of idiopathic tuberculosis is especially great in cattle, for even tuberculin only shows a tuberculous infection after some time. A small number of experiments has only a conditional value, and solitary exceptions in a large number are generally the

consequence of faulty experiments. Further, the animals must be strictly guarded from unintentional infection by separation.

For conclusive comparisons the inoculation should not be made with particles of tissue, but with a carefully weighed mass of culture, and not with too large doses; also not an intraperitoneal, nor an intravenous, but a subcutaneous injection should be made, as otherwise non-virulent, even dead, bacilli may induce similar changes by toxins, or the effect of foreign bodies (*e.g.*, tubercle bacilli not sufficiently finely disintegrated). (See Kossel's experiments with Timothy bacillus.)

The material must first be injected into guinea-pigs, to avoid any failure with direct culture, especially as such passage through guinea-pigs does not influence the character of the culture in any perceptible degree; from this a pure culture is to be made, and a culture which is not too old, either in the first or second generation, first for bouillon culture, then for inoculation into rabbits. The animals must be allowed to live long enough to enable one to distinguish between progressive and retrogressive processes. When the result is doubtful further tests must be made on a number of cattle.

We must take into account the possibility of mixed infection of bovine and human types with which, in experiments on animals, the bovine bacilli can get the upper hand and lead to errors (see the cases of Kossel, Weber, Heuss, and others).

In sputum tests the possibility of particles of food which contain butter or milk must be carefully excluded. Koch points especially to such faults in experiments on the part of the English Commission.

These maxims, the justice of which must be acknowledged, are to be the measure by which their value and convincing power in such experiments are to be judged.

The course of investigation which is of great importance for scrofulosis is, according to these maxims, to be arranged as follows:—

Passage through Guinea-pigs.—The material which is to be tested for its origin and type is to be triturated into the smallest possible particles, and if an emulsion can be made, injected subcutaneously, or into a fold of the skin in the right abdominal region of two or four guinea-pigs. To guard against idiopathic tuberculosis the animals must be kept separated a long time beforehand and secured against possibility of infection. Guinea-pigs are used for the passage of the material, as they are easily susceptible to both types. They die somewhat more quickly from bovine infection, but sometimes with less extensive changes in

the organs than when inoculated with human type, apparently on account of increased toxic effect (Oehlecker).

After eight to fourteen days the enlarged glands lying nearest to the site of inoculation can be distinctly felt; after about four weeks the animal is killed, and the most suitable portion of the spleen or other tuberculous organ is employed for making cultures.

To obtain a speedier result Bloch's crushing method, in conjunction with antiformin, may be employed (see p. 250). But as a safeguard a second animal, in which the glands have not been crushed, should be kept in reserve, but only used for cultures after four weeks.

Serum Culture.—Serum without (or according to Burckhardt with 5 per cent.) glycerine has proved the best culture medium for this purpose.

In slaughtering, the blood of the animal is caught in a sterile receiver and kept in a cool place, the serum which has separated is centrifugalized after three days, placed in tubes, and then closed with cotton-wool, subjected to fractional sterilization on the three following days, every three hours, at 58°, then placed in the ice-chest. Before use the tubes must be placed to set in paraffin at 70° in a moist atmosphere, obtained by saucers of water.

The tuberculous particles of tissue of the guinea-pig to be inoculated are well crushed with the forceps and rubbed into the serum with a platinum spatula in six or twelve tubes, the tubes closed with cotton-wool pushed slightly into the tube and then singed at the top, to guard against evaporation and the intrusion of bacteria, at first boiling hot, and then warm paraffin is poured on it (or the cotton-wool cork is soaked in very hot paraffin) and the tubes are placed in the incubator.

As a precautionary measure it is advisable to inoculate another guinea-pig with particles of the organ to carry on the stock.

The formation of a so-called salt film often disturbs and hinders growth in the serum culture medium. With normal development the appearance of the serum tube culture will, after a short time, allow of a conclusion, even if not a binding one, as to which of the types we have before us.

The human type forms a drier, more brittle layer, pushing itself up the side of the tube.

The bovine type is more difficult to cultivate, rises up the side more slowly and more scantily, and is inclined to become merged into one.

Buckhardt succeeded in some cases in preserving bovine strains on glycerine agar, and he prefers this culture medium,

which, by the by, has long been used for experiments in differentiation in the place of the troublesome serum culture.

The transmission of the culture to the glycerine bouillon may take place in from three to six weeks, but if the growth be too scanty the culture is again to be transplanted on serum, when enough material for further inoculation will be obtained in two or three weeks.

Glycerine Bouillon Culture.—For bouillon culture we employ a slightly acid 2 per cent. glycerine bouillon, which is filled into flasks which have before been tested as to their suitability for the culture of tubercle, each containing 50 c.c.

To obtain reliable results in the comparison of cultures it is advisable, according to Oehlecker, Burckhardt, and others, to prepare at one time a large quantity of glycerine bouillon, so as to ensure a uniform culture medium and thus avoid slight differences in growth, due to variation in the culture medium.

The serum cultures are now carefully taken off with a platinum spatula and inoculated into about a dozen small flasks filled with glycerine bouillon. It requires some practice to get the layers of culture from the serum medium into the flasks without letting them sink to the bottom. The more thinly the cohering film of culture is laid on, the more characteristic the growth becomes.

The further development of the culture goes on in the incubator relatively quickly, and soon distinct differences are perceptible.

In the human type the film spreads tolerably quickly and in from three to four weeks spreads itself out in a layer, intersected by folds, covering the whole of the surface of the bouillon and rising up the side of the vessel. It becomes gradually thicker, at first forming fine, crinkly folds, but the surface is soon covered with light-yellow, puffy masses of folds, a condition which has been known for decades. At the fifth week it becomes darker and a dirty yellow, single fragments are loosened and fall to the bottom. If the particles of culture have been laid on more thickly the growth is slower and looks more like felt.

The bovine type is distinguished by its slow growth. The delicate film, often thin as tissue paper, shows no puffed-up folds, but little warty excrescences, which develop more on the under surface of the film, which often appears grained like "finely and closely punched leather" (Burckhardt).

The cultures differ most distinctly after three or four weeks and permit of a certain diagnosis of their origin, which may then be confirmed by experiments on animals.

Bonome has proposed a method of distinguishing the two

types by precipitation; Spengler also recommended a similar method. Theobald Smith emphasizes the quality possessed by the bovine type of reducing the acidity in a 3 to 5 per cent. glycerine bouillon with a degree of acidity of 2 per cent. normal acid (with phenolphthalein as indicator) to weak alkaline reaction. These methods have been confirmed only in part, or at least not to their full extent (Möhler, Washburn, Fibiger and Jensen, Beitzke, G. Schröder).

According to Arpad, based on Wolbach and Ernst, the human type on glycerine potato forms a yellowish-red dye; the bovine tubercle bacilli remain white; Beitzke, Dammann and Müssemeier, Lydia Rabinowitsch, Weber, as well as Burckhardt, find this phenomenon constant, and therefore not adapted to differentiation. The exuberant growth of human bacilli on egg-culture medium, noted by Dorset, has been confirmed by Wolbach and Ernst.

Testing on Animals.—For this purpose the human bacilli are taken after twenty to thirty days, the bovine bacilli, on account of their slower growth, about fourteen days later, with a sterile platinum loop, then placed on good blotting-paper, and when the bouillon has been soaked up (after five to ten minutes) placed on a watch-glass of known weight and the contents weighed.

Then, according to weight, they must be made up with 0·8 per cent. sterile solution of common salt, so that each c.c.= 1 cg. of culture mass (for example, in an amount of culture weighing 0·85, 8·5 salt solution is necessary). The culture mass must first be cautiously (as sometimes in this manipulation rigors[1] are induced [Oehlecker]) and thoroughly rubbed down in a sterilized porcelain mortar and the salt solution added drop by drop; the mixture is best inoculated at once, as the bacilli settle very quickly.

For testing in animals a rabbit, of about the weight of 2,000 grm., is used; this does not entirely replace the ox, which is much dearer, but on account of its characteristic of not exhibiting any tuberculosis, or only slight changes, when injected subcutaneously with not too great a quantity of human bacilli (when the same quantity of bovine bacilli subcutaneously introduced would cause decided tuberculosis and would kill the animal), allows us, as a rule, to draw a sufficiently reliable and clear conclusion as to the origin and type of the bacillus. Besides the infinitely

[1] Leschke also notices the poisoning from the smell which sometimes occurs whilst working with solutions of tubercle bacilli, and which he has himself experienced, rigors, increase of temperature of short duration, pains in the limbs, stupor, confusion of ideas, which passed off after about three days.

smaller cost of the rabbit and its being more easily kept, it has also the advantage of seldom being idiopathically affected with tuberculosis, which in cattle often gives rise to errors.

The deposit of bacilli prepared in the manner mentioned (1 c.c. = 0·01 grm. culture mass) is, after removal of the hair, disinfection, and careful avoidance of small veins, so as not to get a direct blood infection, subcutaneously injected into the abdomen, pushing the needle cautiously forward after the puncture without stretching the skin. If fewer than four animals are employed the result often appears less certain and unequivocal, as one may meanwhile die, and another, on account of individual tendency, may react more or less decidedly.

According to Weber we must guard against intramuscular infection, which might induce great tuberculous changes in the rabbits even with the human type.

Burckhardt specially recommends subepidermal injection, in which there is less danger of piercing a vein (by which infection through the blood occurs), and in which the difference between bovine and human infection is more sharply defined, the skin of the abdomen is fixed during the injection and pierced as superficially as possible, as if the needle were to remain in the epidermis.

For my part, I see one disadvantage in this, viz., that the abscesses, which are formed more readily, burst, and by the dispersal of infectious material further both simultaneously and later, spontaneous and double infections.

The result of the inoculation exhibits a cardinal difference. If the bacilli are of human type, at the most, a transitory swelling of the nearest gland appears in the rabbit, which involutes after a time, but frequently the gland remains normal and exhibits no tuberculous changes if the animal be killed after four months; the inoculation of the gland into guinea-pigs is often unsuccessful (Oehlecker). Only at the site of injection does a callosity appear, or more frequently an inoculation abscess, varying in size from a hazel-nut to a hen's egg, with caseous suppurative contents. Burckhardt only found caseated glands in two cases. Thus the evidence of advancing tuberculosis is wanting.

Now and again small foci are found in the lungs, generally only fibroid tubercles, contracting or healing processes; in the kidneys it is very rare to find any small suspicious foci.

Burckhardt considers that Oehlecker's statement, that rabbits never die from cutaneous inoculation of human bacilli, is going too far, and considers it much more probable that if one allowed the rabbits to live more than four months the greater part of them would die later, thus the end is only delayed.

Tromsdorff informs us of parallel experiments on white mice,

in which these animals, having been inoculated with bovine bacilli in the veins of the tail, died four weeks later from general tuberculosis, whilst when inoculated with the human type two to three and a half months after not a single one had died of idiopathic tuberculosis. Mice and rats, according to Beck, exhibit differences in such inoculations, even if not always distinct. The regional glands are apparently more severely implicated in rabbits only when human bacilli are inoculated into the anterior chamber of the eye, as the experiments of Cohnheim, Koch, G. Cornet, Takewossianz, and others proved.

Should the material for inoculation be of the bovine type, in all animals a distinct enlargement of the regional glands is exhibited after three or four weeks, from which a thick cord of inflamed lymph vessels extends to the site of inoculation; if the animals die spontaneously (as a rule after forty to a hundred days), or if they be killed after four months, they exhibit severe tuberculosis; caseated glands up to the size of a walnut, large foci, especially in lungs and kidneys, submiliary nodules in the spleen and liver.

Of diseases of rabbits which often interfere with the experiment, septicæmia is to be especially noted, the causative agents of which are small ovoid bacilli, staining at the extremities. It shows itself by loss of appetite, quickened breathing, and wet nose; the pathological changes are fibrinous deposits in the lungs, fibrinous and suppurative pleurisy, and pericarditis, all of which might erroneously be taken as of tuberculous origin.

Very frequently the cause of death is found to be coccidiosis of the liver, irregular yellow liver foci, which in a smear preparation show coccidia and which are not really looked upon as tuberculous changes, as even I have known to be done by a tolerably well-known pathologist. In coccidiosis of the intestine with enteritis (also a frequent cause of death), cysticerci are found in the reticulum, leaving in their train abscesses with caseous suppurative contents, forming another source of error when mistaken for tuberculous reticulum nodules.

They also occur in the cæcum, at the peripheral end of which Oehlecker has found small yellow foci, the size of a pin's head, lying in lymph nodules, which even histologically might resemble an incipient tuberculosis (epithelioid cells, but no giant cells), which, however, apparently have nothing to do with tuberculosis, as is proved by inoculating them.

To shorten the proceeding, which demands time and is costly, we may resort to intravenous inoculations, which in rabbits lead to useful, if not always unequivocal, results; but instead of the

dose formerly recommended by Kossel and Weber, of 1 mg., which by the effect of toxins and foreign bodies might lead to death, only a dose of $\frac{1}{100}$ mg. is to be used, as established by Oehlecker, or else the differences between human and bovine injections are sometimes effaced.

Should the rabbit not give unequivocal results the experiment must be repeated on a larger number, or (which can rarely be done in practice) on young cattle which have been proved by tuberculin to be healthy (for precautionary measures, see pp. 32 and 267), which afford the surest means of differentiation; 5 c.c. in 50 mg. of culture mass and physiological salt solution is subcutaneously injected in the neighbourhood of the prescapular gland. An intravenous injection is avoided, as human cultures may sometimes prove actively virulent in intravenous injections in cattle in consequence of high toxic properties (see Koch and Oehlecker); avian tuberculous strains intravenously injected in cattle often lead to death by toxins for the same reason (Weber).

In infection with the human type, besides infiltration and abscesses at the site of injection, swelling of the prescapular gland in connection with it occurs, sometimes of considerable size; but these symptoms involute and the fever, which may have intervened, disappears after a few weeks. If the animals be slaughtered after four to six months, with the exception of tumours of the connective tissue, up to the size of a goose's egg, at the site of injection, no other changes are found; or at the site of injection, small caseous suppurative or calcified foci are met with, or caseous chalky foci in the prescapular glands, or even in the nearest glands, which are in a clear state of involution, as we have described on p. 117, but other organs are free from tuberculous changes. We have to do, therefore, with a strictly localized, non-advancing process, with retrogressive metamorphoses.

With infection by bovine type in cattle, extensive swellings and abscesses are formed at the site of injection, there is great enlargement of the prescapular gland and neighbouring glands, up to the size of a man's head; and high fever, which remains constant for a long period, even till death, which generally occurs in from forty to seventy days. If the animal does not die spontaneously, but is killed after four to seven months, it exhibits the evidences of general disseminated tuberculosis with tuberculous nodules the size of a pea in spleen, liver, lungs and kidneys.

It would be of great diagnostic and prognostic value to be able to confirm rapidly to which type of bacillus a case before us belongs, for the troublesome differential diagnostic method by which we are

at present bound is inapplicable in practice; therefore, at the same time Tedeschi and Détre tried to bring out such a differentiation by means of cutaneous inoculation, employing simultaneously tuberculin of human and bovine type, old tuberculin, and the even more effective human and bovine filtrate, which induces more intense reaction. The result was that sometimes a decided positive reaction occurred after the one, and a decided or mostly negative reaction after the other, and especially in visceral and surgical tuberculosis, in which bovine reaction is remarkably frequent; Gebhardt, Heim and John have also made such experiments with human and bovine filtrates, and confirmed the difference between the human and bovine type.

The last-named investigators had ninety-one positive reactions in 140 children and five adults. The human and bovine papules were of the same size in fourteen cases. The human were larger than the bovine papules in twelve cases. The bovine were larger than the human papules in thirty-five cases.

In Klose's experiments with human and bovine tuberculin, in 120 children 9·33 per cent. reacted only to human tuberculin, 5·34 per cent. only to bovine tuberculin; all the others to both tuberculins; the theory of Klose that he had to do here with double infection is unjustified.

Meisels and Progulski, on the contrary, in parallel experiments with human and animal tuberculin, found identical reaction in forty-seven cattle (see also A. Cahn's similar experiments); Clarke and Forsith in pulmonary tuberculosis generally confirmed both forms of reaction. The experiments of Rentzler and Blumenfeld on differentiating cutaneous reaction are not at present very valuable.

Experiments on animals do not enable us to recognize any clear difference. Guinea-pigs, whether infected with the human or bovine type, reacted to small quantities of both. Those infected with the avian type reacted principally to the same type, but also to human and bovine tuberculin. Even animals infected with Timothy bacilli and acid-fast milk bacteria show a positive reaction, although perhaps not always (Klemperer), just as tuberculin prepared by Moellers from Timothy bacilli (para-tuberculin) can produce positive reaction and after-reaction in a site in the eye which has responded before (Irimescu).

For the present, therefore, the differentiating method is not applicable, as we have to do with groups of symptoms, both in subcutaneous tuberculin injection and in serum reaction.

SECTION VII.

Prophylaxis.

To bring into broad daylight the importance of scrofulosis, especially of scrofulo-tuberculosis and the mode of combating it, it would be natural to remove from the rhetorical armoury the statement that the whole fight against tuberculosis rests upon its rational attack in youth, that tuberculosis is a child's disease, which is contracted in childhood, and which must be combated then, and similar arguments which we have often heard from Schlossmann and others.

I hold this standpoint to be absolutely false, and not supported by any exact proof.

If v. Behring brought forward the statement that tuberculosis is especially contracted in youth he has at least captivated many doctors, especially children's doctors, thanks to belief in authorities—faith, which in medicine only too frequently decides the issue. But neither v. Behring nor his followers have brought any proof.

All that has been spoken, written, and affirmed about primary childhood infection, and the protection gained by it against further later infection, is up till now unproven from first to last; it is mere hypothesis based on hypothesis, for where are the exact proofs?

The facts which we at present know give quite a different impression. Let us only call to mind the statistics of mortality from tuberculosis at different ages, before whose iron laws we all have to bow.

Taking an average of sixteen years, the mortality from tuberculosis in Prussia was as shown in the table appearing on the following page.

We see from this that a child in its first year, because it is closely associated with its mother, has about the same death-rate from tuberculosis—26·4 to 22·94—as women capable of bearing children, respectively, 19·18 to 32·8, only somewhat lower, because

naturally amongst those who bear children healthy are more numerous than tuberculous ones. From the second year, when the child is not so much with its mother, the frequency of tuberculosis sinks to 20·80; still more in the third year to 12-13 per 10,000, because the tuberculous mother, or parents, cannot look after the child so much, perhaps because both may be at work. For we must not forget that the deciding vote in statistics is not cast by the well-to-do, but the numbers principally represent the conditions of the working classes, the population with an income of 900 marks (£45) or a little more.

Age	Amongst 10,000 living of the age-class in question dying from Tuberculosis				Amongst 10,000 persons of the sex and age in question in the category of occupations are	
					Earning their living and engaged in household duties	
	Males	Females	Males	Females	Males	Females
	2	3	4	5	6	7
Under 1 year	26·4	22·94				
1—2 years	20·89	20·85				
2—3 ,, ...	12·45	13·54	8·85	10·44		
3—5 ,, ...	6·87	7·95				
5—10 ,, ...	4·52	6·00			402	256
10—15 ,, ...	4·89	8·93				
15—20 ,, ...	17·63	19·80	...	...	8966	6672
20—25 ,, ...	32·32	25·34	34·68	29·14	9685	4659
25—30 ,, ...	36·62	32·82				
30—40 ,, ...	43·54	37·54	...	...	9781	2173
40—50 ,, ...	54·70	38·10	...	...	9715	2403
50—60 ,, ...	75·88	49·52	...	...	9378	2776
60—70 ,, ...	99·65	68·33	...	...	7989	2436
70—80 ,, ...	69·30	45·69	...	...	4658	1425
Over 80 ,, ...	26·21	19·69	...	...		

From the third to the fifth year the child of the working classes is but little with its relations, who may be tuberculous, for they are either at work or in hospital, and the child is more out of doors during the day, whilst (as I believe I have conclusively proved in another place) the danger is not so great at night (see Cornet, "Die Tuberculose," second edition, p. 399). Accordingly, the death-rate from tuberculosis sinks 6·8—7·9 per 10,000, and is on the whole somewhat higher in girls who are tied more closely to their mother's apron strings, and sit more at home.

The frequency of tuberculosis becomes still less when the child is kept away from tuberculous adults by school. From the fifth to tenth year it is only 4·5 to 6·0. From the tenth to fifteenth year 4·9 to 8·9 per 10,000.

Clinical investigations as to the spread of tuberculosis

amongst school children correspond with this. Kerr found amongst 1,670 school children sure signs of pulmonary tuberculosis in only eight (0·5 per cent.). Hay also only 0·5 per cent. Lecky and Morton, in Brighton, 0·37 per cent. We must not take the positive reaction which every inoffensive bovine focus gives as a standard, for this would lead us astray (see pp. 19 and 259).

In the last years of childhood, from 10 to 15, we notice a slight rise of tuberculosis, for from the ages of 13 to 15 employment and apprenticeship begin (as shown by columns 6 and 7).

From the twentieth year the frequency of tuberculosis rises continually to the seventieth year, when it even attains in males 99 per 10,000; with women it rises, as we perceive in columns 6 and 7, much more slowly, because they have to earn their living less often than men. If, then, we hold the theory that infection principally takes place in childhood, then the child's organism must possess a most extraordinary power of resistance to the bacilli, for, in spite of the infection supposed to have been taken, so few children die of tuberculosis.

On the other hand, morbid anatomy and clinical experience teach us that infection in childhood is most dangerous, that nearly all tuberculosis in infancy ends fatally, that the bacilli in the child's body exhibit a decided tendency to disseminate, and even to lead to general miliary tuberculosis; herein lie clear contradictions between experience and hypothesis, which are difficult to solve.

The gradual rise in the frequency of tuberculosis, from the twentieth to the seventieth year, is quite explicable to us, for the more battles the soldier has gone through, so much the more probable is it, on an average, that a bullet will strike him, and the longer one is at a trade, the more natural is it that he will be in close contact with tuberculous persons, and that he will at last be infected.

Comby explains the increasing frequency in advancing years by the simple fact that older persons are for a longer time exposed to the numerous opportunities of infection, which agrees with the instance I have so often brought forward, that 1,000 soldiers who have gone through ten battles have, as a rule, more wounds and scars to show than after the first battle.

But as soon as a man after 70 years retires from industrial activity the death-rate from tuberculosis sinks from 99 to 69, and even to 26, and with females to 19; in other words, the frequency in those confined to the house is the same, whether they be children, women capable of bearing children, or old people who can no longer get out much. No attempt has yet been made to

contradict this by explaining the high mortality from tuberculosis in later life from the standpoint of infantile infection.

We must, if we keep to facts, flatly decline to recognize that infection and tuberculosis in the child has any great influence on the tuberculosis of adults.

At the same time there is reason to combat tuberculosis and scrofulosis in children for its own sake.

The prophylaxis of scrofulosis has the greater prospect of success the more the conviction gains ground that for this disease, especially in its severe tuberculous form, neither descent nor race cause any special susceptibility, but certain external conditions are distinctly necessary to cause it; the more we seek its cause, not in man alone, but outside him, the less shall we lay the responsibility on things over which we have only slight influence or none at all.

I should like to offer the following opinion of Virchow, in answer to the one-sided and exaggerated emphasizing of predisposition: "But one should not overlook the fact that even with existing predisposition it is only the opportunity for the cause which produces disease, therefore these opportunities should be watched over as carefully as possible." The precautions against infection and predisposition, against pyogenous and tuberculous scrofulosis are in many cases the same; we may therefore leave out a separate and systematic consideration of them which otherwise would be demanded. The precautions, though apparently only directed against predisposition, before the occurrence of bacteria, acted for the most part (though perhaps unconsciously) against bacteria and against infection. For example, air and light increase the power of resistance of the body, and they are also incontestably the best means of destroying or keeping off certain bacteria in our environment.

CHAPTER I.

THE CHILD IN THE FAMILY.

The general interest in the bringing up of healthy, strong children which have powers of resistance, makes it necessary for us doctors, even if we cannot entirely fathom the great influence of heredity, to do what we can to hinder the marriages of weakly or delicate persons, of those who are too young or too old, the propagation by such individuals, and births following too rapidly one after the other, on account of the consequent exhaustion of the mother—in truth sometimes only a pious wish, as the doctor does not bring his conviction to bear with sufficient emphasis. Conception under the foregoing exhausting conditions lays still heavier duties on the pregnant woman. More than others, in this condition she must during pregnancy avoid as much as possible all that may further weaken the embryo, all bodily and mental harm, all extravagance and excess; she must do her best to make her life follow hygienic demands, to keep up her strength—and thus also that of the child she bears—by proper and sufficient nourishment and fresh air, avoiding exertion that weakens, and all clothing that may obstruct. If she suckle the child herself later, this care must naturally be extended during the period of lactation.

Air, light, cleanliness and nourishment are the chief weapons which we have to use to avoid scrofulosis, especially with those children who, from the history of their parents, brothers, and sisters (scrofulosis, tuberculosis in the family, or weakening diseases of the parents at the time of conception), or their own antecedent circumstances, lead one to fear scrofulosis for them in the future. As a matter of precaution, even in families to which hitherto suspicion has not been attached, rigid attention should be paid to these four cardinal demands for general hygienic reasons.

AIR, LIGHT, CLEANLINESS.

The demand for fresh, good air is founded on its greater freedom from germs and its indirect invigorating influence on nourishment. As the air of the house, enclosed within four walls, even under the best circumstances, can never be so pure as the open air, children should be accustomed at an early date to fresh air, as far as climate and weather permit, and doctors should overcome the objections of too anxious mothers.

According to the old rule of v. Ammon, in spring and summer a child can be in the air at about ten days after birth (avoiding bright sunshine), in winter six to eight weeks after birth—at first only for half an hour or an hour. Up to the second year a temperature of 2° of frost, and from 3 to 6 years a temperature of 5° of frost must be avoided, or only allowed for a short time—laws which, with proper clothing and when there is no wind, may be relaxed to a certain degree.

The longest possible enjoyment of fresh air is also to be recommended on account of the sunlight, the bactericidal powers and stimulating influence on nourishment and metabolism of which are well known, to say nothing of its effect in transmitting chemical rays, a subject which has as yet been little investigated.

But living in the open air, even in a favourable climate, and much more in the colder, more inclement northern countries, is limited as to time. Therefore, care must be taken that light and air have free entry to the dwelling house, which plays a much more important part in the life of the child than in that of the adult who lives more outside the home. Where the means allow of a choice the nursery should always be roomy, high, facing south, south-east, south-west or west; a north* aspect should never be chosen, but an aspect which has for at least one hour in the day direct sunshine, and of course in a dry house, not in a newly-built one. But how frequently is this law disobeyed, even when there is no necessity, especially amongst the middle classes?

How dearly must many a mother pay for the bright and beautiful situation of her little-used drawing-room, with the scrofula, even with the life of her children who have to occupy less advantageously situated rooms. Hygienic demands suffer shipwreck most frequently from our bad social conditions, which crowd families, especially those in which there are many children, into small, dark rooms looking out on narrow streets or courts. Even a good current of air, to which, unfortunately, the poorer

* I refer again to the evidence of increased mortality amongst those living on the north side of a street.

classes are very much opposed, may purify the air and lower the amount of germs contained in it; a thorough improvement is hardly to be obtained without the help of the Government, without a law bearing on the hygienic condition of dwelling-houses.

Cleanliness in its most far-reaching sense, in the child as well as in its surroundings, is one of the most important, if not the most important, means of avoiding the production of scrofulous changes by the entry and settlement of pus cocci or tubercle bacilli. Scrofulosis has been called, and not entirely wrongly, a "dirt disease." In families where cleanliness reigns we rarely find the severe forms of pyogenous scrofulosis which are frequently met with in dirty houses.

The child must from its birth be bathed daily (in water at first 35°., later 33° to 30°), and then swilled with colder water, and thoroughly rubbed.

Special care must be taken to keep the natural covering of the body as intact and free from germs as possible. A scalp which has a tendency to form dandriff must be carefully cleansed with soap and water, scurf softened beforehand by means of olive oil, glycerine, or yolk of egg, and the hair well brushed and cared for. In cases of seborrhœa sicca, to remove the grease, the skin must be rubbed with spiritus saponis alkalinus or fluid tar soap, washed with warm water, and then covered with an ointment such as

℞ Zinc. oxyd. ... ... 6·0
Sulph. præcip. ... ... 4·0
Terræ silic. ... ... 2·0
Adip. benz. ... ... 28·0
M. f. pasta. (Unna.)

Pediculi, which may indirectly cause infection by scratching, are removed by petroleum, balsam of Peru, or sublimate solution (1 in 300).

To protect tender parts from becoming sore (intertrigo) from the fæces, urine, or perspiration, they must be cleansed several times a day with cold water and powdered (especially where the skin forms folds, in fat thighs, in the neck, &c.). Napkins must be constantly changed, and washed after changing, not only dried. A child must be accustomed to regularity and cleanliness in emptying the bladder and bowels. It must be taught early to blow its nose. Very often children close the nose with the handkerchief by blowing it awkwardly, which favours catarrh of the nose, and by so doing mucus is easily forced into the Eustachian tube and the middle ear. It is very important to accustom a child to gargling and care of the

teeth at an early age; a child must early be taught to clean the teeth, especially after every meal, and they must be regularly examined (see p. 142 : The Danger of Carious Teeth). Carious teeth must be treated, and if necessary removed; the use of the same comb, towel, and even tooth-brush (!) is to be avoided as far as possible.

Acne pustules, which appear in older children, and which by scratching sometimes become a starting point of lupous changes, must be emptied aseptically and treated.

As with the body, so also with the clothing and bed linen the greatest care must be used. It must all be placed in the sun as frequently as possible, this being the cheapest disinfectant. For children, white or light materials are to be preferred, because dirt can better be seen on them, and therefore greater cleanliness is enforced.

According to the investigations of Roepke and Busch, twenty-four hours' soaking in a 2 per cent. solution of lysol is to be recommended for the certain disinfection of contaminated (tuberculous) linen. Amongst the poorer classes, the beds in which people have died are slept in without precautionary disinfecting measures being taken, and thus, especially in tuberculosis, the bacilli are further disseminated. To cleanse such beds, the methods employed in the so-called factories for cleansing beds do not by any means suffice. Once I had a bed which was infected with tuberculous sputum " cleaned " six times one after the other, and each time took tests, which I inoculated into guinea-pigs.[1] Each time, from the first to the sixth, the guinea-pig became tuberculous. Reliable disinfection can only be made by steam, by which the feathers, if they be kept away from the direct inlet, are not in the slightest injured, but fluff out beautifully. I mention this especially in contradiction of a statement by Schablowski.

Not only the child, but its environment, must be kept studiously clean; the nursery must be cleaned daily and aired at least twice a day, the child during that time being taken elsewhere, and only allowed to enter the room again one hour after cleaning, so that the dust which has been stirred up may be laid before it returns. The floor must be kept specially clean, as little children crawl about a great deal and come closely in contact with it. It must be wiped with a damp cloth, and should not be trodden with dirty boots or shoes. The best floor covering is linoleum, because it is easily cleaned, is soft, and does not crack;

[1] G. Cornet : " Dissemination of Tubercle Bacilli outside the Body." *Zeitschrift für Hygiene*, vol. v, p. 328, 1888.

curtains, carpets, upholstered furniture, and such-like dust traps, must be done away with as far as possible in children's apartments.

To avert the danger arising from the habit children have of touching everything, of putting their dirty fingers in mouth and nose, and making their faces dirty, the mouth and hands, and especially the nails and folds of the nails must be constantly cleansed, especially before meals (in infants the mouth must be cleaned with a wet linen rag after every meal). Little excoriations which often appear on the tender skin, after being cleansed antiseptically, must be closed with collodion. We have seen above (p. 137) how often the little hands are soiled with tubercle bacilli. Toys, as far as possible washable ones, must be kept clean; smaller objects, such as beads, beans, peas, coins, which they delight to push into the mouth, nose and ears, must be kept out of reach, besides endeavouring to correct this bad habit as early as possible.

The protective frame, recommended by Feer, is suitable for children as soon as they can sit up alone, that is, from the fifth to sixth month, till the second or third year if there be room enough; it is similar in shape to that mentioned by the old Viennese doctor, Gölis, to teach children to walk without incurring any danger.

The protective frame is made of wood 70 to 75 cm. high, about 100 to 150 cm. long and wide, the sides of which are joined together with hinges and hooks, representing a frame of wood filled in with rails, made with thin laths of wood or strips of linoleum about 6 cm. apart; the floor inside this square enclosure is covered with a mattress, exactly fitting, with a waterproof cover or tightly covered with a white washable blanket.

This arrangement has the advantage that the children may be left alone in it without fear of danger, and, it is noted by Gölis, their muscles are exercised and their walking powers are early developed, as the children can move about freely. But the chief advantage lies in the fact that the children are isolated, and thereby the possibility of infection reduced.

NOURISHMENT.

In many cases of scrofulosis there is a probable connection between the disease and mistakes in nourishment; from what has been said above (pp. 50 and 166), the prophylaxis must be looked at from three points of view.

(1) The food chosen must be appropriate and sufficient, so

that it is capable of leading to the development of normal power in the youthful body.

(2) It must be suited to the capabilities of the child's digestive organs for the time being, both in quantity and quality.

(3) It must not be in a state of decomposition, and must be free from germs, absolutely free from pathogenic germs.

Mother's Milk.

The proper nourishment for infants is, as a rule, that which Nature has herself provided in the breast of a healthy mother; by breast feeding we remove a series of difficulties which are otherwise unavoidable. It is the duty of a doctor to induce the mother to suckle her child herself if it be in any way possible.

It is not the place here to enter with more detail into the preparation of the breasts from the sixth month of pregnancy, for the duties they have to undertake, on the conduct and mode of life of a nursing mother, her nourishment, and the avoidance of all bodily and mental excitement. Besides the cases where a mother cannot suckle her infant on account of defective development of the breasts, or for want of milk, she must not do so when there is great weakness, severe anæmia, tuberculosis, recent syphilis, or severe diseases, because she would only use up her own strength and endanger the infant by doubtful food (toxin contents of milk) or infection (see Deutsch and the opposing opinions of Biedert, Czerny-Schlossmann; toxin content, Rappin and Fortineau).

In these cases, where circumstances permit, a wet nurse should take the place of the mother as the most natural and best substitute. It is not the place here to speak of the ethical side of the question of wet nurses. With a child who, from his descent, may be suspected to be scrofulous, one must be more careful than with another to choose a wet nurse who is strong and not too old, who was confined at about the same time as the mother, or in any case has given birth to her child longer than six weeks. Care must be taken by most thorough examination that there is no suspicion of tuberculosis, scrofulosis, syphilis, or other weakening affections. The result of Wassermann's reaction insures against syphilis. Thomsen requires that the serum as well as the milk shall be examined. The claim for tuberculin inoculation, in itself justifiable, involves some doubt, as completely healed, inoffensive (bovine) lesions react positively, and thereby many wet nurses would be excluded who might be allowed to suckle without fear of consequences. The milk of the

wet nurse must answer the demands as to quantity and quality. One must not neglect convincing oneself, by inspection of the foster child, of its thriving and regular increase in weight. Besides, the milk of the nurse can be chemically and microscopically examined, but many children's specialists (Heubner and Czerny) consider this unnecessary.

Cows' Milk.

If nourishment by a nurse cannot be carried out, or if the mother's (or the nurse's) milk flow too slowly, as known by the motions of the child being scanty, brown and green instead of yellow, and by the weight of the child before and after feeding, then nourishment by cows' milk with a bottle must be resorted to as a substitute or in addition. There are so many natural advantages in this that it becomes a very important duty to assure ourselves of the benefit resulting from it on scientific lines, the more so as the slightest neglect with children suspected of scrofulosis might have very serious consequences. One should endeavour at all costs that at least for the first week, the most serious time, nourishment by mother or nurse should be obtained; then should a change be absolutely necessary, at first only one meal of cows' milk may be substituted, then, according as necessary, two or three may be given; but breast milk should be given as long as possible, at least in the first half year.

After asses' milk, which on account of the difficulty of obtaining it can hardly be taken into consideration, cows' milk comes next in quality.

To render cows' milk more similar in its composition to human milk, and more suited to the child's power of digestion, one must add two parts of water to one part of milk in the first month; in the second and third months equal quantities of milk and water; in the third and fourth months two parts of milk to one of water; after that pure milk. To every 100 c.c. add one teaspoonful of milk-sugar, or Soxhlet's nutritive sugar up to 10 per cent. of the mixed milk. Instead of water, a very suitable gruel which may be given is made of two teaspoonfuls of oats, wheat, barley, or maize meal (mondamin) mixed with half a litre of water and boiled. The quantity for the day, in from five to six meals, is from 400 c.c. in the first month to 800 or 900 c.c. in the fourth month. Czerny (see below) increases from five times 100 c.c. to four times 250 c.c., and one supplemented meal of soup at the end of the first year. Undiluted milk has been given from birth; the results of this are not yet definite.

The harmful variations in the constituents in consequence of changes in the milking, the race or age of animals, may be lessened and neutralized by using milk from several animals.

A few years ago preference was given in general to dry feeding for milch cows, and it was thought to be the best means for assuring good infant's milk free from germs. According to present opinions, we think it much more important that fodder should be chosen containing the proper proportions of nourishment, and sudden change of feeding should be avoided.

Besides, living in stables with dry food has many disadvantages over being in the fields, and especially it increases the danger of infection by bovine tuberculosis.

We may presume that it is well known that the milk of diseased animals is inferior and often very harmful for infants. Scrofulosis and tuberculosis are the two diseases the prevention of which, in milch cows, has chiefly to be considered, and the wide spread of which we have demonstrated by statistics above (see p. 108).

For obtaining milk, especially milk for children, only such animals should be chosen as are completely and most certainly free from bovine tuberculosis; this is a demand which it is often difficult to fulfil owing to the prevalence of bovine tuberculosis.

As a rule, tubercle bacilli are only transmitted to the milk when the cows suffer from tuberculosis of the udder. But tubercle bacilli have been found in cows apparently free from tuberculosis of the udder, so that the demand that all animals with any, even closed tuberculosis, shall be excluded, as milch cows, especially for children, appears to be justified.

Only those animals afford a complete guarantee which with appropriate and repeated tuberculin injection show no reaction, and which thus proclaim their immunity. There is no doubt that by tuberculin reaction many animals are excluded which give no tuberculous milk. Thus, for example, amongst eighty-four cows which reacted with Bolle, it was only the milk of one single cow which, on further injection, produced tuberculosis. On account of the variations which animals exhibited in reaction, the question was raised whether a monthly examination of all cows by a veterinary surgeon and testing of the mixed milk would not be sufficient.

But that this method is not an entire substitute for tuberculin injection for clinical examination does not suffice, even if clinically healthy animals have tubercle bacilli in their milk only exceptionally (Yong). The transmission of tubercle bacilli to the milk by one single cow, whose disease had escaped notice, can

infect the whole of the (mixed) milk of the others (Moellers and R. Koch).

We must keep to the demand for tuberculin injections, at least for cows giving milk for infants, which is also sold at a very high price.

Unfortunately, many dairymen only use the tuberculin injection as an advertisement and for obtaining high prices; many cattle dealers often profit by the fact that cattle become accustomed to tuberculin to a certain degree, and after a short time there is no reaction, no increase of temperature, and the animals appear healthy. But we can protect ourselves, when we suspect a previous injection made with the intention of deceiving us, by employing a double dose, and taking the temperature every two hours (Klimmer and Kiessig); further, after testing the condition of the animals, repeating the test after three or six months, and only, should this prove negative, allowing the animal to come into the milking shed.

According to Klimmer, no tuberculin habit is formed with the conjunctival test, and hitherto no particular harm has been observed as resulting.

Besides tubercle bacilli, the contamination of milk by other bacteria is of great importance in scrofulosis. To say nothing of dilution by the addition of (bad) water and chalk and plaster of Paris, which the inspectors have to strive against by frequent supervision, the milk may become contaminated by the excrement of the cows, or later by dirty vessels, or infection from the air. Once in the milk they proliferate rapidly in so excellent a culture medium, and reduce the nourishment of the child by the decomposition set up by them and their products, and are a direct menace by their invasion to the tender, penetrable mucous membrane, so capable of absorption, together with the lymph glands belonging to them (causing tabes mesenterica non-tuberculosa).

It is most necessary, therefore, from the very beginning to endeavour as far as possible to prevent the entry of germs into the milk.

To avoid this danger, as far as may be, there must be extreme cleanliness in the whole of the dairy farm, rapid removal of excrement, the prevention as far as possible of dust when bringing in the germ-laden dry fodder, cows must be milked in a place free from germs, punctilious cleanliness in milking, previous cleaning of the udder and the bush of the tail, and the milkers, clean vessels, immediate thorough cooling of the milk after milking, cool temperature, both in transport (in sterilized cans or bottles) and when kept.

In modern model dairies milking takes place in antiseptic sheds under antiseptic precautions, by employés especially trained, and prepared antiseptically; the milk is put at once into bottles, and immediately brought to a low temperature.

Only milk taken from animals proved to be healthy, and collected with antiseptic precautions can be considered as completely free from bacilli and free from all objections, so that it can be taken by children in its raw state or boiled. But the cost entailed by such precautions is much too high at present to be afforded for the greater number of our children; besides which, the great advantages gained by the use of raw milk are not entirely uncontested (A. Keller and Planteng).

For the greater number of our children we must be content if the milk is obtained at least as free as possible from germs, by low temperature and sterilization, and comes to us as little changed in condition as may be.

Sterilized milk usually obtained in shops is, as a rule, heated in bottles to 65° or 75° C. for thirty minutes, or to 70° C. for fifteen minutes, or in other dairies to 100° C. for ten minutes. Unfortunately, the repeated observation of such milk proves that the proceeding is not always carried out sufficiently conscientiously.

If the milk is not bought at a model dairy, where it is sterilized or pasteurized and put into closed bottles, it must at least be divided at once into portions at home, boiled for quite five minutes, then kept in a cool place, and consumed within twenty-four hours. For household use the apparatus and method of Soxhlet, Soltmann and Bertling have proved the best; if these are not obtainable, one can use a simple enamelled saucepan "with a lid which covers the spout" (Biedert).

Just boiling up, as is usual in most families, is by no means sufficient to destroy germs. Intense heating certainly has disadvantages for the milk, as the curdling, reducing the salt, and changing the sugar diminish its nourishing qualities.

The so-called Moeller-Barlow's disease has been traced to the use during many months of overheated milk. Besides which, raw milk contains a number of useful ferments, protective materials and immune bodies which are destroyed by the great heat.

On account of the last-named reasons v. Behring endeavoured to make the consumption of pure milk possible by obtaining milch cows which were free from tubercle bacilli (prophylactic bovine vaccination), and, besides this, to sterilize the milk and render it free from germs by means of a low temperature.

v. Behring recommended at first an addition of formalin for the preservation of the milk, and rendering it harmless with respect to bovine bacilli, later Sufonin and Hepin to improve the taste; but hitherto these attempts have led to no practical result.

To ensure obtaining pure milk from healthy and properly fed cows, it should be taken only from dependable model dairies or shops. In dairy farms where breeding is also carried on we are more likely to meet with animals which have been injected with tuberculin than in milk dairies only, which have less interest in breeding.

The same caution must be exercised with respect to butter, cream, curds and whey, cheese, kephir and yogurth, in which it is well known the bacilli remain virulent for a long time.

As one alone among thousands is much too weak to protect himself, and as an individual in many cases does not understand the question, it becomes incumbent on the State, and more especially on the district councils, to take energetic measures on a question that is so highly important for the weal or woe of the population, and by strict superintendence of the milk put on the market, as well as by undertaking the production of milk for children from its own model dairies, to be able to sell a hygienic milk free from all suspicion at moderate prices, and thus to supply the poorest children with that food which is necessary for their life and growth. Only in this way can the terrible evils which at present exist in the handling of milk be in some measure redressed. A whole series of tasks lie before the councils, which might be undertaken in conjunction with charitable institutions; the foundation and support of a bureau for advice to mothers, with examination of the mother with respect to her ability to suckle her child (in relation to tuberculosis); feeding institutions for nourishing the mothers during the period of lactation, with offers of prizes;[1] institutions for the care of infants and children,[2] in which milk would be given; milk kitchens, infants' homes, fresh air homes, and children's sanatoria. These institutions exert a favourable influence, not only on the mortality of children, but their bringing up in general, and have a doubly important

[1] Hohlfeld found that the offices for advice for mothers were only visited after prizes for suckling had been offered, and only mothers seeking advice were eligible for the prizes.

[2] It is quite right what Comby says, that the care-stations as far as they reduce the danger of milk infection are only of secondary importance, especially in the fight against tuberculosis, but they are of great importance in the avoidance of scrofulosis.

effect on the control of bovine infection, which plays a considerable part in scrofulosis (see Bibliography; also Latour, Comby, and the Minutes of the XIV Hygienic Congress).

On the State, too, devolves the more difficult task which, unfortunately, has as yet only reached the initial stage, of combating and exterminating bovine tuberculosis. Propositions have not been wanting to give up the breeding of cattle entirely in Europe on account of tuberculosis, and to replace it by the breeding of sheep, goats, and horses (Mendez). But no uniformity has been arrived at as to the best means of attaining this end, nor have any propositions been forthcoming which are rational and worth discussing.

The radical measures of slaughtering all animals that react to tuberculin is rendered abortive, according to experience in Massachusetts and in Belgium, on account of the cost and the difficulty of obtaining a new supply.

The only thing to do at present is to follow Bang's methods, viz., to separate those animals which react from those which do not, and thus to obtain by special precautions a breed of calves free from tuberculosis by means of sterilized milk free from bacilli and to kill all cattle with open tuberculosis, and if possible those that have clinically manifest tuberculosis. Denmark, Sweden, Norway, &c., had good results by these methods. I refer, amongst others, to the excellent treatise on the experience gained in Sweden. In Germany there are many supporters of the less severe methods of Ostertag, according to which one endeavours, without employing the tuberculin with older animals, in the first place to put aside at first those proved by clinical and bacteriological examination to be dangerously tuberculous with open pulmonary and intestinal tuberculosis, &c., a practicable suggestion on account of their relatively small number. Besides this, an attempt has been made to obtain a breed of cattle free from tuberculosis by separating all calves two days old from the mother and feeding them with boiled milk. Here and there success was obtained by this means.

The different methods of protective vaccination—namely, the bovine vaccination of v. Behring; the injection of dried human tubercle bacilli into the blood-stream twice at intervals; according to Koch, Schulz (Neufeld), Wiesner, Heymann's method of injecting tauruman; according to Klimmer, the injection of antiphymatol—give a certain protection against natural infection; but this increased power of resistance does not appear to be of long duration (Eber and Klimmer), and therefore has on the whole not yet led to any practical results.

Milk and Food Preparations.

To increase the nutritive properties of milk we often have recourse to artificial milk preparations, which, although they do not offer a complete substitute for natural milk, are yet highly valuable on occasions and as a supplementary diet.

Natural cream mixtures (according to Biedert, fresh cream, water, milk, sugar and milk in six gradations) and cream conserves increase the fatty contents (so important for digestion and nourishment) of diluted cows' milk, and render good service in protracted disturbances of digestion, in constipation (often intercurrently with diarrhœa), and mucous enteritis. But in fat diarrhœa, on the contrary, skimmed cows' milk or buttermilk is advisable.

Of such artificial preparations, those which chiefly come under consideration are that of Biedert von Pizza, prepared in Zwingenberg, containing 7·1 per cent. caseine, 15·5 per cent. fat, 46 per cent. sugar; artificial cream mixture (ramogen); Lahmann's vegetable milk; Löfflund's cream conserve, with the addition of maltose; Bolle's keeping cream; Drenkhaus' tinned milk (gaseine 6 per cent. and fat 16 per cent.); centrifugal cream, which is put on the market fresh; and Steffen's cream mixture, with veal broth prepared from it; Gärtner's fat milk (the fatty contents are increased by centrifugalizing diluted milk); vegetable milk of Hewel and Veitter in Cologne, prepared from nuts and almonds (according to Klemperer, containing albumin 10 per cent., fat 25 per cent., sugar 38·5 per cent., salts 1·5 per cent.).

The digestion of the caseine is said to be facilitated by Timpe's milk powder (pancreatic powder and sugar), Voltmer's artificial milk (a cream conserve digested with pancreas), Backhaus' children's milk (obtained from rennet ferment and trypsin added to milk), Rieht's albumose milk (with heated albumin of fowls' eggs), and lastly somatose (cream mixture, with addition of this albumose).

On the whole these preparations are less used than formerly.

As preparations rich in sugar but poor in fat may be mentioned Liebig's soup, Keller's malt soup, Allenbury's infants' food, Soxhlet's nutritive sugar, buttermilk (15 grammes wheatmeal, 60 grammes sugar, 11 grammes buttermilk).

As an addition, to make the caseine more digestible, and for a short time as a change from milk, the following, which are poor in substance, may be mentioned: the glutinous fluid from boiled oatmeal or barley, gelatinous solutions (veal bones, gum arabic),

arrowroot, raccahout, salep, tapioca, and especially when there is a tendency to diarrhœa, white of egg and water, but where there is a tendency to constipation, sugar water.

If milk does not agree with a child, even when diluted (1 in 10), for example, in fat diarrhœa, but not before the tenth week, recourse must be had to disintegrated flours, the carbohydrates of which are already dextrinized, but by some the rapid change of flour into sugar is looked upon as a disadvantage.

Other preparations are Nestlé's children's meal, especially Kufeke's children's meal, Liebe's soluble leguminose, Rademann's children's meal, and Mellin's food for infants, Theinhardt's hygiama (very good with cocoa), Timpe's strong semolina, Löfflund's biscuit meal, Odda (a cocoa and milk preparation), Muffler's sterilized infants' food, Riedel's strength food (the effective components of barley malt), Pfund's condensed milk.

Other preparations easily digested by reason of the fine disintegration of the meal are :—

Knorr's meals (oatmeal, rice, flour, or tapioca); Hartenstein's leguminous meals, maizena, mondamin, arrowroot, and lastly, the cheaper biscuits, in which, by the double heating process of baking and roasting, the starch is dextrinized and becomes more soluble; Friedrichsdorf, Wurzen, Opel's biscuits. These preparations should not be used before the tenth week.

These meals can be used as gruel, or as soup, or form a dish in themselves, and may serve in the second half-year as an introduction to solid food. This transition has from time immemorial consisted of pap from ordinary flour, bread, semolina with sugar and milk, which should not be given before the sixth month to children suspected of scrofulosis. According to the more recent observations of Gregor and Czerny the early and regular feeding with preparations of meal (wheat, oats and maize) as an addition to milk, instead of a sugar solution, even from the fourth month, will rather diminish than increase the danger of scrofulosis.

It has often been remarked that scrofulosis mostly develops some time after weaning, "when the child begins to take other food than milk," and that it not rarely shows itself in the earliest years in those children who have been brought up without mother's or nurse's milk. Early and plentiful diet of amylaceous foods has long been considered to have a causative connection with scrofulosis, but more recently too plentiful feeding with milk has been brought forward.

The weaning of children, which may usually begin at about the sixth or eighth month, is preferably postponed with children

suspected of scrofulosis, but after six months and a half, instead of mother's milk, once a day thin semolina, sago or rice, soup of fresh meat, and bones without fat, with soup herbs are given. The same may be given to children brought up on cows' milk. After perhaps three or four weeks a second milk meal is replaced, and a pap of one or two biscuits or toasted bread, or semolina, or groats with sugar, milk and water, is given in the usual manner, or one may prefer the powdered meals and finely triturated, leguminous foods. Yolk of egg or soft-boiled eggs are also given. The mother's or nurse's or cows' milk must still predominate. About the ninth or tenth month the child must be completely weaned. See Theodor's "Practical Hints."

As an additional nourishment, the different albuminous preparations may be mentioned:—

Milk albumin preparations: Sanatogen (caseine, with 5 per cent. glycero-phosphate of sodium), Plasmon, Bioson, Galactogen, Eulactol, Albulactin.

Vegetable albumin preparations: Roborat, Nutrol, Tutulin, Enterorose.

Meat albumin preparations: Somatose, Calodal, Riba (made from fish, especially recommended by v. Noorden).

Preparations from combinations of albumin: Tropon (from animal and vegetable albumin), Panopepton (beef and wheat), Visvit, Biocitin, Nutrin.

Meat preparations, especially Valentine's meat juice, Wyeth's beef juice, Brand's beef essence, Carvi's meat juice, Denaeyer's meat peptone, Valid's meat preparation, extract of meat and peptone, Liebig (formerly Kemmerische's peptone), meat meal and meat cocoa, Mosquera (also recommended by Montin), Robur's meat juice, &c.

The less frequent occurrence of tuberculosis amongst flesh eaters, as compared with vegetarians, induced Richet and Hericourt and others to recommend diet of raw meat to raise the power of resistance. The results appear in some cases very favourable (Monier, Philip, Josias and Roux, and Raissonier), but in others no success was observed. In any case, the use of meat freshly compressed, about ½ kilogram of meat (Klein's meat juice pressed fifteen minutes) or finely scraped raw beef, in small balls (with apple or apricot jelly for weakly persons), is to be warmly recommended (see Cornet, "Die Tuberculose," second edition, p. 937).

In the second and following years foods containing starch meal, which easily induce intestinal catarrh, pulse, cakes, brown bread and fermentative foods must be given as sparsely as

possible, and nitrogenous animal food, milk (1 litre daily), is to be preferred, also lightly boiled eggs and meat. When the back teeth are cut, light meats, such as fowl, pigeon, veal, calves' brains and scraped ham, boiled till tender, minced finely and mixed with vegetables rubbed through a sieve and of thin consistence, may be given.

A mixed diet is the best, giving special attention to foods containing mineral salts, such as fresh young vegetables, especially spinach, and most fruits; such vegetables, rubbed through a sieve, and cooked fruit are to be recommended for children suspected of scrofulosis from the tenth month (Ritter and others).

In the third year the children can, with certain restrictions, gradually take their place at table with their parents, provided the food is prepared under hygienic conditions and is not too highly spiced; the only condiment allowable for children is salt; at the same time milk must form a part of the diet, $\frac{1}{3}$ to $\frac{1}{2}$ litre a day; it is sufficient to give meat once a day.

Coffee and tea are best entirely avoided in early childhood, or only given with a great deal of milk just to give it a taste. Acorn coffee may be given to thin children, according to v. Ammon, but not to fat children. Alcohol, which was formerly recommended as strengthening, is now generally condemned, and rightly so; it is now only ordered for children as a medicine in cases of acute illness.

As further nourishment cod liver oil and malt extract, as mentioned in Therapeutics, are to be made use of (see p. 324).

Older children must be accustomed not to be dainty. Too great indulgence in giving way to fads and dislike of dishes that are the most appropriate, frequently from the example of parents, brings its own punishment often for the whole life. Children refuse at a critical moment food upon which their life may depend, with "I can't," which often with the weakly ones prevents any continued and decided improvement of their state of nutrition. Of course, it is a different matter when dealing with real idiosyncrasies such as now and again appear, for instance, the distaste for milk, butter, &c.

One chief condition for successful development is strict order and punctuality in feeding. At first, after birth, a child should take nourishment (at 36·5° C.) every two or three hours; after a few months every three hours, with the exception of when it sleeps; at most, six or seven times daily altogether; the older child should not take more than five meals at stated times in order to give the digestive organs time to rest between meals. As a feeding bottle,

only one that is easily cleaned, is smooth and has an india-rubber teat is allowable, and it must be kept punctiliously clean by boiling, &c.; an emphatic warning must be given against the bad habit, which is as dangerous as it is disgusting, of blowing the food or chewing it beforehand, a habit which has claimed many a victim to tuberculosis and scrofulosis (see Cornet, "Die Tuberculose," second edition, p. 243).

A child must be accustomed to masticate solid food thoroughly; by eating quickly, large pieces which cannot be penetrated by the digestive fluids are easily swallowed, and give rise to similar evil conditions as are caused by excess of nourishment in over-feeding.

Not only the necessary and allowable quantity of nourishment, but also its suitable nature demands our whole care and superintendence. The instincts of the child can be allowed to come into play only so far as is consistent with convincing ourselves of its thriving by regular weighing.

Experience teaches us that over-feeding is more to be feared than under-feeding. Owing to the narrow limits of the powers of the child's stomach, either the surplus food is vomited or—which is less harmful—it passes through the intestines undigested and unused; but under certain circumstances, especially in continued over-feeding, undigested remains of food are retained in the intestine, irritate the mucous membrane by the processes of decomposition, lead to inflammation, and thus diminish the secretion of the normal intestinal fluid and the absorption of the chyme.

Over-feeding thus becomes under-feeding, in the strict sense of the word, but surpasses the latter considerably in its harmful consequences, as the undigested remains of food in the intestines become a breeding place for all sorts of bacteria and a source of infection.

Thus over-feeding has an important significance in the production of scrofulosis. The bacterial invasion favours to some extent the inflamed condition of the intestinal mucous membrane, and leads, as a further consequence, to the swelling of the mesenteric glands, the non-tubercular form of tabes mesenterica, and may also favour the appearance of the tuberculous form, though this is more frequent from other causes.

The more indigestible the food, which is given in too great quantity, the greater are the evils it induces. In this particular the caseine of cows' milk appears considerably to surpass that of human milk, but the most dangerous is undigested starch flour; perhaps this is the chief cause of the evil odour which

attaches to excessive and premature feeding with pap containing starch flour, especially in connection with scrofulosis.

One must, therefore, carefully endeavour to avoid over-feeding, and also to cure as speedily as possible stomach and intestinal catarrh and other affections of the intestines which are accompanied by proliferation of bacteria. It goes without saying that we must relieve all direct under-feeding quickly, and derangements in nourishment caused by faulty construction of the mammary glands by aphthous inflammation, by thrush, and cold in the head of the child, which make sucking difficult, and in case of necessity see that sufficient is obtained by means of the spoon or feeding boat, or in many cases have recourse to stomach tube feeding, as Neumann and Hochsinger have done in cases of thrush with swelling of the bronchial glands.

Faulty Nutrition—Exudative Diathesis.—The experience that many children, in spite of apparently appropriate and sufficient milk food, do not thrive has been traced in the last two decades principally or entirely to the changes in milk induced by bacteria, and their harmful effect on the mucous membranes of the stomach and intestine. It is only in the last decade that a further and in many cases perhaps a more important reason has been found in the unsuitability of certain of the component parts of milk. Biedert considers the cause to be especially in the caseine which is over-abundant and more indigestible (faulty nutrition due to albumin). Czerny, who has developed the theory of "faulty nutrition due to milk," lays especial stress on the derangement of the changes in fatty matter, on the innate incapability of some children to sufficiently digest the fat of the milk which has been introduced in large quantities, a condition which he considers to be the expression of exudative diathesis, and is to be combated by a diminution in the quantity of fat given, which should be replaced by food richer in carbohydrates. By others the amount of sugar in the food was accused of the disturbance of nourishment (faulty nutrition due to sugar, Finkelstein and F. L. Meyer). The harmful bearing of the salts in cows' milk in the nourishment of infants has been noted (faulty nutrition due to salts); infantile eczema has been connected with it, and an endeavour has been made to relieve the eczema by a diet poor in salt (Finkelstein, F. L. Meyer, Geisler, Witzinger, E. Müller, and others).

In opposition to these stands the faulty nutrition due to flour, which is often the consequence of diet for infants consisting principally or entirely of meal (Langstein, Salge, and others). With this diet the children, who look blooming, exhibit remarkably low powers of resistance against infection; later they become

weaker, though they may cover their bodily defect for a time by œdema. This condition, due to lack of albumin, will be improved and cured by leaving off the meal, and replacing it by human or cows' milk, Biedert's cream mixture, Gärtner's fat milk, Biedert's cream conserve, Backhaus' milk, &c.

In the lively discussions of the last ten years on exudative diathesis, which is stated to be the preceding stage of scrofulosis, the question of the nutrition of scrofulous children, and children of exudative diathesis who have a tendency to it, plays a very important part.

Contrary to older opinions, which supposed a connection between nourishment and the lymphatic constitution, in the last few decades very abundant nutrition, especially with milk and eggs, has been considered to be appropriate for the scrofulous, both prophylactically and therapeutically. Czerny, and numerous physicians who make a speciality of children's diseases, in recent years look upon it as a releasing agent of the exudative diathesis, and base their theory on the fact that exudative symptoms appear especially just at the time of a great increase in weight.

As before mentioned, it is the derangement in the metabolism of the fatty materials which are accused by Czerny as being the releasing agents. On the supposition that the limit for the assimilation of fat, especially that in animal milk, lies particularly low, it is required that fat in food and the giving of milk shall be reduced to the minimum possible, consistent with the age of the child; even human milk, which is more digestible than that of animals, appears from this not always to be the very best diet, and a diminution in the quantity, and a partial replacement by soup, is considered necessary under certain circumstances. At the same time eggs are to be excluded from the diet as far as possible, being strengthening food which induces over-nourishment, especially when symptoms of exudative tendency are already present. The loss thus sustained is to be made good by introducing carbohydrates, but without falling into the other extreme of their too abundant introduction, which has just as prejudicial and dangerous an effect, whilst meat diet is not considered harmful.

According to this, in the first two years of life, when milk is the principal article of food, it may be supplemented by carbohydrates, and later by soup and vegetables. With infants which do not thrive with ordinarily appropriate food, or when they increase excessively in weight and exhibit symptoms of exudative tendency (p. 54), the meals at the breast will be reduced from five to four sooner than with normal children, even at the fourth

month, the time for feeding reduced from twenty to ten minutes, and the mother's milk replaced once a day by meat soup (made from any meat), with meal from oats, barley, or rice.

According to Czerny, after the second year vegetable diet should be given chiefly, with some milk ($\frac{1}{4}$ to $\frac{1}{2}$ litre), meat, uncooked fruit, but no eggs, no cream, little butter, and no sugar.

As regards the success of this mode of diet, by means of it many of the symptoms which have been noted as those of the exudative diathesis frequently pass off, for example, paleness (not caused by anæmia), catarrh and swelling of the mucous membranes, lichen urticatus, &c. The scrofulous habitus with puffy swollen lips is often favourably influenced, though this occurs from tuberculin without change of diet (Heubner).

But many patients, on the other hand, and many phenomena of the exudative diathesis, eczema, &c., are little benefited by this treatment (Pfaundler), so that there can hardly be a question of "conquering the diathesis by dietary therapeutics," as Czerny believes.

If it were proved that the exudative diathesis depended on disturbances in the changes of fatty matter, the principle of removing the low capability of performing this work before it had begun to manifest itself, and by great care to change it to physiological activity, would without doubt be justified.

It is just as little proved that this mode of dieting is the cause of the temporary favourable effect, for it is questionable whether this effect is to be ascribed to the reduced amount of fat given, or the removal of the harmfulness due to fatty nutrition, or if it be not the simple consequence of the cessation of over-feeding.

Vegetable food with spare diet has long been recommended by the French for arthritis in children, and the early giving of vegetables, which has been especially recommended by Ritter for years, is appropriate in the exudative diathesis, but principally on account of avoiding over-feeding (Steinitz).

But nevertheless Czerny's method in the prophylaxis of simple pyogenic scrofulosis and its precursors, especially in puffy, fat children, will be kept in view and will often be used with advantage.

The modern device, "no over-feeding," is certainly justifiable for those many mothers who stuff their children, without knowing when to stop, as if they had a goose to feed for the table, or a calf to fatten for slaughter. So far the general opposition to over-feeding, to the heaping up of puffy spongy tissue, which is defenceless against every infection, is well grounded.

But the theory propounded by Czerny of only giving the smallest quantity of cow's milk or food which is just enough to procure "sufficient increase of weight to satisfy moderate demands and to ensure good bodily development" is too one-sided, unless one has to combat threatened over-nourishment with its consequences, for a certain excess of food and a moderate putting on of fat is frequently not without value at a later time.

Brehmer was not wrong when he formed a worse prognosis for the tuberculous who from their youth had had poor appetites than for those who were accustomed to eat well.

When we are dealing with tuberculo-scrofulosis, with a manifest infection of the body—I am anticipating the next chapter—I consider it a direct error to be so anxious to avoid putting on more weight, as the future of the tuberculous adult often depends upon whether we can at the proper time successfully combat the threatening falling away of the body by plentiful nourishment, even by a certain amount of feeding, of course kept within bounds, as in this case loss of weight, from whatever cause it may arise, is, as a rule, connected with an aggravation of the disease with a spread of the process, and often introduces the beginning of the end; therefore it appears to me that scrofulo-tuberculous children in a good state of nutrition have more prospect of cure than those moderately nourished, who have been only accustomed to eat what is absolutely necessary. Recently Calot, as the result of years of observation, has recommended over-nutrition in coxitis.

HARDENING.

To protect the little ones from a tendency to cold and catarrh of the mucous membranes, which often become the point of entry for bacteria and may become the starting-point for scrofulous symptoms, they must be subjected to rational hardening, which increases the functional efficiency of the skin and prevents too great stagnation of warmth internally.

One must begin at 2 or 3 years of age. The child must be sponged down with cool water, from 30° to 20° C. temperature, in a warm room (for the method, see Cornet, "Die Tuberculose," second edition, p. 958), to be followed either by exercise or resting a quarter of an hour in a warm bed, and other necessary baths may be reduced to 1 to 2 in a week. As this sponging is to be preceded by a storing up of heat on the surface of the body, the child should be taken from the bed to be sponged down, or it should be given after first subjecting it to dry rubbing. With

very weakly children a part may be rubbed at a time, or they should be rubbed with diluted brandy.

Very frequently every sort of procedure that strikes cold or that draws heat from the body disagrees decidedly with so-called lymphatic children and especially fat children; they get headache, giddiness, &c. In such cases we must not try to accustom them, but let them have warm mineral baths instead of cold sponging (see p. 328), which almost always are followed by good results.

The living rooms of the child must be moderately warm, not over-heated, the bedroom kept at a temperature not under (8° to) 10° C., the clothing must be suitable to the time of year. The spoiling of children by over-anxious mothers by too warm clothing, thick comforters, scarves, &c., is as bad as just the opposite habit of letting the children run about with naked arms and legs in cold weather. Owing to the great sensitiveness of the skin in these children, irritation by coarse woollen clothing must be avoided.

CAUTION DURING ILLNESS IN THE FAMILY.

Should there be a tuberculous person in the family, with open tuberculosis, either the patient or the child should be removed as soon as possible. This is naturally all the more necessary the smaller and poorer the dwelling conditions are. There is in France a Society, called "Œuvre de préservation de l'enfant," whose object it is to take the children of tuberculous parents from their endangering environment and to place them with suitable persons in the country at a cost corresponding to their position in life.

With such care for the children a certain pressure on the parents is justified (see Neudecker's statements at the Vienna Conference on Tuberculosis, 1907). The Americans are much more energetic in carrying out measures which they consider necessary. For example, in Philadelphia some parents who refused to allow their children to be treated for an affection of the eyes in the way proposed by the school doctor were summoned for neglect of their children (Ensch).

If the removal of the child is not possible it should be kept as far as may be from the patient.

In any case in the family of a tuberculous patient the greatest care should be exercised in removing the secretion in the most hygienic manner. The patient must expectorate the sputum into a vessel or a spitting cup which contains water, to prevent its drying, this must be prevented from falling and be constantly

emptied; when coughing he must hold a handkerchief before his mouth, as I recommended in 1888, long before "Flugge's droplet infection" was introduced (for fuller details, see G. Cornet, "Die Tuberculose," second edition, pp. 839-840). Other necessary measures in tuberculosis (which I have fully entered into elsewhere), such as cleanliness in the room, on the landing and stairs, in schools, placing spittoons about, serve to keep scrofulous infection from the child.

The same precaution is necessary for patients with every sort of catarrh, because their secretions generally contain pus cocci.

Successful prophylaxis in this direction necessarily presupposes that the tuberculous patient and those about him are not deceived as to the nature of his disease by euphemistic terms, but are informed that danger of infection is present and how it is to be avoided.

The intention of sparing the feelings of the patient by suppressing the diagnosis, so as not to excite him, is a crime against those about him which cannot be sufficiently condemned.

For more than twenty-five years, amongst my numerous phthisical patients, I have followed the principle of informing them in a considerate, tactful way of the diagnosis, naturally emphasizing the prospect of recovery, and I have never had any harm result to the patient, and only benefit to those about him.

If a member of the family suffer from other suppurations or open scrofulous foci and fistulæ, a dry or damp dispersal of the secretions containing bacteria is prevented by covering the wound or fistula; the covering must be changed when children are absent, taken away at once and destroyed, together with any soiled pieces of bandage (for disinfection of linen, see p. 282).

The danger of transmission by tuberculides is, perhaps, not quite excluded, but hardly plays a part worth mentioning on account of their being seldom caused by virulent bacilli.

Kissing, especially on the mouth, is to be avoided, not only by near relations, but also by acquaintances, more especially by those affected with catarrh or tuberculosis. Children must be taught impressively never to allow themselves to be kissed by strangers.

These precautions are not only for parents and brothers and sisters, but for all persons who come in contact with the child. We trouble ourselves far too little about the state of health of our nurses and servants, their sense of cleanliness, or their bad habits, and then wonder when scrofulosis or tuberculosis is found in the family—"dropped from the clouds," as the saying is—which then spreads further.

Sometimes a child has tuberculous glands although the greatest care has been exercised with him, although the whole family and servants are healthy and infection by milk is as good as excluded, so that one is inclined to despair of the use of all precautions. On closer inquiry among the circle of acquaintances one discovers that at the house of the grandmother, or some other relation or friend, whom the child often visits, either one of these persons was tuberculous, or one of the servants who had occupied herself with the child.

In a case of tuberculo-scrofulosis which was at first difficult to explain, I was once able to demonstrate that the apparently healthy housemaid of the aunt was doubtless the source of infection; she was tuberculous, and when fetching and bringing back the child, which later became tuberculous, had kissed and hugged it.

Rational prophylaxis, therefore, must notice such apparently remote points and must watch over and embrace the supervision of the whole circle with whom the child comes into contact. A custom usual among the poorer classes of utilizing the clothes of adults, or clothes which have been given to them for the children, is a source of many dangers unless they have first been disinfected, which should be done free of cost!

Increased caution is demanded for the child at home and amongst one's friends shortly after recovery from measles, scarlet fever, or whooping-cough, as after these illnesses the mucous membranes appear to be especially sensitive and capable of infection. At this time change of air, with the opportunity of being much in the open air, is especially urgent. Fears which were formerly connected with vaccination have lost their meaning since the method of vaccination from arm to arm has been given up, and animal lymph is generally used, but the vaccination wound requires thorough protection from dirt.

DIFFICULTIES OF PROPHYLAXIS.

The special measures given above for the prophylaxis of scrofulosis are, on the whole, not new. If I except the measures for avoiding infection which have been more exactly laid down within the last twenty years, and which, as I believe, are based in the greater part on my experiments on animals (see p. 79) and the better knowledge of the paths of infection due to them, they have been recommended emphatically in very little altered form by older authors at the end of the century before last, and at the beginning of last century by White, Hufeland, and Lebert, but the success was, on the whole, as far as can be judged without

trustworthy figures, quite incomplete and unsatisfactory, for scrofulosis hardly played a lesser part in pathology (at least till a few years ago) than formerly.

The reason for the unsatisfactory results lies partly in the disregard of the opportunities of infection and the non-avoidance of them, but no less in the difficulties and direct impediments which the carrying out of the phophylaxis described has met with in many respects through the great increase of the population.

Instruction.

The prophylaxis lays such heavy tasks on the nutrition, care and bringing up of children, that the proper carrying out of it presupposes a high sense of duty, devotion and self-sacrifice, and last, but not least, a proper understanding on the part of those entrusted with the care of the children. Even with mothers who are willing to devote themselves to their natural duty—the care of the child—these qualities are not always combined. In consequence of the false modern education, without knowledge of household matters, the necessary measure of understanding is wanting in the young mother, when the new task of careful attention to children lies before her, though she have all the love and devotion. She is forced to hand over the care of her child to hired strangers as an inevitable resourse. These, too, even with goodwill, lack the necessary training and bring with them only the barest knowledge or old-fashioned wrong opinions. Just as it is required of male adults that they shall attend continuation classes, so should it be required of female adults, in the interests of their general culture, that they should attend a course of housekeeping.

We must continually, by word and picture, by effective placards and by disseminating notices, work and instruct others in the avoidance of diseases, especially of tuberculosis and scrofulosis, and in the rational care of children in all places where the mother can be influenced, in information bureaux and places for the care of adults and children, in maternity homes, in kitchens for nursing mothers, in milk kitchens, in short, in every charitable institution, by midwives, vaccination officials and sick nurses when they are called to families.

For older children there should be posted up in the schoolroom, and in other suitable places, pithy rhymes, such as the following :—

"Wash your hands before you eat,
Clean your nails, then take your seat."

These are small weapons in the fight, but here and there the suggestions may fall on good soil and bear fruit.

Dwelling-houses.

Besides want of proper understanding, which amongst the better classes is the principal drag on prophylaxis, other causes, which comprise by far the greater part of the cases, namely, outward bad conditions, are in themselves opposed to rational measures. Want forces the mother to assist in earning the living, and as long as she is away at work the child is left to itself. The condition of the dwellings makes a mock of the most modest demands, and even cleanliness and the use of water are kept within the narrowest limits for the sake of economy.

Our investigations in tuberculosis have only too often led us into houses or dark dwellings up a court, where parents and five children have shared two or three beds (see also my "Die Tuberculose," second edition, pp. 409 and 885; also Marcuse and Köhler). In Prussia in 1896, 342,612 children up to the age of 15 died, amongst whom 116,217 died from diseases (excepting disorders of nutrition) for which insufficient or too confined living conditions must be made answerable in a very great measure, either directly or indirectly, by being favourable to contagion: deaths, that is, from tuberculosis, scrofulosis, measles, scarlet fever, whooping-cough, &c.

The great influence poor living conditions exert on the production of scrofulosis is certain, and radical redress can only be expected from a law respecting dwellings which takes hygiene in some measure into account. But as carrying it out would dive deeply into the pocket, it can only be done slowly and by degrees, and with all possible forbearance. Hitherto the governing and law-authorities have carefully avoided the matter; but even should such a law be passed, years must elapse before any striking result can follow.

Are we to sit down quietly till then and look on while scrofulosis decimates our children and, which is worse, creates lifelong cripples and sufferers unable to earn their own living? Let us, till a statutory improvement of unhygienic dwellings takes place, at least endeavour to remove those children who are most exposed to danger from the worst dwellings and so reduce the evil.

INSTITUTIONS FOR THE CARE OF CHILDREN.

We would formulate our demands thus: in all districts sufficient arrangements shall be made to allow of there being placed during the day in a healthy environment all those children who, in consequence of bad conditions of dwellings and of poverty, are exposed in a considerable degree to the danger of

arrested development, of falling victims to tuberculosis or scrofulosis, or other such diseases which experience has taught us are consequent upon such improper conditions.

The above figures prove, by their terrible magnitude, the pressing necessity of our demands, not only to recommend much air and good nourishment, but also to procure the means by which a larger number of poor children will be able to enjoy these advantages.

First we must deal with children under school age, then with school children.

For the former there are crêches, establishments for taking charge of children, kindergartens, and forest recreation grounds.

Crêches, which have existed for years, may answer our purpose of taking children out of their dangerous surroundings, even if only within very modest bounds. They are intended for infants and children up to one year, and were first instituted, as far as I know, by Marbeau, somewhere about the forties of the nineteenth century, in Paris. Establishments for taking care of young children from the ages of 2 to 6 were instituted earlier, at the end of the eighteenth century, by Oberlin in Alsace, and in Scotland by Owen. They are intended especially for children whose parents, being at work all day, cannot give them the necessary attention; they have since had imitators in all countries.

The children stay in these institutions from 7 a.m. till 4 or 6 p.m., are waited on by a trained kindergarten teacher, and are amused with games, go home at midday, or are fed in the institution at a cheap rate (10 to 20 pfennig). When there is a garden, and the weather and the teacher allow it, they spend most of their time in the open air. The parents pay different prices, from half a mark to $4\frac{1}{2}$ marks per month, and frequently nothing is demanded.

These institutions, which, when first started, only took school and some social considerations into account, need reform hygienically, where possible they should be removed outside the town and increased to a sufficient number; then they might be of importance for public hygiene, and a support in the battle against the high mortality amongst children.

In my former edition on scrofulosis I gave the supreme rôle in the fight against scrofulosis especially to kindergartens, but I must confess these institutions have been outstripped; a far more important plan, the most useful weapons in the fight are the forest recreation places, instituted by Wolf Becher and Lennhoff, which enable a number of children to enjoy a sojourn in good air for a small outlay.

Ritter's attempt may be considered as the pioneer of the

forest recreation places. In 1893 he took scrofulous children living in Berlin from their unhealthy houses, and gave them a place during the day free from dust and amongst trees, made them do calisthenic exercises, had them massaged, and provided good nourishing food.

Unfortunately, after a few years the institution was given up for lack of means to carry it on.

Wolf Becher and Lennhoff first brought their idea of founding forest recreation places before the Congress on Tuberculosis in Berlin in 1899. For this purpose a piece of Government or common forest in the neighbourhood of the town should be given free of cost, to be used as a place of recovery for the sick and convalescent, a place of shelter being provided also for rainy weather by constructing a Döcker shed, and a simple kitchen should be arranged for.

With the help of the Red Cross the first forest recreation place was established in 1900 on the Jungfernheide, near Berlin; later others were started in Leipzig, Frankfort-on-Main, Hanover, &c. These forest recreation places, which were first intended as day sanatoria, differ from all other similar institutions by their much simpler arrangements, by having their land free, their low cost on first building, and the way they are carried on, which renders it possible to give a hygienic place to stay in for the day, answering all purposes with very little expense. At first intended for adults, the good results attained induced similar recreation places to be erected for weakly children (in Charlottenburg), and for infants (by the Women's National Union in Pankow). In the infants' recreation places the little children may often remain all night (the charge being 1 mark for day and night), whilst the mothers go home at night.

Such recreation places must naturally be easily reached from the town. A piece of forest from 3 to 4 morgen[1] is generally sufficient; the land must be dry and permeable, be slightly on the slope, and wholesome fresh water must be in the neighbourhood. I cannot here go into details.

Soon stronger sheds in special material and reinforced concrete replaced the Döcker sheds; sometimes heating arrangements were added.

Often the children are fed entirely and milk is given; of course, with the small means at command the food is simple, but it is sufficient and nourishing. Oatmeal with milk, oat cocoa, rye broth, milk and bread, and at midday meat, vegetables, &c.

In Berlin the whole cost of feeding the children comes to about 50 pfennig (6d.) per day per head.

[1] Roughly 1½ to 2 acres.—Translator.

In many cases the recreation places could be combined with workmen's kitchens to reduce the cost and the number of persons employed. The cost of forest recreation places is not to be compared with those of consumption sanatoria, where one bed comes to about 5,000 (£250) to 6,000 (£300) marks, whilst the building of an entire forest recreation place costs 10,000 (£500) to 12,000 (£600) marks if there is no outward show, and only useful and necessary requirements are kept in view, so that the cost for one year for two or four consumptive patients would in a forest home benefit over 100 persons.

Insurance offices and district councils have here and there granted loans without interest to enable these institutions to be erected, and the central committee for combating tuberculosis has often given subscriptions for the purpose.

It is the children in such institutions who repay us most. To live in narrow courts and streets is most dangerous for the development of their bodies, and stamps them for their whole life with the seal of inferiority, while life in the woods revives and strengthens them bodily and mentally.

The day's programme is about the following: Immediately on their arrival the children have their breakfast, then under the superintendence of the kindergarten teacher they do easy gymnastic exercises; next they are occupied with school work, instruction and play, which is interrupted for a short time for a light lunch. After the midday meal they have to rest awhile; in the afternoon simple games, walks, collecting flowers and insects, and tea; after a light supper they start home.

The infinite hygienic utility of these forest recreation places needs no further justification; they enable the children to spend the day in the fresh forest air and bright sunshine instead of in small, close, dark houses, and instead of insufficient, inappropriate food, they get good, plentiful, wholesome food with vegetables and milk. The increase in weight of the children, their improved and sometimes blooming appearance after a short time, speak much more plainly for it than long expositions.

To-day we may truly say it is a disgrace for a medium-sized or large town if it has not one or more forest recreation places according to its population.

With further organization it would be desirable to arrange them also for night work on the lines of the American sanatoria. The "night camps," too, are very useful, as they enable workwomen who specially suffer from the bad conditions of dwellings to sleep in good air (Latz and Effler).

But how far are we from a national prophylaxis capable of being carried out and answering to our demands?

FOREST RECREATION PLACES.

* Denotes open day and night. † Denotes open during the winter also.

Province or confederate state	Name and place of institution F.R.P. = Forest recreation place	Number of inmates: Women	Number of inmates: Children	Amount charged in marks
East-West-Prussia	*†Schneewalde, nr. Königsberg ...	20		2.0
	Heubude, nr. Danzig	150		1.50 for women 1.10 for children
Brandenburg	Leopold Koppel, F.R.P. ...	—		—
	*†Eichkamp, nr. Berlin	250		Summer 0.55 Winter 0.70
	* Pankow, nr. Berlin	250		0.55, full board 1.10
	Sadowa, nr. Berlin	—	250	0.30—0.50
	Wolf Becher, F.R.P., nr. Berlin	—	250	0.30—0.50
	* Schönholz I, nr. Berlin	—	250	0.30—0.50
	* Schönholz II, nr. Berlin ...	30	30 infants	1.25 for children
	Schöneberg I, nr. Eichkamp-Grünewald	—	150	1.0
	* Schöneberg II, nr. Eichkamp-Grünewald	—	200	1.0
	† Madlower Heide, nr. Kottbus ...	80—100		—
	† Spandau II	Projected		—
	* Westend, nr. Eichkamp-Grünewald	—	240	0.80, or 1.70, including lodging
	*†Mädchenhort Eberswalde ...	—	110	1.50 free patients
	Königsheide, nr. Johannisthal ...	100		0.55
	Forst Lausitz	30	Children	0.5 for children 1.0
Pomerania	Hohenkrug II, nr. Stettin ...	60	—	0.75 for children 0.60 for dinner and 1 litre milk
	* Jeeser, nr. Griefswald	70—80		2.0 for board and lodging 1.50 2.0 with lodging
Posen	† Unterberg II, nr. Moschin ...	75	—	1.40
	Unterberg III, nr. Moschin ...	—	75	—
Silesia	Karlowitz, nr. Breslau	—	Children	1.0—1.40
	Oswitz, nr. Breslau	—	120	1.0—1.40
	* Krampe, nr. Grünberg	10	Children	1.80
	* Bunzlau, in Silesia	8	12	1.50 2.0 with lodging
	* Görlitz	50	Children	0.60—0.90 with fare
	Derschau-Oppeln	20	Children	1.50
	* Glogischdorf, nr. Glogau ...	Women	30	0.60 for children 1.60 for women
Province of Saxony	Haynau	—	50	Planned
	Rogätz, on the Elbe	—	45	0.60
	* Halberstadt	35	Children	1.20 1.0 club price
	* Märkische convalescent home, Luisenheim, nr. Kuhfelde	23	22	1.50 for children 2·75 for women
	Magdeburg-Sudenburg Fort II	100	Children	0.50—0.80
	Dölauer Heide, Halle on the Saal	—	20	—
Hanover	Vinnhorst, nr. Hanover ...	—	Children	0.20—0.30 dinner
	Misburg, near Hanover ...	150	150	0.20—0.30 dinner
	* Harburg, on the Elbe ...	30	—	According to meals taken

FOREST RECREATION PLACES—*continued.*

Province or confederate state	Name and place of institution F.R.P. = Forest recreation place	Number of inmates		Amount charged in marks
		Women	Children	
Westphalia	* Sülldorf, nr. Blankenese ...	75	—	1.70—2.50
	* Viehburg, nr. Kiel	100		0.85 for children 1.0 for women
	* Weidenau, nr. Siegen	—	35	25.0 for 4 weeks
	Herford in Westphalia	20	Children	Projected
Hesse-Nassau	* Cassel II	70	—	1.50
	* Cassel III	—	70	1.25 with instruction
	Frankfurt-on-Main	150	Children	1.30
	Wiesbaden-Chausseehaus ...	50	—	1.25—1.50
Rhine Province	†M.-Gladbach	100	Children	1.0—2.0
	Düsseldorf II	50	—	2.0
	Düsseldorf III	To be opened		—
	Burgholz II, nr. Elberfeld ...	50	—	2.25
	* Wappelsberg, nr. Berg-Gladbach	—	30	1.50
	Hochbend, nr. Crefeld	50	—	1.50—2.0
	Ohligs	—	20	—
	Stadtwald in Jagenburg, nr. Solingen	To be opened		
	Bonn	Projected		—
Bavaria	Holzapfelkreut, nr. Munich ...	150		0.70 for children
	* Josephine Abel's F.R.P., Holzapfelkreuth, nr. Munich	—	50	0.70 for day's food, 1.50 food and lodging
	Frida Schramm Institute, Rückersdorf, nr. Nürnberg	300	Children	1.50 including fare, children less
	Fürther Stadtwald, Fürth in Bavaria	50		1.50 including fare
	Weissenburg in Middle Franconia	Projected		—
	Aschaffenburg	Projected		—
Kingdom of Saxony	F.R.P. King Frederic Augustus, Chemnitz	50	30	1.60
	Freiberg in Saxony	Opened in 1911		—
	Stötteritz, near Leipzig	36	—	1.30
	Marienberg in Saxony	Women		—
	Zwickau	15	—	—
Hesse Baden	Mannheim II, Neckarau ...	—	100	—
	Dieterschlag, nr. Darmstadt II...	50	—	0.65 1.20 for private
Thüringen	† Dessau I	20	Children	1.0—1.10
	Dessau II	20	—	—
	Treben, nr. Altenburg	20	20	0.20 dinner at cost price
	Sonneberg	Projected		—
Hansa free towns	Kattenturm II, nr. Bremen ...	Women	—	—
	Wesloe II, nr. Lübeck	50		0.60 for children 1.0 for women
Alsace	Strassburg I	50	—	1.60
	* Strassburg II	100	—	1.70

FOREST RECREATION PLACES FOR MEN.

Jungfernheide, nr. Charlottenburg. Wst. Luise v. Studt, Johannisthal. Madlower Heide, nr. Kottbus. Spandau I. Forst Lausitz.* Hohenkrug I, nr. Stettin. Unterberg I, near Posen. Oplawitz, nr. Bromberg. Karlowitz, nr. Breslau. Krampe, nr. Grünberg.* Bunzlau, Silesia.* Görlitz* Derschau-Oppeln.* Haynau, Silesia. Möser, nr. Magdeburg. Döllauer Heide, nr. Halle. Halberstadt.* Quedlinburg.* Vinnhorst, near Hanover. Harburg on the Elbe. Sulldorf, Holstein.* Herford Westphalia. Cassel I. Frankfort-on-Main.* Chausseehaus, nr. Wiesbaden. M.-Gladbach.* Cologne-on-Rhine. Düsseldorf I. Burgholz I, nr. Elberfeld. Aix-la-Chapelle. Hochbend, nr. Crefeld. Bonn. Rheindorf, nr. Bonn. Frieda Schramm Institution, nr. Nürnberg.* Fürther Stadtwald, Fürth.* King Frederic Augustus, Chemnitz.* Stötteritz I, nr. Leipzig. Zwickau.* Ettlingen, Baden. Mannheim I. Waldhof. Lenzenhütte, nr. Darmstadt. Jena. Dessau I.* Dessau II.* Treben, nr. Altenburg. Kattenturm I, near Bremen. Wesloe I, nr Lubeck. Strassburg II.

Those marked * take both men and women.

From the foregoing list of the existing forest recreation places in Germany, with a few interesting statements taken from the account of the German Central Committee for combating tuberculosis, we see that for the present we have only 98 forest recreation places, eleven of which are open in winter, containing :—

Women	room for	1,517	in	12	forest recreation	places.
Children	,,	2,329	,,	17	,, ,,	,,
Women and children ...	,,	1,000	,,	12	,, ,,	,,
Men, women and children	,,	610	,,	16	,, ,,	,,
Men and women	,,	585	,,	10	,, ,,	,,
Men and children ...	,,	240	,,	2	,, ,,	,,
Men (only for men) ...	,,	2,375	,,	18	,, ,,	,,

We will exemplify from Berlin how much remains to be done, even in highly advanced communities.

The amount of taxes paid gives a certain insight into the social position, and therefore to the dwelling conditions which are dependent on it. In Berlin,[1] for example, in 1906, in a population of 1,991,658 persons, there were 1,112,397 liable to income tax. Of this number 509,523 were exempt,[2] their income being under 900 marks (£45).

We had in Berlin (in 1905) :—

Children under 14 years	470,549
Of these there were :—	
Under 2 years	74,574
From 2 to 6 years	137,374
,, 6 to 14 ,, ...	258,601

Reckoning from former statistical annuals, about 42 per cent. of the total of children would belong to those persons exempt :

[1] I am indebted to the kindness of the Berlin Statistical Office for these records, for which I here express my heartiest thanks.

[2] Including 10,711 who were exempt on account of very large families and small incomes.

Thus about 197,000 children (an uncertain computation, I allow) of parents with a yearly income under 900 marks, and therefore living in penury.

Now in Berlin, besides forest recreation places, there are some forty-three institutions for the care of young children, thirty-one kindergartens, six crêches, thirty-two refuges for children, twenty-eight refuges for girls: these shelter from 9,000 to 10,000 children during the day. The other 187,000 children, who live in poverty, are in most cases condemned to small, unhealthy rooms which in many instances beggar description. Perhaps scruples of an ethical and material nature will be brought to bear against our demands for further development of kindergartens and special forest recreation places, which on closer consideration will prove themselves invalid.

Will not the feeling of responsibility of the parents be dulled by a far-reaching care of the children by societies? Will not carelessness and idleness be encouraged in mothers if we take part of the burden of the children off their shoulders?

That would be the case if the mother had the choice, the possibility of caring properly for her child. But by far the greatest number of those cases which we are now considering are mothers who, by the necessities of life, are forced to help to earn their living either at home or outside, and are obliged to leave the children to themselves. We have to reckon with conditions as they are; the children are there once for all, and the demand to restrict the number of children for reasons of economy has, unfortunately, in later years been obeyed more than is desirable in the interests of the nation, as we perceive from the reduction of the figures in the birth-rate. The more we make the keeping of the children easy for the mothers, and the more we advance and ensure their bringing up, the more we provide with far-reaching vision for the future of the nation. We see what efforts France is making to keep up the numbers of her few children, and what gloomy fears we frequently hear uttered in her press.

But is not the great mortality amongst children an advantage economically, inasmuch as it weeds out the weakly, and leaves only those capable of resistance, who then grow up a sturdy race? If this were really so, then the ethical justification of exposing the children to the wretched condition of their dwellings like a modern Taygetus might be left to subjective feeling. But this weeding out is partly only a chimera of the study-table and is very problematical, for it is well known that many children's diseases snatch away the strongest and leave the weakly ones behind.

Besides, we do not lay on kindergartens and forest

recreation places the task of bringing up the weakly children at the expense of a world of trouble, for that they are not capable of accomplishing, but that they should primarily protect children who have hitherto been healthy from most severe hygienic ills by the enjoyment of fresh air and by a suitable mode of life, for children are inevitably exposed to such ills at home, and the strongest succumb to them; our duty is to harden the children, strengthen them, and nip diseases in the bud.

The fear that through such kindergartens and forest recreation places the spread of children's diseases would be more favoured than it would be in their small, wretched homes can be just as little entertained if only care be exercised. On the contrary, we see that measles, scarlet fever, &c., have decreased during the school years in a most striking manner, when we contrast the statistics with those of former years when our children lived more at home.

In Prussia, in 1906, of 10,000 living there died of scarlet fever, measles, German measles and whooping-cough—

Under 1 yr.	1 to 2 yrs.	2 to 3 yrs.	3 to 5 yrs.	5 to 10 yrs.	10 to 15 yrs.
112·0	74·5	29·0	17·3	7·0	1·6

The doubt whether children are really much benefited through such apparently half measures, if they are only taken from the conditions of the parents' houses for a time, but are at home in the evenings and at night, is completely unjustifiable. The benefit is incontestable. As I have already remarked on other occasions the great hygienic ills must be mathematically investigated and analysed quantitatively. According to the laws of probability, to speak only of infection, a person is only half as much endangered by an exposure to it of twelve hours than one of twenty-four hours. But in our case the conditions are much more favourable. With a child who leaves the house in the morning before the dust has been disturbed by sweeping, and returns only at night, when no dust is raised and when the air is freest from germs, the danger is reduced to a minimum (for full reasons, see G. Cornet, "Die Tuberculose," second edition, p. 398).

Every hour outside the house reduces the harmful influence, and especially reduces the dangers of tuberculo-scrofulosis.

The hygienic benefit is incalculably great if the children are not all day in an unhealthy home, in foul air, in a dirty environment full of germs, or playing on the dusty stairs which have been spat on, or in the courts and streets with no one to look after them, and exposed to all sorts of dangers; if they have not to be fed with

a piece of bread spread with margarine (because the mother is not there to cook), but are in the fresh air, well looked after, passing their time in innocent play, hardened, regularly fed and washed, the protective means against scrofulosis and the foundation of a healthy, resistant, able man is laid.

And with what few and simple means is that which may be called the hygienic right of children to be attained, only with a small fraction of the cost of the expenses which yearly must be laid out for sickness, ill-health, and burial?

Kindergartens must be extended and increased, removed to the outskirts of cities and differently organized, on the lines of the forest recreation places, then they will benefit one and all. Through the education of the caretakers who are trained for the work in proper schools, and amongst whom it is to be hoped will be found the daughters of the better classes, a large number of hygienic and instructive ideas for the education of children will be spread amongst a wide circle, and the pitiful ignorance of many mothers and nurses about the regulations given by doctors for the avoidance of scrofulosis and the care of children generally will be mitigated.

I will not here enter into the further advantages on ethical and educational grounds, on the protection of children from moral infection, on the national economical side that the mother will be freer in her work without blunting her feelings by her inability to give sufficient care to her children, and that home comforts will be increased, &c.

The question, in what manner and with what means these kindergartens are to be instituted, answers itself by considering whose interests it furthers. Private charity alone is not able to grapple with the new task to the desired extent. The parents, who are freed from the burden of their children at home and have the greatest interest in the health of their children, must be called upon to at least a moderate degree for the cost of their care and upkeep.

The whole of society, the district, and the State have hardly less interest in the health of those belonging to them.

Besides the losses which cannot be calculated, the losses in mental and moral capital, the State suffers a considerable yearly economical loss by the mortality amongst children, which is in direct proportion to the expenses incurred for food and bringing up of the child (the so-called cost value of a man) which have been rendered useless. These costs are not covered later by the work of the man, and so are a national economic loss, amounting every year in Prussia alone from scrofulosis, tuberculosis,

pulmonary catarrh, measles, scarlet fever, &c., in short, from diseases which are considerably favoured by bad dwelling conditions, to at least 20,000,000 marks (£1,000,000) for 110,744 children under 10 years of age who have died (according to a reckoning given in another place, and the further consideration of which here would lead us too far).

In addition to this, the considerable reduction in the power of defence of the land must be taken into consideration, as the greater part of those born do not reach the age at which they could carry arms, or are so weakened by the unfavourable conditions under which they live, that they must be set aside as incapable of military service.

The great harm done every year to the health of the population by scrofulosis and other diseases favoured by the wretched dwelling conditions, the national economical harm arising from this grievance, the impossibility of radical improvement by other means (as a century of trial of measures recommended, but which have proved useless, shows), this point of view makes it the duty of the State and of the community to seriously prepare a way towards improvement, on the lines here given, of hygienically arranged peoples' kindergartens, and especially of forest recreation places, and also makes it the duty of us doctors to help in the work by instructing influential circles. We might then hope to save every year a not inconsiderable part of the living victims and material sacrifices. It appears to be a special duty for those doctors who consider the predisposition created in youth to be the chief cause of the scrofulosis and tuberculosis which appear later, to prevent this original predisposition in an effective manner, to strike at the root of the evil, and it must especially affect those doctors who consider that the chief cause of infection is due to overcrowding.

For mineral baths, seaside homes, and holiday camps which occupy a large place in the combat against scrofulosis, see Therapeutics (p. 331).

CHAPTER II.

THE CHILD AT SCHOOL.

A GREAT and gratifying task falls to the school in the prophylaxis of scrofulosis. I will not here enter more closely into the claims of general hygiene demanded in school buildings with respect to pure and sufficient air, cleanliness (prophylaxis in the matter of sputum), duties which are incumbent on the community, and which result from compulsory education; these are fully treated of in manuals on school hygiene (for example, Baginsky, Wehmer, and others). At any rate, the ventilation must be permanent, and not left to the whim of teachers who are afraid of air; ventilation must take place thoroughly in the intervals between the lessons, cleaning must be done sufficiently often and always with damp cloths, not in the morning before the commencement of studies, but after the school hours are over. To prevent dust, the use of dust-combining materials is recommended; for example, dustless oil, or similar preparations which, as they become ineffective after some weeks, must be renewed from time to time. During school hours a proper position of the body must be insisted upon, especially with girls when sewing.

The demands of the school must be sensible, and such as are suited to the later necessities of life. Many complaints are made, and rightly so, of overburdening the children with home-work, which often occupies even the child of average cleverness till late at night, shortening the time for sleep (which in the early years of development must be from ten to twelve hours), and leaving insufficient time for recreation in the open air. The natural consequences of such mental overburdening, the failure of nutrition and development, and other consequences prepare the way for scrofulosis. The (school) doctor must influence the decision as to the quantity of home-work allowable, for doctors have the products of mistaken education, the cripples in body and mind brought under their notice. Between each lesson there should be a pause introduced for recreation, which the scholar

should spend either in the playground, or in bad weather in the gymnasium.

Not less important in the prophylaxis of scrofulosis is that which is the distinct task of the school, not only the care of the mental training, which is often done very one-sidedly, but also the charge of the bodily development of the youth under its care. The natural aim of the school is to step in and help to complete the work where the home training fails; it must not be indifferent to anæmia, bodily weakness, reduced development of the muscles, and other signs of physical deterioration caused by working too long seated at a desk.

We know now of the scrofulous tendency, be the cause of it what it may, that it disappears with increasing development, and is hardly ever present in adults. Therefore,. to advance bodily development is one of the first laws of clear-sighted prophylaxis. For this reason obligatory gymnastics (in the open air), playing out of doors, cycling, swimming, skating, sliding, football, lawn tennis, cricket, racquets, and so on are urgently recommended, of course in a degree suitable to the age, and avoiding any excess.

Proper gymnasia and playgrounds are a requisite for every school, both in the interest of avoiding scrofulosis and otherwise, demands which advanced school committees have recognized in practice. Drill halls should only be used in case of necessity, on account of the greater collection of dust, which is unavoidable.

The present generation of educationists do not keep themselves entirely aloof from the idea of the necessity of attention to the bodily care and development of youth; many stand side by side with the hygienists and strive manfully for their cause. The institution of a prize for boat-races for schoolboys by the Emperor, and in Bavaria by the Regent, has had an extraordinary effect in furthering games for young persons.

Even now the greater number of our schools limit the whole of their physical instruction to a few hours in gymnastics, others have the superintendence of games in their curriculum, and in girls' schools too special hours are set aside for instruction in games. The number of teachers (male and female) who have gone through a course of training for games in Germany gives a general idea of the extension of the movement. There were, in 1890 and 1896, 1,672 and 3,260 respectively.

The goal for which we should strive should be that the morning, commencing at (seven or) eight o'clock, be devoted to lessons, with the necessary short pauses for airing and resting, but that the afternoon should be left for bodily training (at least two hours daily), and home-work should be reduced to a definite amount.

The benefit we derive from obligatory physical training, *quoad sanitatem,* is twofold, not only the direct advantages which we can appreciate at once, on which I need waste no words, but also a great indirect advantage, because the child of the (middle and) poorer classes is removed from the unhygienic home conditions, the small rooms, and the menaced danger of infection there, for at least a few more hours—a fact which is so important for the avoidance of scrofulosis.

The school gardens and playgrounds, and in bad weather the well-appointed gymnasia, which must be provided, especially in town schools, should be left open to the scholars, especially the younger ones, out of school hours, on Sundays and on holidays, for a playground, especially during the holidays when the children are under no superintendence, and often get into all sorts of mischief to the annoyance of the parents; the introduction of holiday excursions and holiday games might be considered, conducted by the teachers or persons especially qualified for it, such as have been started in some of the Rhenish provinces, and which have been so highly successful. They offer a substitute, if only a poor one, for holiday camps.

Every school should take a pride in possessing its own recreation and playground in the nearest wood, on common or State land, which should be open to the pupils on half holidays, Sundays, and in the vacations, needing only to be provided with a shelter for sudden storms; holiday camps, homes, &c., which give children of the poorer classes, especially the weakly ones and those suspected of scrofulosis, the desired opportunity of spending a few weeks of the year in the country and forest air, will be spoken of under "Therapeutics"; by such care poor children would be removed from the danger of unhealthy dwellings and protected from the harmful effects of the streets.

School Baths.—Regular bathing is urgently demanded as a means of education and cleanliness, also as a means of avoiding disease, but especially for the avoidance of scrofulosis. How, in the small houses, can the elder children, even of middle-class people, get a bath, to say nothing of the families of the work-people?

What is the good of all the preaching about the practice of cleanliness and care of the skin when not the slightest arrangements are made to fulfil the demand? A short time ago there were in Germany 1,131 warm bath establishments to 32 million inhabitants—1 for 30,000 persons. The prices charged are sometimes so high that the frequent use of them is denied to the great mass of the people who require them most. In other

countries things were, and still are, worse. In Rome, the city of the warm baths of Caracalla and Titus, some years ago I knocked in vain at the door of three baths, they were closed during the winter.

In recent years there has been a satisfactory change for the better, especially in Germany; the Berlin Society for People's Baths has done great service in this matter; the object of the Society is to arrange for cheap and even free baths, and in its buildings only 25 pfennig (3d.) is charged for a bath and 10 pfennig for a shower bath. Thanks to these endeavours, Germany has become an example to other countries by the institution of numerous baths (even if the number be still insufficient) for the people, for factory hands, and for barracks.

The idea of introducing baths for the young people who go to school—school baths—was first carried into practice by Oberbürgermeister Merkel in Göttingen in the year 1886; he arranged them there in the simplest, and in the cost and working the cheapest, and therefore the most practical manner, as shower baths. The conception that it was the right thing for the school to train youth to cleanliness and to the care of its health at last conquered the many doubts and difficulties which educationists at first raised as to the advisability; the results completely silenced all objections.

The first shower bath in Berlin was opened in 1894 in the Government municipal schools; up to 1899, eighteen schools and nine "mixed"[1] schools had followed the example, and to-day hardly a new municipal school is opened that has not its shower baths. They are open to the scholars free, including soap, once a week, and are fully appreciated by the children. Success was claimed both hygienically and educationally, in that children with dirty and ragged underclothing were ashamed of it and came with decent clothing.

A further extension of baths, their introduction into "middle" schools (Mittelschule),[1] but especially into kindergartens—which up till now have been very badly treated in this respect—is required on general hygienic grounds, and pressingly needed for the avoidance of scrofulosis.

School Feeding.—The well-known fact that school children are often underfed and frequently come to school without breakfast, and because the parents are at work must content themselves

[1] "Mixed" schools (Doppelschule) correspond as nearly as possible to the schools in England taking boys and girls together; "middle" schools correspond to the County Council Schools.—Translator.

for a whole day with a piece of bread, in recent years has brought about the feeding of the poorer children in many places, a result which is also important from the point of view of avoiding scrofulosis. The children are given a simple midday meal in the school; rice, semolina, peas, lentil and bread soup containing meat, or rice milk, or a bowl of milk, eggs, vermicelli and grated cheese; besides which, in many places, a hot breakfast, bread and milk, with the addition of malt coffee, cocoa, &c., and at lunch time a piece of bread. A commencement has been made of having the food prepared by the girls of the higher classes in the school kitchens; in others, where this arrangement cannot be carried out, the feeding might be done in connection with the people's kitchens. School feeding appears to find its best development in Munich, where it has been introduced through the initiation of Oppenheim. There are twenty-two soup kitchens in that town.

School Doctor.—There are so many hygienic questions to solve in modern schools that the work can only possibly be done by doctors who have completely studied that branch of science. A part of the duties of school doctors is to superintend the whole hygiene of the school, airing, cleaning, and the removal of refuse, &c. Children and teachers should be regularly examined for tuberculosis and scrofulosis; persons with open tuberculosis should be suspended from school as long as they are infectious (Kirchner, A. Fraenkel, and others), and should be sent to suitable institutions, sanatoria, convalescent homes, forest schools, forest recreation places, &c.

Besides this, the school doctor should conduct the hygienic instruction, and especially that concerning infection from tuberculosis; leaflets should be distributed to teachers and scholars; and by parents' evenings, the parents and relations of the scholars should be instructed in hygiene; in the school rooms coloured pictures, placards, and rhymes (see above, p. 303) should be hung up of a kind suitable to the ages of the children; of course the school doctor must have decisive influence in all questions of hygiene if he is to fulfil his duties.

Forest Schools.—Next to forest recreation places, one of the most important weapons in the fight with scrofulosis and tuberculosis (as well as other diseases) is the arrangement of forest schools; these were first brought about on the suggestion of B. Bendix in Charlottenburg, and have since proved very beneficial in several other places. The number of pupils in the Charlottenburg Forest School has risen from 95 in 1904, to 250, some with scrofulosis and open tuberculosis, who have about

2½ hours' instruction daily in the open air when the weather permits; they are fed at school and are out of doors all day. In many forest schools, for example in Mühlhausen in Alsace, the children may remain all night in the school (Bienstock). Forest schools and forest recreation places are distinguished by the healthy endeavour to create institutions free from all hygienic objections with the simplest possible outlay, outward show not being entertained. The schools are open about six months or longer, till the cold weather sets in.

The number of forest schools in existence is, in proportion to the need, only as a drop of water in the ocean, but it is to be desired and hoped that more energetic measures will be taken in this matter so all-important for the development of youth and for the prophylaxis of scrofulosis. The good results which have been obtained by us in the open-air schools have led to similar institutions being introduced into England, which work with complete satisfaction (Johnson, see also Kelynack and M. Fürst).

By erecting forest schools the removal of weakly and sickly children from the ordinary school is considerably facilitated, as the fear that their education will be entirely neglected is eliminated, at least in part.

Forest schools for children of the people are: Charlottenburg-Eichkamp for 240 children in 6 classes; Ziegenhals in Silesia for 40 children; Mildstädt, near Husum, for 10 children; Dortmund-M. Gladbach for 120 children; Solingen-Burg for 100 children, 2 classes; Elberfeld, with 20 sleeping beds.

J. Abel's forest recreation places: Holzapfelkreuth, near Munich, for 18 children; Frida Schramm Institution in Rückersdorf, near Nuremberg; Dresden-Blasewitz, planned for 20 children; Glauchau, projected for 40 children; Giessen, 2 classes; Wesloe, near Lübeck, for 60 children; Mülhausen, in Alsace, for 200 children; Hohenlychen, in the Uckermark, for 100 children, with opportunities for learning housekeeping and gardening.

Forest schools for scholars needing higher educational establishments: Charlottenburg-Eichkamp II, for 120 boys and girls.

SECTION VIII.

Therapeutics.

The tasks before us in the therapeutics of scrofulosis are the following :—

(1) To do away with the abnormal condition of the tendency to scrofulosis, the local diathesis, which we have termed embryonism, or heightened infantilism, by raising the individual, so to speak, to a higher and older stage of his development as the result of strengthening the body.

(2) To keep away from the body further germs of infection, tubercle bacilli and pyogenous bacteria, as long as the above condition is present.

(3) To hinder the infection already existing from spreading further in the body, and to localize, to heal, and to remove the consequences of the infection, or to cause them to encapsule.

This we endeavour to do by the method of general strengthening of the body (by general therapeutics, which blends in many instances with the prophylaxis, which has just been discussed), and by local treatment.

Thus, with a scrofulous patient we have in the first place to improve as far as possible the general hygienic conditions (by better air, nutrition, &c.), to consider a stay in the country and the use of mineral or sea baths, which experience has taught us are favourable, to use internal medicines which have stood the test of time, and to pay the greatest attention to the removal and avoidance of local affections.

CHAPTER I.

GENERAL THERAPEUTICS.

General therapeutics consists for the most part in the utmost attention to hygiene.

To sever the thread of a continuance of evils which might lead to fresh infection an exact investigation of the conditions under which the patient fell ill is of special importance in scrofulosis. We must not content ourselves with confirming one of the conditions which are usually accepted as disposing to the disease, but must critically test the patient as to his whole manner of life, his habits, good and bad practices (for example, picking the nose, and such like), as well as his personal and material surroundings, and where these conditions give rise to the slightest need for caution on hygienic grounds to change them to the greatest extent possible, so that a certain impulse, a change of feeling is produced in the organism. Change of air and food different from what the patient is used to, change in the mode of life and environment (of course, within the limits demanded by hygiene), have been attended with the greatest possible success. Air, light, exercise and nourishment are the foundation pillars both of prophylaxis and therapeutics.

What good results may be obtained by the simplest means is shown by the example of Ritter, which has already been mentioned. In 1894 he took forty scrofulous children out of the forest of houses in Berlin every afternoon for months, to a grassy place free from dust, where they were exposed as far as possible to sun and sand baths and did physical exercises under trained superintendents (in rainy weather in a hall). Besides their home food, the children were given milk, fruit, and a mixture of Lipanin and malt extract with 2 per cent. lime and 5 per cent. iron. The result was a remarkable increase in weight, increase of chest measurement, and involution of scrofulous symptoms. In the forest recreation places, also arranged with limited means, these favourable experiences have been repeated a hundredfold.

NUTRITION.

We have, in the former section, discussed closely the exact rules with reference to nutrition. A food easy of digestion and assimilation, the limitation of starchy foods and sugar, and the preference for an animal and vegetable diet, which we desired as precautions for a healthy child and for the suspect, have been emphatically recommended, and become an important law for a child who is already scrofulous. The food for the first months must be milk and preparations from milk; later, besides milk, broth made with meat, pounded and finely triturated meal, light vegetables (spinach, carrots, cauliflower), and soft-boiled eggs may be given. Potatoes, chestnuts and pulse are only suitable as a purée, bread is best given toasted. Dainties between meals are not allowable, and special care must be taken that meals are given regularly.

Precise, written directions for diet should be given, and one should convince oneself, by weekly weighing, of the success of the treatment.

The choice may be given of :—

Breakfast : Cocoa, milk, malt coffee, gruel, with white bread and butter (honey or marmalade), and a compote of stewed fruit.

For early lunch : Bread and butter with fresh or stewed fruit, or a small glass of milk or an egg.

Dinner : Soup, meat or fish, plenty of vegetables, especially green vegetables, fresh fruit or stewed, and a little bread.

In the afternoon, a small glass of milk, with biscuits or toast, or bread and butter, with fruit, fresh or stewed.

Supper : Milk soup, potato purée, dishes of rice, semolina, mondamin, fresh vegetables, fruit, compote, and milk.

For these meals the different nutritive preparations (see pp. 290-1) may be used according to need or choice.

With excitable thin children plentiful nourishment with easily digested fats, cream, and butter, with which may be mentioned cod-liver oil, have proved of service, and metabolism is to be furthered as far as possible, especially in the case of scrofulous children, by fresh air, exercise and change of air. In the exudative form the limitation of fat and milk with the exclusion of eggs, as recommended by Czerny, is to be tried.

Good water is the chief beverage, perhaps with a little fruit juice; to give wine and beer, and especially spirits, in early life, unless they are specially indicated, is harmful, but sometimes with torpid children a light wine, or with erethistic children wine or beer in small quantities is indicated. In diarrhœa proper diet

is generally sufficient; if it continue, acorn coffee and Bordeaux, or an astringent Greek wine, *e.g.*, Kamarite, is given, from a teaspoonful to a tablespoonful at a time.

A number of remedies have in the course of time acquired reputation for markedly furthering nutrition.

Helps to Nutrition.

In the first place comes cod-liver oil, which, on account of its fatty acid contents, is easily digested and assimilated, and is employed preferably for thin excitable children who need fats; no specific effect can be ascribed to its iodine as it contains so little. The darker kind is in general considered more effective on account of its containing a large quantity of fatty acid (even 6 per cent.), the lighter, clear refined oil is milder. The dose rises from one to three teaspoonfuls, if it suit the patient three or even six tablespoonfuls may be given. Many children like it pure, for others the taste of the oil must be disguised, for which purpose countless more or less good correctives are recommended. The simplest is the addition of one drop of oil of peppermint to one tablespoonful of oil or anise oil or ethereal oil of eucalyptus (2 drops to 150 cod-liver oil, Duquesnel). De Pontini recommends an emulsion of one tablespoonful of cod-liver oil with the yolk of one egg, one or two drops of peppermint oil and half a tumbler of sugar water. Kanzler recommends for scrofulous bone diseases with symptoms of rickets a mixture of lime-water and other substances, for example:—

℞ Ol. jecoris aselli
Aqua calcis ... āā 100·0
M. f. mist. adde

Tinct. cinchonæ co. ...	20·0	or	Tinct. aloes
Tinct. rhei vinos ...	15·0		Tinct. ferri pomat.
Tinct. calami	5·0		Liq. ammon. anis. 6·0 to 10·0

M.D.S. A dessertspoonful or more, once to three times a day.

The addition of chocolate (dragées) does not fulfil the purpose, and the addition of rum, spirit, or a little malaga or sherry after, is not advisable, as alcohol is unnecessary and harmful for children. The combination of cod-liver oil with iodine and iron will be spoken of later.

Cod-liver oil must be taken for a long time and always shortly after a meal; in winter it can be taken for months; still, short pauses are to be recommended, say, every two or three weeks, when a pause of five days may be introduced; should indigestion occur, or constant eructation, loss of appetite, a sick feeling,

vomiting or diarrhœa (in the latter case tannalbin should be given), it must be discontinued for some time.

Morrhuol, prepared by Chapoteau from cod-liver oil and said to contain its effective constituents (a capsule of 0·2 = 5·0 cod-liver oil) is used but little by us.

Where there is very great dislike to cod-liver oil there is no necessity to insist upon it, as the Lipanin of v. Mering (94 per cent. olive oil, 6 per cent. fatty acid), though certainly somewhat dearer, has an agreeable taste and is at the same time an easily assimilated substitute. The dose is the same as that of cod-liver oil; a tablespoonful is, according to Klemperer, equal to 186 calories. Sesame oil, which is cheaper than cod-liver oil and is easy of assimilation, is also used.

The alcoholic fermentation products of milk, koumiss, yogurth, kefir, although suitable in promoting nutrition, should only be ordered for children in cases of urgent necessity, as koumiss contains 1·5 to 3 per cent. alcohol, and kefir 2·1 per cent., the child would get in 500 grammes the same quantity of alcohol (60 per cent.) as in a small glass of rum. Kefir of one day old contains less alcohol than when two days old, and still less than when three days old. In kefir prepared from milk containing tubercle bacilli, the bacilli were found to be virulent after three days (am Sande).

Of preparations of carbohydrates, besides the nutritive meals and legumens already spoken of, we may mention malt extract, which children enjoy so much (Löfflund's and Brunnengräber's Maltocrystol, Gehe's Maltylkandol, &c.). A teaspoonful to a tablespoonful is taken three times a day (one tablespoonful = about 60 calories), pure or combined with cod-liver oil and lipanin. Other valuable aids are honey (one tablespoonful = 75 calories), also cocoa, and especially the Kraftschokolade (strengthening chocolate) of v. Mering (with the addition of free fatty acids), Cassel oat cocoa, Ovomaltine (biscuits, consisting of malt extract, eggs, milk and cocoa).

Similar preparations are Scott's emulsion, Ossin Stroscheïn (egg and cod-liver oil, half a teaspoonful to a tablespoonful three times a day); Ossogen (hæmatogen and cod-liver oil); Chocosana (a preparation of cod-liver oil in solid form; cod-liver oil, cocoa and sugar; for children under 4 years, two sticks; over 4, three or four sticks; or a teaspoonful daily).

As substitutes for cod-liver oil, the following may be mentioned: Angier's Emulsion (petroleum with hypophosphites); Fucol (a preparation extracted from fresh seaweed, containing iodine with fatty oils, which is sold mixed with iodide of iron, guaiacol, or malt extract).

The neuropathic constitution of many scrofulous persons explains the beneficial effect of preparations of phosphorus; Lecithin (glycerine-phosphoric acid, the higher fatty acids, and cholin); also Lecithin chocolate and "Lecithin granulé Clin" are all very suitable for children (one teaspoonful = 0·1 gramme lecithin, but lecithin injections are not to be employed on account of being painful); Neocithin (one teaspoonful to a tablespoonful several times daily); Lecithol (Ovo-Lecithin, one to two perles, 0·05 gramme in each; or one to two Lecithol chocolate tablets; or in ampullæ an injection every other day); Protylin Roche (phosphorus albumin), one to two teaspoonfuls for a child ½ to 5 years old; or four to eight tablets for a child 5 to 12 years old; two to three teaspoonfuls, or eight to sixteen tablets, or as iron protylin, containing 2·3 per cent. or iron); Regenerin (Ovo-Lecithin, manganese and iron, one teaspoonful or a tablet three times a day); Phytin (prepared from the seeds of plants and containing 22 per cent. of phosphorus); Nucleogen, Rosenberg (nucleinic acid and iron in organic combination with arsenic and phosphorus, which is much liked, one, or for adults, two tablets, 0·05 gramme in each, three times a day after meals, either subcutaneously or intramuscularly in sterilized ampullæ, containing 0·1 gramme, daily or every other day; for children, half an ampulla, strongly recommended by v. Hoppe and others); Leciferrin (Ovo-Lecithin-Iron Schütte, half a tablespoonful three times a day).

The following may be used with advantage: Fortosan (a preparation of phytin and milk-sugar; a substitute for phosphorized cod-liver oil, two or four measured teaspoonfuls, according to age, three times a day); Fellows's Syrup of Hypophosphites for adults, two teaspoonfuls at every meal; for children, from 9 to 12 years of age half the amount, from 5 to 9 years of age a third of the amount, and for children from 1 to 5 years of age a quarter of the adult dose, in each case mixed with plenty of cold water); and Egger's Hypophosphites Syrup, both much valued, containing sulphate of quinine and strychnine besides hypophosphoric acid combined with iron and manganese. Then the following may be mentioned as having proved of value in promoting the appetite and strengthening: Vial's Tonic Wine (meat juice, cinchona bark, calcium-lacto-phosphate, with Spanish wine); cinchona Serravallo, with iron (highly recommended by Drasche); Condurango Cinchona Elixir Glaser (with or without iron; one teaspoonful to one tablespoonful three times a day); Nanning's Extract of Cinchona (five to ten drops in port wine or milk three times a day); Dung's Cinchona Calisaya Elixir (one to two teaspoonfuls). See also other combinations with iron, p. 372.

OPEN-AIR TREATMENT.

On the first appearance of manifest symptoms of scrofulosis a profusion of air and light is an imperative demand, the only limit with respect to exposure to light being certain symptoms of disease, *e.g.*, conjunctivitis. For a child already affected the general recommendation of plenty of fresh air is embraced in a systematic open-air line of treatment, in a place free from dust and wind, preferably on a common, and in all weathers, if in the least suitable. The child must take exercise without much exertion, unless the nature of its disease (*e.g.*, coxitis) confines it to a carriage or couch. Any increase of temperature of the body forbids exercise, but does not limit the open-air treatment for one minute. By a two-hourly record for several days running one finds out the state of the temperature.

The patient must be spared too much mental exertion, school teaching and studies must be reduced within suitable bounds, or must be given up entirely; but one must consider with this whether the child will not be overexerted and more injured by making up for lost time resulting from so much holiday than by continuing to go to school. In case of serious illness the loss of a year's schooling (a serious sacrifice for ambitious parents, but a point on which the doctor must insist) is richly rewarded by increased health. The chief object is to act radically from the very beginning, without wasting time by trying mild remedies, if one wishes to have lasting success.

We must endeavour to place children whose parents have small means for a long period in a forest recreation place or forest school, according to their age and the degree of their strength (see pp. 307-317).

Where patients are well-to-do one must emphatically insist, especially when the improvement at home is unsatisfactory, that the child shall be taken to a place with a favourable climate. If it be difficult to find the necessary person to accompany the child for some time, or other difficulties present themselves, one may allow the alternative of sending the child to relations in the country or of exchanging homes with a country child, provided that other demands are sufficiently met. Such a change of environment, of climate and food, has a stimulating and favourable effect mentally and physically.

As long as we are only taking preventive measures for debilitated children, or if for some cause mineral or sea baths are not indicated, holiday resorts far from working factories, in a position sheltered from the wind, with forest or mountain air,

where the food is good, render valuable service. It is incontestible that children with slight scrofulous symptoms (eczema, &c.) often lose these symptoms with incredible rapidity only by change of place, a stay in the country and constant fresh air. But where we have to do with manifest scrofula, a severe chronic illness threatening the future and directly dangerous to life, we must not content ourselves with "idyllic country life," but must set in motion the whole of the climatic and balneo-therapeutic apparatus.

The wants of invalids are, unfortunately, in many so-called health resorts not sufficiently taken into account. The demands of Goldschmidt and others to make the right of using the title "health resort" like that of doctor, subject to approval by the State and dependent on fulfilling certain hygienic postulates, deserves more serious consideration than has hitherto been given to it. The more renowned health resorts have, in essential matters, better hygienic arrangements, and, especially in prophylaxis against tuberculosis and other infectious diseases, offer more security than any other places one may name.

It is an inconsistency met with in doctors, on the one hand, to emphasize the importance of hygiene and to demand a good water supply, the removal of refuse, good drainage, healthy dry houses, control of food supply (examination of meat and milk), isolation in case of any infectious disease, playgrounds for children, houses with spacious balconies, on which patients may lie, supervision of bathing establishments, and hundreds of other things—in short, a sanitary superintendence—and yet not send patients who have the means to do all that is necessary for health to such places which have cost hundreds of thousands, and even millions of marks, in order to be able to satisfy all these demands, but to content themselves with a simple holiday resort or a badly arranged health resort, because "that will perhaps be sufficient to effect an improvement." By this indolence in health resorts is encouraged to an unwarrantable extent, and the task of the doctors who have often given themselves an enormous amount of trouble working for the improvement of hygienic conditions, of itself no easy matter, is rendered even more difficult; the patient is badly advised, because, besides all sorts of incidents which may arise, the things that he most needs for his health are often wanting.

Therefore, in the interest of the patient, the doctor should acquaint himself exactly, and as far as possible personally, with these conditions, because the statements made by the authorities of health resorts usually paint everything in glowing colours.

A.—CLIMATIC HEALTH RESORTS.

Purely climatic health resorts often achieve good results in quite slight cases, and in treatment after mineral and sea baths, or when these are contra-indicated, climatic treatment may be taken into consideration, but for the greater part of scrofulous patients, unless we wish to content ourselves with piecemeal therapeutics, we recommend the combination of the treatment by mineral or sea baths with climatic treatment.

In the choice of climate the chief point to keep in view is the possibility of being much in the open air. For special cases one must remember that the cold air draws the warmth from the body and considerably stimulates metabolism, but also favours catarrh of the respiratory passages when evaporation is promoted by simultaneous dryness of the air. Warm and dry air with a relative moisture of under 60 per cent. with plentiful recreation, is suitable for scrofulous catarrh, and for the torpid form of scrofulosis; warm and damp air (about 80 per cent. and more) calms, and even relaxes, and stimulates metabolism less, but has a beneficial influence on dry catarrh and irritative conditions of the mucous membranes, as well as the erethistic form. The purity of the air and its freedom from germs, as well as the pressure, the force and direction of the wind, the content of ozone and amount of sun, must be taken into consideration.

Inland health resorts on low-lying ground, or heights up to 400 metres above sea-level, have almost an indifferent climate, and therefore only a slightly stimulating effect. When they are surrounded by forests or shut in valleys the climate is generally moist, warm and uniform, which renders them suitable for susceptible patients with no power of resistance, and for a great part of the year also as intermediate stations, and especially as winter stations when in southern positions.

The places in a sub-Alpine climate (400 to 950 metres) with moderate moisture and changes of temperature, are also good for susceptible, weak, excitable natures; they stimulate the nerves and metabolism in a higher degree, but do not make such great demands on the powers of resistance as mountain or sea climates.

The so-called high mountain ranges—heights over 950 metres—with their attributes of pure air, rarefied atmosphere and powerful insolation, stimulate the body to a very high degree. According to the researches of Zuntz, A. Loewy, Müller, Caspari, and others, it effects an increase of red corpuscles, which reaches its maximum within two or three weeks and only sinks again on a return to the plains. This increase reaches, even in German

mountains of medium height, to 1 to 1½ millions per c.mm. The high mountain climate is said especially to stimulate the bone marrow.

According to experiments by Bürker on the Schatzalp, and by Morawitz, the increase of red corpuscles is not so great as is generally believed, and amounts at medium heights to 5 per cent., and that of the hæmoglobin to 7 per cent. Schmincke found an increase of erythrocytes up to 8 per cent. Durig could not confirm an increase either of blood corpuscles or of hæmoglobin.

The improvement in appetite owing to increased metabolism, the stimulation of the activity of the bowels, and the influence on the respiration is incontestable (see also Alb. Robin). On account of the dry air, cool even in summer, and the changes of temperature, which are often considerable, the climate of high mountains presupposes good powers of resistance. In this respect it resembles a sea climate (in spite of other differences) by a certain meeting of extremes; it is only in recent years that it has been more utilized for scrofulosis, and has, according to the experience of Leysin, sometimes achieved brilliant successes in bone and joint tuberculosis (see p. 342). High mountain air is also much to be recommended in after treatment, when the organism has become more resistant owing to preceding mineral bath treatment, and in many cases as treatment in winter, on account of plentiful insolation; mountain air is contra-indicated in very anæmic, nervous, susceptible, excitable, scrofulous patients. In irritative conditions of the eyes, the great intensity of light rays have often unfavourable effects.

The climate of the sea and coast is distinguished by its purity, its humidity, and the presence of salt, by its frequent movement, high pressure, and relatively regular temperature at different seasons, and greater brightness owing to the refraction of the surface of the water. It has a powerful effect on metabolism, and is excellent for torpid, scrofulous patients who need bracing; but for debilitated anæmic patients, or erythistic persons with hypersensitive mucous membranes it is, as a rule, not indicated, for such often lose their sleep and appetite, become depressed, and return "tanned by the sun, but physically weaker" than when they went away. Besides which, sea and coast climates exhibit great differences according to geographical position. On the North Sea and Atlantic Ocean these climatic peculiarities are most clearly noticed, but the Baltic Sea, the south coast of England, and especially the Adriatic and the Mediterranean Seas are far milder, and therefore may be recommended with good prospect of success for more weakly natures

even during the winter (see Determann, Gmelin, Moll and Henig). An increase of hæmoglobin and red corpuscles has been found (Helwig) to occur at the seaside just as it does in mountain air; but Loewy, in contradiction to Häberlin, could not confirm a permanent increase in the total quantity of blood.

Sea voyages, as recommended by Hermann Weber in so-called ship sanatoria for the phthisical, as well as remaining on the open sea near the coast in ships arranged for the purpose, appear to have rendered good service according to present experience, though this has hitherto not been very extensive. In New York a steamer daily takes 1,000 to 1,500 children to the open sea, where they are well cared for (see also Natwig).

B.—MINERAL BATHS.

Mineral and sea baths, as well as salt baths, have a well-deserved reputation in therapeutics for the scrofulous; they are to be considered, in the first place, when change of climate is thought of. Mineral baths have the one distinct advantage over sea baths, that the stimulation can be regulated, suited to the strength of the patient, and increased according to necessity. It has long been noticed that by such baths, not only the body in general is strengthened often to a remarkable degree, but that with a sufficient number of baths local affections, and even large glandular tumours, return to a normal size, white swelling disappears, fistulæ close, open foci form healthy granulations, and this improvement appears considerably sooner and more fully than under change of climate alone. Therefore, when change of climate is contemplated, places with mineral and sea baths should be preferred as a rule.

Effect.—Even in a fresh-water bath more resistance is opposed to the breathing, the muscular movements, and the circulation on account of the pressure of the water on the body than by the air alone, a certain stimulus is produced, and this mechanical stimulus is slightly increased in a mineral bath owing to the greater specific gravity of the salt water, the thermic stimulus is also increased because the mineral bath is given somewhat cooler below the natural temperature of the body. But the chief effect is explained by the fact that the chlorides are not, as formerly stated, absorbed and taken up by the blood, but permeate the epidermis, and there cause exosmosis of the fluids of the tissues, and by this a stimulation of the branches of the terminal nerves in the cutis. This may be often felt subjectively, and may be objectively proved by a measure of the increased sensibility (Clemens, Santlus and Beneke).

The mineral bath has, therefore, this advantage over the ordinary bath: that the necessary stimulus is given with a lower temperature of the skin (Braun) and by the increased stimulus which it causes, the feeling of coldness, resulting from a bath under the normal temperature of the body, is lessened, and thus a cooler temperature is possible for a longer time (Senator).

Opinions as to the effect of these baths in detail are very varied. The energy of metabolism is increased by reflex action, pathological products are absorbed, the excretion of carbonic acid, according to Röhrig and Zuntz, and of urea, according to L. Lehmann and Beneke, is increased, whereas that of uric and phosphoric acids is reduced.[1] According to Robin and Heubner (two experiments made with Langstein and Rietschel) the excretion of nitrogen is increased; a retention of chlorides, as Keller (Rheinfelden) had stated to be the case under the influence of mineral baths, could not be confirmed by Heubner. As a result of increased appetite and food with assimilation and growth the weight of the body is improved.

Many authors (Wimmer and Kanzler) attribute higher stimulative properties to chloride of lime and chloride of magnesia (as being highly hygroscopic bodies) than to chloride of potash and to chloride of soda, and based the stronger action on their specially abundant mother lye. According to Clemens and Neubauer, solutions of sulphates, iodide of potassium, and Glauber salts are entirely lacking in such action. According to E. Lehmann, the evidence of the adhesion to the skin of the salts contained in the bath, both during and even after the bath, explains the itching and smarting of the skin, and the sensation of shivering and the formation of boils after taking strong mineral baths for some time.

The value of iodine and bromine combinations in the mineral water of the baths, formerly so highly prized, has not been clearly shown; still a certain influence is not to be denied, perhaps by respiration of the exhalations from these minerals. For the amounts of iodine and bromine in the drinking mineral waters, see below.

The carbonic acid contents of many mineral springs strengthens the action by the increased stimulus exercised on the nerves of the skin; this is shown—*cæteris paribus*—by an increased feeling of warmth and of redness of the skin, even after the bath, and allows of a further reduction of the temperature of the bath below the temperature of the body down to 29° C., even

[1] According to Keller a mineral 3 per cent. bath is followed by a greater increase of chlorides in the urine than a 6 per cent. mineral bath.

to 27° C. (24°-22° R.), without causing a disagreeable feeling of coldness. In some health resorts arrangements are made for the artificial addition of carbonic acid to the mineral baths. The rather complicated methods of Dr. Raydt, Kiefer, and especially that of Keller (saturating the water or evaporated water with CO_2 under high pressure), which are only suitable for large bathing establishments, satisfy all requirements according to my experience, at least in Reichenhall. Senator praises Bloch's method, the simple method of production by Sandow (the addition of bicarbonate of sodium and bisulphate of sodium) and that of Quaglio; bicarbonate of sodium and hydrochloric acid are very poor substitutes, and can only be used at home; Zucker's method is better.

The addition of extract of pine needles to the bath is very suitable.

We await further researches as to how far the therapeutic effect of the radio-activity of mineral baths is useful and has predominating influence.

INDICATION.

Mineral baths are in general indicated for patients suffering from all forms of scrofulosis, except in very early childhood, or in conditions of great weakness or fever. Phlegmatic children who need powerful stimulation are given highly concentrated mineral baths of long duration; for weak, susceptible, irritable, excitable children they must be weaker and shorter. When any affection of the ears is present mineral baths, and, indeed, all forms of baths, require special care.

We must bear in mind that if they are not to be harmful, being a different remedy from what the patient is used to, they require to be exactly regulated as to strength, temperature, length, number and sequence, and they require also careful watching of the effect by a weekly control of the weight of the child. Mineral baths act on different people in a different manner; an apparently strong man will often be greatly prostrated by a bath of medium strength, whilst sometimes delicate children and women feel wonderfully well after the strongest mineral bath; therefore, with even great practical experience, it is not always possible to determine how the mineral bath will suit the patient, and often in the course of treatment it is necessary to alter the regulations.

Patients will often receive detailed regulations from the family physician for weeks in advance respecting the use of mineral and sea baths, and do themselves harm either by taking too many or not enough, and so in this case depriving themselves

of the full effect of the treatment. Although the family physician is best capable of advising because he knows the patient and his constitution best, he must use a certain reserve, lest he be made responsible in case of non-success. For invalids who so frequently take the baths on their own authority the axiom—*volenti non fit injuria*—is appropriate.

Over-stimulation from mineral baths generally shows itself by great lassitude, continuing even beyond the time of rest after the bath, by a feeling of weakness, restless sleep with disturbed dreams, loss of appetite, excitability, a morose, irritable state of mind, by whims, fits of crying, rudeness, and—after a long-continued over-stimulation—even by rapid pulse, feverish attacks, and loss of weight. In case of such disturbances the baths must be at once discontinued for a few days, or even longer, if the treatment is to be successful, and are only to be renewed later in reduced strength for a shorter time, and less frequently.

Such want of success of mineral baths in the scrofulous is almost entirely caused by inappropriate apportioning of the strength of the constituents, and seldom by being contra-indicated.

But, on the other hand, too weak baths from over-caution are a failure. The principle must be to give as many baths and as strong as possible suitable to the patient; for this there must be constant and attentive superintendence by a doctor.

Carbonic acid baths are often accompanied by oppression, a dazed feeling, headache, giddiness, buzzing in the ears, palpitation, even a condition similar to intoxication. These symptoms are caused by inhaling the carbonic acid released from the water, and may be avoided by keeping the acid from the respiratory passages by means of a frame of wood laid on the bath and covered with oilcloth, and having a hole for the head to pass through. If the disturbances continue, in case of palpitation and so on, it may be necessary, especially with very sensitive children, to have recourse to mineral baths with free CO_2.

MODE OF USE.

The intensity of the effect of mineral baths depends on the individual as well as upon the mode of use, the strength, temperature, length, frequency and number.

The morning is the best time for the baths, about an hour after a light breakfast. They do not suit weakly persons when fasting, and cause headache, paleness, &c., neither may they be taken on a full stomach; therefore, if taken during the after-

noon, at least three or four hours' interval after the meal is required.

The strength of the mineral baths—the amount of chlorides—must be arranged according to the vigour and susceptibility of the patient. On an average

Children of	1 year are given	½-1½ per cent. mineral baths
,,	2-4 years and delicate children	1-2 per cent.
,,	5-10 years	1-4 ,,
Torpid and older children and adults	...	2-6 ,,

In exceptional cases 8-10 per cent. is reached, and recently a few up to 12 per cent. and over have been given (see Kúthy—with phlegmatic children—9 per cent.).

As a rule mineral baths from 0·5 to 2 per cent. are styled weak, from 2-4 per cent. medium, from 4-6 per cent. strong.

I have found it best to begin with very weak baths and gradually to increase the strength; in this manner much stronger baths are borne much better later than if one ordered a certain percentage at once, even if it were of moderate degree.

The concentration of natural salt and mineral springs varies within very wide limits from 0·5 to 30 per cent.; those under 1·5 per cent. are generally termed salt springs; the stronger, mineral springs. We distinguish further, cold and warm springs, simple springs, those containing iodine or bromine, and lastly carbonic acid springs.

The weaker springs are, in the case of scrofulous patients, often only used in drinking; when used for bathing, to get the necessary degree of concentration for stronger or phlegmatic persons, a condensation or addition of mother-lye[1] is needful, which adds very little to the expense, but may lead to a decrease of the desired strength, and even to falsification in bathing establishments which are not properly superintended.

Strong mineral springs have the advantage of easily giving any degree of concentration desired by the addition of water; there are no other reasons which make them less desirable than weak springs.

The temperature of the mineral baths is regulated in the first place according to the individual; for the anæmic, 35°-33° C. is used, otherwise 31°-32° C.; for the strong, who rapidly replace lost warmth, 31°-30° C.; the temperature may be reduced within these limits according to the increase in mineral strength.

[1] Mother-lye is the mineral deposit which remains as a very concentrated solution of chloride of lime, chloride of magnesium, and chloride of potash, &c., after heating common salt.

Mineral baths containing carbonic acid are generally given at 32°-29°-27° C.

The duration of each bath is also regulated according to individual constitution, and a gradual advance and habituation are most suitable. We begin, as a rule, with five or ten minutes, rising to twenty, thirty, and even forty-five minutes. The shorter baths serve for exciting metabolism; the longer and warmer ones for absorption.

After the bath a cool, or even cold, shower bath or douche is advisable according to the nature of the case, after which the patient must rest from half to one hour, best in bed, but at least with loose clothing (without corsets!!), otherwise there will be headache, loss of sleep and appetite; delicate persons may take a glass of milk or wine or a little bread and butter. When the bathing establishments are far from the house which the patient occupies, as in many health resorts is unfortunately the case, and opportunity for rest is not offered in the establishment itself, some cooling process is all the more necessary for susceptible persons to avoid taking cold. Exercise in the open air after a bath is only to be allowed for very strong persons in good weather; study or letter-writing at this time is injudicious.

The frequency of the baths is determined by the result. With delicate children the baths may be given every three days, with others every other day; strong persons take them, if they suit, every day, or leave out every third or fifth day. A doctor must not allow himself to be influenced by the importunity of the patient, but only by the effect of the baths. With rapid increase in weight one can advance more quickly to stronger baths; with many patients this increase only takes place after the end of the baths, during the after-treatment.

The total number of baths for very young children is fifteen to twenty, for older children thirty to forty, seldom fifty. A certain difficulty arises from the mistaken idea that the patient must take a fixed number. In reality the number is unimportant; the result is to be the chief guide. On the other hand, the maximum number has been arrived at from the usual length of the treatment based on other reasons, and as long as the baths suit the patient there is no reason why this maximum should not be surpassed.

The total length of the bath treatment is about six to nine weeks (for the length of the climatic treatment, see pp. 167, 329 and 343).

Mineral baths may be taken at any time during the year. Bathing resorts are mostly open from the beginning of May to the end of October.

For lasting success in the treatment of scrofulosis (with the exception of the very slightest cases) the mineral baths must be repeated two or three times in consecutive years, and it is well to draw the attention of parents to this fact at once. The repetition in the same year (spring and autumn) I have generally found to be less advisable; an immediate return home, and especially a return to school, may often endanger the whole success of the treatment, as according to experience this is followed for a long period by a condition of hypersensitiveness, and often the full effect is only developed later; if in any way possible, a rest of from two to five weeks in the same place, or one climatically somewhat different, is to be recommended. When the mineral baths have had good effect and there has been considerable gain of strength, such places are the most suitable which make increased demands on the physical powers rather than places in higher altitudes, or by the sea (unless further sea baths be taken).

To prevent misconception about the total length of such a treatment till complete recovery is obtained, refer to the results communicated below in mineral and sea bathing stations (see p. 361).

C.—SEA BATHS.

Hippocrates advised washing with sea water for those *qui ab acribus humoribus ardentur*. The founder of modern Thalassotherapeutics may be considered to be the English doctor, Russel, who in 1750 recommended them in his book "De tabe glandulari sive de usu aquæ marinæ in morbit glandularum." Sea baths, in conjunction with mineral baths, have achieved an important position in the therapeutics of scrofulosis.

EFFECT.

In sea baths, besides the effect of the salt, which is unimportant owing to the short duration of the bath, the cooler temperature acts as a powerful thermic stimulus; the great loss of warmth of the body consequent on the baths is only felt by the bathers in the first few moments, it is then covered by the great mechanical reaction caused by the exertion required to withstand the beating of the waves, and the pressure and friction which the mass of water exerts on the body. The powerful reflex stimulation of metabolism is shown by a great increase of urine and reduction of uric and phosphoric acid in the urine, and is visible in keener appetite and increased weight. The frequency of the pulse is increased, and transitorily the systolic blood-

pressure is heightened (Loewy). A number of works on the effect of sea baths have been published in recent years (see Häberlin).

INDICATION.

As an energetic means for promoting active metabolism, the indication for sea baths is the same as that of sea climate and sea air, discussed above. They are most excellent for phlegmatic, fairly robust constitutions which are able to withstand strong impulses; they have proved themselves unsuitable for weak, very anæmic, thin, excitable individuals who are unable to compensate for increased loss of material by taking an extra amount of nourishment, and by further assimilation to prevent bodily bankruptcy, and for persons who suffer from a nervous and obstinate irritant cough. With weakly patients sea baths may only be cautiously tried in their very mildest form, in the Mediterranean and Baltic Seas (pregnant women should only bathe in the sea up to the sixth month) as a rule. In doubtful cases mineral baths are preferable.

Sea baths are contra-indicated for children up to 1 year old, especially as their fear at the sight of the sea is a hindrance; as they grow older they may be gradually accustomed to cool baths by sponging them down with sea water and by warm sea baths (in its effect the same as mineral baths).

In scrofulous ear diseases, as in any other affection of the ears, sea baths are contra-indicated.

As signs that sea baths are unsuitable, or that over-stimulation has taken place, loss of appetite and loss of sleep occur, as in the case of mineral baths; chilliness and shivering in the bath, excitability, paleness, prostration, considerable loss of weight are a warning to discontinue the treatment, and either to take to warm baths or even to change to a less exhilarating climate.

Some disadvantages which sea baths have over mineral baths are that the amount of salt cannot be arranged to suit individual needs (the North Sea contains about 3 per cent. salt), also the motion of the waves and the temperature are not under our control, and the use of these baths depends very much upon the weather.

MODE OF USE.

The mode of use is in certain respects different from that of mineral baths. With weakly persons they must only be begun in very warm weather. The bath is best taken at high tide, if

possible before noon, and never fasting; delicate persons may take a glass of warm milk, cocoa, or wine or brandy beforehand.

The duration is according to the powers of the individual. At first, for scrofulous patients, only a moment or half a minute, then one to five minutes, seldom more. At Berc-sur-mer ten minutes is rarely allowed. In any case the bath must cease before the feeling of warmth has given way to shivering.

The sea bath is to be followed by a walk and a meal.

We often observe a loss of weight during the bathing period, and considerable increase after the baths have ceased.

The frequency and total number of baths is arranged according to their effect and the strength of the patient, partly also according to local circumstances. At Berc-sur-mer, for example, scrofulous children bathe almost daily; in German stations (according to Brauer) they seldom bathe daily, generally two or four times weekly. The total number of baths in the North Sea bathing places is fifteen to twenty for women, twenty to twenty-five for men, fewer for delicate persons, whilst, according to Brauer, in Sestri the children take on an average sixty-five baths.

The season for bathing varies greatly according to the geographical position of the place, and the more northerly the situation the more it is limited to the hottest months. Whilst in the Mediterranean bathing is carried on until late in the autumn, and for delicate persons a stay there during the whole winter is suitable, in the German North Sea one can only bathe from the beginning of July until the end of September. In order to somewhat extend this short time, and to be independent of weather and seasons, and to find a substitute for weaker persons whom cold sea baths do not suit, in many places, especially northern ones, warm sea baths have been established, which naturally differ in no way from a mineral bath with a fixed concentration of salt.

These, as well as sponging with sea water, are used for delicate persons as a transition to cold baths. In some places—at Norderney, for example—in this manner a complete winter course of treatment has been arranged.

D.—SULPHUR AND ARSENIC SPRINGS.

Sulphur springs, the action of which needs a better scientific foundation, have in many cases proved themselves empirically of value for scrofulous patients, and are much prized in France,

where there are many sulphur springs, especially in the Pyrenees. The baths are taken for scrofulous skin diseases, in scrofulous catarrh of the respiratory passages, and to promote digestion. Sulphur springs—for example, those of Weilbach—are used internally. The same may be said of arsenic springs.

E.—AUXILIARIES TO MINERAL AND SEA-BATHING TREATMENT.

Besides the baths, certain climatic and balneo-therapeutic auxiliary remedies for scrofulosis may be taken into account.

In the choice of a watering-place, the presence of a "graduating house" is often considered.

A graduating house is a long scaffolding of beams filled up with bundles of twigs, from which the mineral water falls, drop by drop, from twig to twig, and is partly evaporated and thus concentrated (graduated).

The air in such graduating works is cool, very damp, impregnated with particles of salt, often smells of bromine, and is rich in ozone, which is liberated by the evaporation of salt water (as at the seaside). It thus in many ways resembles sea air, but there is no great motion in the air, as the graduating fences afford protection from it.

A stay there is very agreeable, especially on hot days; it provides the advantages of abundant inhalation, and has a beneficial effect on irritative conditions and dry catarrh of the scrofulous, but possesses no specific qualities. A visit to these houses demands certain precautions on account of the considerable difference of temperature (4-8° C.) in them from their surroundings, especially on warm days, the neglect of which must often be dearly paid for by those not acquainted with the existing conditions (see Locher, Krone).

The water-drinking treatment arranged in most watering-places is used with advantage by many scrofulous patients, and may be discussed here, although belonging to internal treatment. Weaker mineral springs containing 1·5 per cent. of solid matter are drunk pure, the stronger are diluted proportionately; imported mineral waters are also much used.

The scientific explanation of the action is not quite satisfactory, and needs further discussion. Langstein and Ritschel have not been able to demonstrate any alteration in the amount of nitrogen, chlorine and phosphorus from internal use of the

mineral waters (for the contrary view, see p. 331). Empirically, the benefit is quite established (see R. Weigert).

The common salt springs are ordered for the scrofulous as the water removes dyspepsia, facilitates the action of the bowels, and furthers metabolism, digestion and nutrition, and in catarrh of the respiratory passages loosens the secretions by rendering them fluid.

The numerous cold salt springs rich in carbonic acid, even when the amount of salt is small, exert a powerful stimulus on the mucous membrane of the stomach by means of their carbonic acid and cool temperature; a warm temperature weakens the direct effect of the salt, hastens its absorption, and thus acts more energetically on the blood (Braun).

Stronger salt springs, free from carbonic acid, are often artificially mixed with CO_2, or drunk diluted with carbonic acid waters (carbonated waters).

Braun preferred the Carlsbad waters to the allied salt springs, which often induce catarrh of the intestinal mucous membrane; Kanzler also speaks in favour of Carlsbad salts in scrofulous patients suffering from catarrh of the stomach and duodenum, chronic constipation, and intestinal inertia, with absorption of pathological products.

By some the iodine and bromine contents of different salt springs is much valued;[1] indeed, the chief effect is attributed to it. But whatever value may be attached to the use of iodine in many forms of scrofulosis, especially in glandular affections in well-nourished older children, the quantity of iodine and bromide contained in the ordinary mineral waters is so small in comparison with the pharmaceutical dose necessary to produce any effect worth mentioning that a result could only be effected by using them for a length of time. The common salt waters of Kreuznach (Elizabeth Spring), Hall (Thassilo Spring), and Heilbrun (Adelheid Spring), containing iodine are in severe cases of scrofulosis to be classed with the ordinary salt springs for internal use.

The chalybeate waters of Pyrmont, Schwalbach and Spa have been used with good effects in cases of scrofulosis, combined with true anæmia; mere paleness is no guide on this point (see p. 54).

Sea water is also given internally, but if unfiltered it readily causes diarrhœa. Dalton recommended ½ to 1½ litres daily.

[1] It has also been stated that the combination of iodine in different salts renders them more easily absorbed.

Robert Simon and René Quinton injected sea water, made isotonic to the fluids of the tissues, subcutaneously every three or four days, 100-300 grammes for sixty days, and mention satisfactory results in fifteen cases. Pagano mentions surprisingly favourable effects after injecting sterilized sea water in quantities from 5 grammes up to 20-30 grammes (sometimes mixed with a little iodine till it takes a straw colour) in scrofulosis of the lymph glands, and even advanced pulmonary tuberculosis (with slight rise of temperature and often with enormous appetite), also involution of the glands, healing of fistulæ, &c., and effects similar to those observed after a stay at the seaside (see also L. Pernossi and Boutellier), but De Lange found no benefit from it, and even harm with high fever, &c.

Whey is much prescribed in health resorts, generally 200 grammes two or three times a day, fasting.

Although the whey treatment is not so much used as formerly and has no specific action, the dissenting opinion of many authors as to the beneficial effect which has been empirically demonstrated, is not justified. The nutrient value is small—320 calories—but it regulates the action of the bowels, helps appetite and digestion, eases diuresis, and loosens the secretions; it is also much liked by children. It is especially suitable for the dilution and warming of mineral waters. Now and then it is refused on account of its insipid taste; in rare cases, too, it is not digested. Limitation of diet is neither demanded, nor is it allowable for scrofulous patients who require good feeding, but naturally the food must be such as is easily digested.

In many places the scrofulous are ordered a glass of the freshly expressed juice of medicinal plants before noon. The taraxacum leontodon, veronica beccabunga, nasturtium aquaticum, menyanthes trifol., glechoma hederac, &c., are rightly valued as a good bitter and stomachic for toning up the stomach, but besides this are of no great importance.

Often systematic air and sun baths are combined with the climatic treatment on account of the tonic effect which excites metabolism and to get the full action of the sunlight. The real sunlight treatment—heliotherapeutics—introduced by Bernhardt in Samaden has been employed, especially by Rollier, for surgical scrofulosis and glandular or other tuberculosis, since 1903 in Leysin. By this treatment Rollier does not open closed foci over a seat of infection, but exposes the patients (in the case of open wounds with fixation bandages) to the sun's rays, and keeps them night and day in the open air. The wounds become healthy and

dry, granulate, and gradually heal. Escherich, Monti, and v. Eiselsberg have convinced themselves of striking successes in Leysin, and have published facts concerning them, so also have Bardenheuer, Franzoni, Hirschberg, and others.

The time extends to two years, in severe cases longer; there is no improvement during the rainy season. Doubtless the intensity of the sun's rays in the high mountains as in Leysin, contributes largely to the success, according to Morin through the ultra-violet rays, which are much absorbed in the atmosphere of places lying at lower levels (see Rollier). Jerusalem informs us that he has had good results from heliotherapeutics in the vicinity of Vienna (see Freund, Sternberg, and others). Monti's observation is interesting, namely, that in contradistinction to patients treated with tuberculin, those treated with sunlight give a characteristic reaction to Moro's test, even after the lesion is healed (Escherich; for Heliotherapeutics, see also Malgat, Borriglione and Alb. Robin).

F.—CHOICE OF A HEALTH RESORT.

In the choice of a climatic health resort, or mineral, or sea bathing place, a number of points of view must be taken into account. The cost, climatic conditions, in many cases the distance, suitable railway communication, the possibility of combining the stay with drinking the necessary waters, &c. It is quite impossible, in view of the infinite number of health resorts and baths suitable for the scrofulous, that a single observer has a sufficient knowledge of them all, or even the greater part, therefore in the following summary we shall only attempt to mention such places as we know by personal experience, or those celebrated as being especially suitable, in order to give doctors a certain standpoint, without denying efficacy to others not mentioned.

From a general point of view we have already remarked that the sea appears to be less suitable for weakly and excitable children, and for such, mineral baths are more desirable. Of sea bathing stations, those of the North Sea, the coast of Belgium as far as Holland, the north and south-west coasts of France, and the east and south-east coasts of England make more demand on the strength of the patient than the south and south-west coasts of England, than Arcachon on the French coast, and especially places on the Adriatic and Mediterranean Seas. Here again the Riviera di Ponente is more suitable than the Riviera di Levante

for the weakly, but in practice the indications are not always so sharply defined as they are laid down in theory.

In scrofulous affections of the ears, as already mentioned, very great caution must be exercised with baths. Sea baths are almost forbidden in affections of the eyes, mountain and sea climates are only to be chosen with reserve on account of the strong reflection of light; in moist acute eczema baths must be avoided, and even a stay at the seaside often has too irritating an effect.

I.—Climatic Health Resorts.

Health and Holiday Resorts, suitable for Spring till Autumn, with certain restrictions according to level above the sea.

(1) In Inland Plains and Heights up to 400 m.

Numerous health and holiday resorts in Thuringia, in the Hartz Mountains, in the Bavarian Alps, in the Black Forest, in Tyrol, in Switzerland:—

Thuringia: Berka on the Ilm, 275-330 m.; Bad Thal, 350 m.; Tabarz on the Inselsberg, 420 m.

Harz: Osterode, 230 m.; Ballenstedt, 264 m.; Altenbrak, 310 m.; Bad Sachsa, 325 m.; Grund, 330 m.; Bad Lauterberg, 330 m.

South and West Germany: Baden-Baden, 200 m.; Cannstadt, Cleve on the Lower Rhine, Bad Triburg in the Teutoburger Forest, 220 m.; Braunfels on the Lahn, 300 m.; Honnef on the Rhine, Hornberg in the Black Forest, 380 m.

Taunus: Ems, 82 m.; Wiesbaden, 117 m.; Soden, 140 m.

North Germany: Eberswalde, 30 m.

Austria: Gleichenberg (Styria), 300 m., and numerous others.

(2) In Inland Tablelands and Heights from 400 to 900 m. (Simple Mountain Climates and Holiday Resorts).

Thuringia: Friedrichsroda, 450 m.; Ilmenau, 530 m.

Bavaria: Bernek in the Fichtelgebirge, 400 m.

Black Forest: Herrenalb, near Baden-Baden, 410 m.; Badenweiler, 452 m.; Triberg, 700 m.; Freudenstadt, 740 m.; St. Blasien, 772 m.

Harz Mountains: Braunlage in the Bodetal, 565-620 m.; St. Andreasberg, 620 m.

Riesengebirge: Wölfelsgrund, 600-700 m.

(3) Inland Heights of 400 to 900 m. (under Alpine Influence, Voralpine Climate).

Germany: Bad Reichenhall, 470 m.; Berchtesgaden, 575 m.; Garmisch, 700 m.; Oberhof in Thuringia, 825 m.; Oberstdorf im Allgäu, 843 m.; Bad Kreuth, 850 m.

Austria: Gmunden on Lake Traun, 422 m.; Ischl, 469 m.

Hungary: Marilla, 714 m.

Switzerland: Gersau on Lake Lucerne, 440 m.; Interlaken in the Bernese Oberland, 568 m.; Thun on Lake Thun, 570 m.; Langenbruck in the Jura, 740 m.; Bürgenstock, 870 m.

(4) High Mountains, 900 m. and over, also suitable for After-treatment after Mineral Baths.

Germany: Seebrugg in the Black Forest of Baden, 914 m.; Höhenschwand in the Black Forest, 1,011 m.; Schreiberau in the Riesengebirge up to 1,200 m.

Tyrol: Igls, near Innsbruck, 900 m.; Gossensass, 1,100 m.; Toblach in the Puster Valley, 1,224 m.; Brennerbad, 1,326 m.; Madonna di Campiglio (South Tyrol), 1,553 m.

Hungary: Neu-Schmecks, 1,005 m.

Switzerland: Felsenegg (Canton Zug), 950 m.; Silz Maria, Seewis, 1,000 m.; Les Avants, near Montreux, 1,000 m.; Engelberg, 1,019 m.; Flims, 1,104-1,150 m.; Beatenberg, 1,148 m.; Churwalden, 1,270 m.; Adelboden, 1,356 m.; Rigi, 1,600 m.; Davos Platz, 1,560 m.; Mürren, 1,650 m.; Arosa, 1,720-1,860 m.; Pontresina, 1,800 m.; Maloja, 1,811 m.; and St. Moritz, 1,856 m.

Transition Resorts suitable for Spring and Autumn.

Tyrol: Arco, 90 m.; Gries, near Bozen, 275 m.; Meran, 319-520 m.

Istria: Abbazia.

Switzerland: Montreux, 380 m.

Italy: Locarno, 204 m., and Pallanza, 193 m. on Lake Maggiore; Lugano, 275 m.; Bellagio on Lake Como.

France: Pau, Biarritz, Dax.

Late Autumn and Winter Resorts.

Most of the above-mentioned.

Italy: Gardone-Riviera, the Riviera di Levante; Rapallo, St. Margherita, near Genoa; Nervi and the Riviera di Ponente; Pegli, Porto Maurizio, Bordighera, Ospedaletti.

France: Mentone, Cannes, Ajaccio in Corsica.

Atlantic Ocean: Madeira.

II.—Watering Places.

D = for drinking; I = containing iodine; Fe = containing iron; As = containing arsenic; S = containing sulphur; CO_2 = containing free carbonic acid.

(1) SIMPLE MINERAL WATERING PLACES.

(*a*) Cool.

Germany.

Swinemünde and Kolberg, on the Baltic, 2—5 m., 5 per cent.
Cammin, 10 m., 4½ per cent.
Segeberg in Holstein, 48 m., 26 per cent.
Essen, nr. Osnabrück, 50 m., 5—15 per cent.
Elmen, nr. Magdeburg, 55 m.
Hohensalza, 96 m., 25 per cent.
Inowrazlaw (Posen), 96 m., 31 per cent., I.
Wittekind, nr. Halle, 102 m., 3·7 per cent., D.
Dürrenberg on the Saale, 105 m., 9 per cent.
Kreuznach (Rhine Province), 105 m., D., 1·3 per cent., I.
Gaudersheim, 107 m., I.
Münster am Stein (Rhine Province), 117 m., D., 1 per cent., I.
Artern, nr. Erfurt, 130 m., 3 per cent.
Frankenhausen Kyffhäuser, 130 m., D., 2—27 per cent.
Sulza on the Ilm, 148 m., D., 12—27 per cent., I.
Sooden on the Werra, 152 m., 4 per cent., I.
Salzdetfurth in the Harz, 156 m., 6 per cent.
Jagstfeld in Württemberg, 157 m.
Soden-Salmunster, 157 m., 3—4 per cent.
Kösen in Thüringia, 163 m.
Köstritz in Thüringia, 165 m., 22 per cent.
Thale in the Harz, 180 m.
Niederbronn, Alsace, 192 m., D., 0·4 per cent.
Suderode in the Harz, 200 m.
Schmalkalden in Thüringia, 232 m., D.
Salzungen in Thüringia, 262 m.
Goczalkowitz (Pr. Silesia), 266 m., 2·6 per cent.
Königsdorf-Jastrzemb, nr. Loslau, 280 m., D., 1 per cent.
Harzburg, 300 m., D., 16 per cent.
Wimpfen on the Neckar, 300 m., 28 per cent.
Hall-Swabia, 301 m., 28 per cent.
Reichenhall, Bavarian High Alps, D., 470 m., 23 per cent., I.

Germany—continued.

Berchtesgaden, Bavarian High Alps, 575 m., 26 per cent.
Dürrheim (Black Forest), 705 m.

Austria.

Ischl, 469 m., D.
Hall, nr. Innsbruck, 559 m.
Aussee (Styria), 650 m.
Iwonicz (Hungary), D., CO_2, I.

Switzerland.

Rheinfelden, 270 m., 31 per cent.
Bex-les-Bains, 430 m., D., 31 per cent., I.
Aigle-les-Bains, 584 m.

France.

Lous-le-Saunier, 30·5 per cent., I.
Salies-de-Bearne (Pyrenees), 40 m.
Biarritz.
Brides-Salins (with small swimming bath for children), 490 m., I.

England.

Droitwich, Worcestershire.
Woodhall Spa, Lincolnshire.

Italy.

Battaglia (Abano).
Salsomaggiore in Parma, 15·3 per cent., I.
Castro-Caro, nr. Florence, I.

(*b*) Warm.

Germany.

Baden-Baden, 200 m., D., 0·2 per cent., CO_2.
Wiesbaden, 117 m., D., 0·8 per cent., CO'_2.

France.

Bourbon-l'Archambault, 270 m., D.
Bourbonne-les-Bains, 275 m., D.

(2) CARBONIC ACID MINERAL WATERING PLACES.

Germany.

Hamm in Westphalia, 63 m., 8 per cent.
Oeynhausen, 71 m., 3—8 per cent.
Salzuflen, Lippe, 75 m., 4 per cent.
Soden in the Taunus, 140 m., D., 0·3—1·6 per cent.
Nauheim, Hesse, 183 m., D., 2—4 per cent.
Homburg, the Heights, 192 m., D., Fe.
Kissingen, Bavaria, 201 m., D., 1—10 per cent.
Cannstadt, nr. Stuttgart, 220 m., D.
Neuhaus (Lower Franconia), 220 m., D., 0·9—1·7 per cent.
Eisenach, Thüringia, 220—396 m., D., 1·3 per cent.
Berg, nr. Cannstadt, 230 m., D., Fe.
Salzschlirf, nr. Fulda, 250 m., D., Fe., I., 1—1·5 per cent.
Gottesgabe, Westphalia.
Königsborn, Westphalia, D.
Salzhausen, Hesse, D., Fe.
Orb, Spessart, D., 0·8—1·8 per cent.
Rothenfelde, Hanover, 112 m.

(3) IODINE DRINKING SPRINGS.

Germany.

Sodenthal, Spessart, 142 m.
Tölz-Krankenheil (Upper Bavaria), 670 m.
Heilbrunn (Upper Bavaria, Adelheid Spring), 800 m.
Sulzbrunn, Bavarian Allgäu, 875 m.

Austria.

Darkau, Silesia.
Lipik (Slavonia), 154 m.
Hall, Upper Austria, 376 m., 13 per cent.
Rabka (Galicia), 540 m.

Switzerland.

Rothenbrunnen, 614 m., Fe.

(4) ALKALINE SPRINGS.

Germany.

Ems (Rhenish Prussia), 82 m.
Neuenahr, Rheinland, 93 m.

Austria.

Gleichenberg (Styria), 300 m., D.
Luhacovice (Moravia), I.

Switzerland.

Passugg, nr. Chur, 829 m., D., I., Fe.
Tarasp, Engadine, 1,200—1,240 m., 0·2—1·5 per cent., D., Fe., CO_2.

(5) IRON AND ARSENIC SPAS.

Germany.

Pyrmont-Waldeck, 120 m., D., Fe., 1—3 per cent. salts.
Dürkheim (Rhenish Palatinate), 130 m., D., As., 2 per cent. salts.
Elster, Saxony, 500 m., D., Fe., CO_2.
Flinsberg, Silesia, 521-970 m., D., Fe., CO_2.
Reinerz, Silesia, 568 m., D., Fe., CO_2., I.

Austria.

Levico-Vetriolo (S. Tyrol), 500 m., D., As., Fe.
Roncegno (S. Tyrol), 525 m., D., As., Fe.

Switzerland.

Rothenbrunnen, 614 m., D., Fe., I.
Val Sinestra, Engadine, 1,485 m., D., Fe., As.
St. Moritz, 1,800 m., D., Fe.

France.

Saint Honoré, 300 m., As.
Royat, 450 m., D., Fe., As.
Brides Salins, 490 m., D., As.
Saint Nectaire, 760 m., Fe., As.
La Bourboule Puy de Dôme, 800 m., D., As.

Sweden.

Ronneby, D., Fe.

(6) SULPHUR SPAS.

Germany.

Oldesloe, Holstein.
Langensalza, Thüringia.
Nenndorf, nr. Hanover, 71 m., D.
Weilbach in the Taunus, 135 m., D.
Meinberg, Lippe, 210 m., D.
Landeck, Silesia, 450 m.

France.

Amelie-les-Bains, 225 m.
Challes (Savoy), 270 m.
Uriage, 414 m., As.
Bagnières de Luchon (Department Haute Garonne), 630 m.

France—continued.

Ax (Upper Pyrenees), 714 m., D.
Cauterets (Upper Pyrenees), 930 m.
Barèges, hautes (Upper Pyrenees), 1,240 m.
Pierrefonds.
Enghien.

Switzerland.

Schinzach (Canton Argau), 343 m.
Stachelberg (Canton Glarus), 664 m.
Gurnigl (Canton Berne) 1,155 m., Fe.

England.

Harrogate, with various springs.

(7) SEA-BATHING PLACES (ARRANGED FROM EAST TO WEST).

BALTIC.

Cranz.
Zoppot.
Stolpmünde.
Kolberg (Pomerania).
Berg-Dievenow (Pomerania).
Misdroy.
Swinemünde.
Ahlbeck in Usedom.
Heringsdorf.
Zinnowitz.
Göhren in Rügen.
Sellin.
Binz.
Sassnitz.
Breege.
Müritz (Mecklenburg).
Warnemünde.
Doberan.
Boltenhagen.
Heiligendamm.
Travemünde.
Glücksburg.
Marienlyst (Denmark).

NORTH SEA.

Fanö (Denmark).
Wyk in Föhr.
Amrum.
Büsum.
Heligoland.

NORTH SEA—*continued.*

Spickeroog.
Norderney.
Juist.
Borkum.
Zandvoort (Holland).
Scheveningen (Holland).
Blankenberghe (Belgium).
Ostend (Belgium).

ATLANTIC OCEAN.

England.

Brighton.
Hastings.
Isle of Wight.

Portugal.

Madeira.

France.

Dieppe.
Trouville.
Arcachon.
Biarritz.

MEDITERRANEAN.

Abbazia.
Grado.
Venice-Lido.
Pegli.
Sestri Levante.
Via Reggio.

G.—HOLIDAY SETTLEMENTS AND CHILDREN'S CONVALESCENT HOMES.

Comparatively few families can afford to pay for the stay of a scrofulous child in a health resort, still less to accompany the child. Therefore in recent years public charity has undertaken the task of sending invalid children of poor parents for a time to suitable places and caring for them there. This is done in holiday settlements, and in mineral and sea health resorts.

In the holiday settlements delicate poor children, chiefly aged from 6 to 8 or 14 years, are sent in batches of twelve to twenty or forty to good country air, either to homes or to families or hired places for three or four weeks; in day settlements and milk stations, the children assemble at a certain place in the town to drink milk, and to be taken, under proper supervision, into the forest, fields, or playgrounds. Mineral and sea hospitals take children who are really ill, and chiefly the scrofulous.

In the year 1876 a batch of poor children was first taken into the country to a holiday settlement by Pastor Bion in Zurich, and about the same time in Hamburg. Since then, especially by the untiring efforts of Dr. Varrentrapps in Frankfort-on-Main, this humane movement has embraced a wide field in Germany, thanks to good organization. According to the reports of the central station in Germany, in 1880 over 1,000, in 1890 over 20,000, in 1898, 28,000, and the total since the beginning of the movement of over 266,000 poor children have shared the benefit of a longer summer stay. In nearly all the countries of Europe, partly also in America and Japan, this splendid idea has been appreciated and made a reality.

We cannot even approximately reckon the value which holiday settlements have in the avoidance of scrofulosis, and in the cure of slight cases owing to the want of proper statistics relating to scrofulosis, but doubtless the use is enormous, as we may conclude from the general gain in strength of the children who have enjoyed the benefit. Very favourable results are rightly attributed to day settlements and milk stations. The weight of the body[1] gives a relatively reliable criterion for the success, in spite of many just objections.

Comparative weighing of the settlement children and those who remained at home showed, with the former (in Leipzig), an increase of double (1,700 and 1,500 respectively, against 700 and

[1] Monti only allows a definite cure of scrofulosis if besides the disappearance of the local processes there is an addition of more than 2 kilogrammes in weight.

780 grammes); in Frankfort-on-Main there was even 1·2 to 1·8 kilogramme increase, against 0·1 to 0·4 of children not sent to a settlement. According to Büsing's estimate, in 2,622 cases the children, to judge by comparisons in weight, were furthered in their development by ½ to ⅔ of a year by a stay lasting about three weeks in the summer in a settlement.

In some towns, Dresden, Mayence, Frankfort-on-Main, an after or winter treatment is practised by giving the children milk, &c. By this means especially the improvement in health attained in the settlements proves to be a lasting one, as was shown by a later weighing (in Mayence, for instance), and a smaller number of absences from school (Ratisbon). The principal result was frequently attained, according to Goepel in Frankfort-on-Oder, only in the following months, so that the holiday change acts "like an accumulator of energy of growth to form strength."

Before the introduction of holiday settlements arrangements had been made in mineral watering-places for the reception of poor, weakly children, especially the scrofulous. The merit of instituting the first mineral-bath hospital in Germany belongs to Dr. A. H. Werner, of Ludwigsburg. He succeeded after much trouble in 1861 in building at the Yagstfeld Spa his own Children's Home, which from 1862 to 1898 received nearly 10,000 children. Now there are over thirty German homes, which in 1898 received 11,000. Later the Central Union for Children's Homes and the Fatherland's Women's Union have made the furthering and foundation of children's home their special task. At present there are the following

Children's Homes in Germany.

For Children threatened with Tuberculosis, the Scrofulous, and Convalescents.

(1) In Mineral-water Spas	44	Institutions—	4,917	beds,	10	open during	Winter
(2) In Seaside Hospitals	41	,,	3,415	,,	9	,, ,,	,,
(3) In other Places	16	,,	807	,,	5	,, ,,	,,

For Tuberculous Children.

(1) In Mineral-water Spas	3	Institutions—	155	beds,	8	open during	Winter
(2) In other Places	16	,,	774	,,			

Such institutions have existed in Austria, in Bad Hall since 1856, and in Sulzbach, near Ischl, Darkau, Lipik, and Hallein.

Practitioners would perhaps like to be informed of the children's homes which exist, in case it might become necessary to choose one.

I.—CHILDREN'S HOSPITALS IN GERMAN SPAS.

(A) For those threatened with Tuberculosis, the Scrofulous and Convalescents.

As a rule they are open from May to September, or October. Institutions open the whole year are marked thus *

Province or confederate state	Name and place of Children's hospital Ch.—Children's hospital Ch. H.—Children's home	Number of beds: Age for girls	Number of beds: Age for Boys	Charge in marks Fr. — some free
	In Spas.			
Brandenburg	Convalescent home and Girls' Refuge, Eberswalde[1]	32 5—4		10·5 per week Fr.
Silesia Posen	Prince and Princess William Ch. Hohensalza	40 6—14		7—8·75 per week Fr.
Province of Saxony	Bethesda Ch., Goczałkowitz ...	100 3—14		17·5 per week
	Königsdorff-Jastrzem, Jewish Ch.	45		9·8 per week
	*Empress Augusta, Ch. I. Bad Elmen-Salze	100 2—16	2—12	60·75 per 4—6 weeks
	*Empress Augusta Ch. II. Bad Elmen-Salze	100 2—16	2—12	60—75 per 4—6 weeks
	Ch. H. III. Bad Elmen ...	30 7—14		Fr.
	Cecilia Refuge, Artern	32 4—14	4—13	40—60 per month
	Empress Augusta Victoria, Ch. Bad Kösen	70 3—14		60—75 per 5—6 weeks
	Süldorf Ch., nr. Osterweddingen	25 2—16	3—14	8·75 per week
Schleswig Holstein	Oldesloe, Ch.	80 5—15		35—50 per 4 weeks
	Oldesloe Children's Nursing Home	30		65 per 4 weeks
Hanover	*Lüneberg Children's Hospital ...	65 1—15	1—14	10·50 per week
	Salzdetfurth Ch.	180 3—12		10·5—24·5 per week
	Elizabeth Hospital, Rothenfelde	105 4—15	4—13	37·5—100 per month
Westphalia	Königsborn Ch.	103 7—14		10·5—14 per week Fr.
	Ch. Bad Sassendorf	172		35—60 per month
	Emperor William and Empress Augusta-Victoria Home, Bad Sassendorf	40 5—14		For children of the Harpen coal miners. A. G. Dortmund.
Nassau	Soden in the Taunus Ch. H. ...	13 6—14	6—10	14 per week
Hesse	Ch. Bad Orb	350 3—14		45—60 Per 4 weeks Fr.
	Ch. Sooden in the Werra ...	107 3—14	3—12	45—75 Per 4 weeks
Rhine Province	Victoria Institution Ch. Bad Kreusnach	290 4—15	4—13	12·25—14 per week
	Children's Spa, Raffelberg ...	150 4—14		10·5 per week Fr.
Bavaria	Bad Reichenhall Ch.	38 5—16	—	10·5 per week Fr.
	Bad Kissengen Ch.	50 5—13		9·80 per week
	The Palatine Ch. Bad Dürkheim in the Hardt	170 3—16	3—14	II Cl. 70 per month I Cl. 100 per month Fr.

(A) For those threatened with Tuberculosis, the Scrofulous, and Convalescents—*continued*.

Province or confederate state	Name and place of Children's hospital Ch.—children's hospital Ch. H.—children's home	Number of beds		Charge in marks Fr. — some free
		Age for girls	Age for boys.	
Kingdom of Saxony	Bethlehem Ch. Berggiesshübel...	70 3—15		About 7·1 per week Fr.
	Bethlehem Ch. Bad Elster ...	34 1—14		12 per week Fr.
	Bethlehem Ch. Lausigk[1] ...	130 3—14		8·75—10·5 per week
	Leipzig Ch. H. Dürrenberg ...	40 6—14		4·5 per week, only for children from Leipzig
Würtemberg	Bethesda, Ludwigsburg Jagstfeld	120 2—15		9—19·6 per week
	*Ch. of the Johanniter Order, Hall, Swabia	90 4—15		9·1 per week
	*A. H. Werner's Ch. Ludwigsburg	200 4—18		3·5—7 per week Also cripples, surgical and orthopædic
	Herrenhilfe Ch. H. Wildbad ...	52 2—17	2—15	9—19·6 per week
Baden	Children's Spa, "Silvah" Rappenau	75		50—70 per 4 weeks
	*Children's Spa, Dürrheim ...	120 3—15		12·6—17·5 per week
Hesse	"Elizabeth Home" Ch. Nauheim	200 3—15	3—14	40—70 for whole treatment Fr.
Mecklenburg & Brunswick	"Bethesda" Ch. Sülze	400 3—16	3—14	45 per month Fr.
	Ch. Bad Harzburg	165 4—14		8·75—10·5 per week
Thuringian States	Children's Spa, Bad Sulza ...	82 3—14	3—12	10·5 per week.
	Charlottenhall Ch. Salzungen ...	94		——
	Ch. Frankenhausen	120 3—14	3—13	45—65 per 4 weeks
	"Helen" Ch. H., Pyrmont ...	100		7—14 per week
	Ch. Salzuflen	308 4—14		8·75—12·25 per week

[1] Eberswalde and Lausigk have only iron springs.

(B) For Tuberculous Children.

	In Mineral Watering Places		
	Prince and Princess William Children's Hospital, Hohensalza	60 6—14	9·8 per week Fr.
	Ch. H. Lippspringe	20 5—16	5—14	14—17·5 per week
	Caecilien Institute, Ch. H. Lippspringe	55 4—16	4—14	15·75—19·25 per week

II.—OTHER CHILDREN'S HOSPITALS (not in Spas).

(A) For those threatened with Tuberculosis, the Scrofulous, and those needing Rest and Change.

Province or confederate state	Name and place of Children's hospital Ch.—Children's hospital Ch.H.—Children's home	Number of beds: Age for girls	Number of beds: Age for Boys	Charge in marks Fr.— some free
Brandenburg	Berlin Ch. Borgsdorf, nr. Birkenwerder	34 4—14	4—10	14 per week Fr.
Brandenburg	Elizabeth Ch. H. Burgsdorf, nr. Birkenwerder	22 ¾—4	¾—4	Fr.
Brandenburg	*Ch. Gross-Lichtenfelde West	60 4—14		13·25 per week
Prov. Silesia	Ch. Lenzheim, Schreiberau ...	60 5—15	5—9	8·4—9·1 per week
Prov. Silesia	Villa Klause, Görbersdorf	12		—
Prov. Saxony	*Ch. Halle on the Saal	70 2—16	2—14	10·5—21 per week Fr.
Hanover	Bevensen, Hanover	52 5—15		10·5—14 per week
Westphalia	Ch. nr. Schalksmühle	100 7—14		Fr.
Nassau	*Ch. Wildeborn	24		8·4 per week
Nassau	Nastätten	—		—
Kingdom of Saxony	Bethlehem Institute Augustus-Bad, nr. Radeberg	80 3—14		About 7 weeks Fr.
Kingdom of Saxony	Bethlehem Institute, nr. Zittau	32 4—14		7 per week Fr.
Kingdom of Saxony	Bethlehem Institute, Hüttengrunde (Hohenstein-Ernstthal)	165 3—14		7 per week Fr.
Kingdom of Saxony	Bethlehem Institute, Niederneukirchen, nr. Bautzen	50 3—14		7 per week Fr.
Kingdom of Saxony	Bethlehem Institute, Zwönitzthal	32 3—15	3—14	7 per week Fr.
Württemberg	Heilbronn (Ebenezer)	14 ½—14 mostly surgical tuberculosis		5—6 per week Fr.

(B) For Tuberculous Children.

East Prussia	Ch. Waldfrieden, nr. Gerlanken	12 5—11		10·5 per week
Brandenburg	*Ch. Belzig	36 6—15		17·5 per week Fr.
Brandenburg	*Ch. Victoria Louisa Hohenlychen	150 4—16		17·5 per week Fr.
Brandenburg	Caecelia Home, Hohenlychen ...	150 4—16		17·5 per week
Brandenburg	Kd. Buch nr. Berlin	100		Projected
Silesia	Division Görbersdorf, Dr. Weicker's People's Sanatorium, Home for Invalids	10		—

(B) For Tuberculous Children—*continued.*

Province or confederate state	Name and place of children's hospital Ch.—Children's hospital Ch.H.—Children's home	Number of beds		Charge in marks Fr.— some free
		Age for girls	Age for boys	
Saxony Prov.	Ch. Frauenhilfe, Aschersleben...	13 3—14		Fr. Extension projected
Rhine Province	Division in Waldhof Elgershausen	6—14		—
	Ch. Aprath	100 4—16		17·5—21 per week
	Louisa Gueury Institute, nr. Gladbach	32 5—14		17·5 per week
	Provincial Nursing Home and School, Rheindehlen	40 —	10—21	—
Württem-berg	*Division Carolagrün	17 5—15		14—17·5 per week Fr.
Kingdom of Saxony	*Division in Böblingen	15 5—16		45—70 per week Also for bone tuberculosis
Anhalt	Ch. Duchess Maria nr. Oranienbaum	63 4—14		15·75—17·5 per week Fr.
Hesse	Reichelsheim in Odenwald	16 6—14		23 per week
Alsace	Pfastatt, nr. Mülhausen... ...	20 Building		—

Seaside hospitals have been established for some time, the example having been started by England in 1796;[1] through the energy of Lettsom and Latham the first institution for poor children was founded in Margate, which was soon followed by others. At present England possesses (over) fifty-three seaside hospitals. It was forty-five years later (in 1841) that a seaside hospital for scrofulous children was instituted outside England, in Italy, at Viareggio, through the initiative of Barellais, the founder of Italian seaside homes, whom his country may thank for about twenty of such beneficent institutions. Now there are about thirty-six seaside hospitals.

The development of seaside hospitals in France is due especially to Perrochaud, Bergeron, and Armaingaud. There are at present about forty in existence.

[1] In 1791.—Translator.

CHILDREN'S HOSPITALS IN GERMAN SEA BATHING PLACES.

Seaside Homes for Children.

B. = Boys; G. = Girls.

Home or hospital	Number of beds	When open	Charge	Conditions for entrance	Disease
Germany.					
North Sea.					
Borkum, North Sea Children's Home	200	All the year	90 M. per month, 130 M. for six weeks.	B. 4—12 years G. 4—14 years	Only those needing change of air.
Büsum-Holstein Children's Convalescent Home	50	,,	65 M. per month	—	—
Föhr-Schleswig-Holstein, Children's Convalescent Home	110	,,	2.50 M. per day	—	Not those with open pulmonary tuberculosis.
Dr. Gmelin's North Sea Sanatorium	3 buildings, each 30	,,	800 M. for 4 months	B. and G.	Not those with open pulmonary tuberculosis.
North Sea Hospital	—	,,	—	—	—
Norderney, Empress Frederick Seaside Home	265	,,	12.5—25 M. per week	B. and G.	Scrofulous children.
Sahlenburg, Nordheim Institution	116	,,	20 M. per week	B. and G. 2—14 years	Severe tuberculous and scrofulous diseases.
Westerland, North Sea School Sanatorium ...	—	,,	150—210 M. per month	B. and G. of the better class 18 years	—
Döse, Donnersches Convalescent House ...	30	March—Nov.	Free	—	—
Duhnen, nr. Cuxhaven, Children's Hospital, Görne Institution	140	May—Oct.	12—20 M. per week, also poor	B. and G. 6—13 years	Tuberculous and suspected laryngeal and lung catarrh, healed or in process of healing. Tuberculosis of bones, joints, and glands.
Duhnen, Jewish Hospital for Children ...	130	June—Sept.	—	—	—
Norderney, Marienheim	102	May—Oct.	30—90 M. per month, also free	B. 6—12 years G. 6—13 years	Scrofulous and weakly.
Schobüll, Children's Nursing Home	32	,,	15 M. per week	B. and G. 7—14 years	Weak and sickly.
Westerland-Sylt, Bethesda Children's Hospital	75	,,	20 M. per week, ½ free, 13 M. per week	—	No open tuberculosis.

CHILDREN'S HOSPITALS IN GERMAN SEA BATHING PLACES—*continued.*

Home or hospital	Number of beds	When open	Charge	Conditions for entrance	Disease
Westerland-Sylt, Dr. Ross's Children's Home...	30	June—Oct.	20 M. per week	B. 6—12 years G. 6—14 years	—
Wangerooge, Protestant Children's Home ...	70	June—Aug.	40—60 M. per month	B. and G. 7—14 years	—
Wangerooge, St. Willehad Institution	50	June—Sept.	35—60 for children from Oldenburg, others 70 M. per month	B. and G. 6—14 years	Not open tuberculosis.
Wangerooge, Missler's Convalescent Home ...	56	April—Dec.	All free	—	—
Wyk in Föhr, Children's Hospital	225	March—Nov.	12.50—20 M. per week.	B. and G. 4—14 years	Especially bone tuberculosis.
Baltic Sea.					
Swinemünde, Martha Elsehaus Children's Nursing Home	—	Whole year	35 M. per week 38.50 M. per week July to Sept.	B. to 14 years G. to 18 years	Convalescent patients.
Berg Dievenow, Berg Dievenow Holiday Settlement	50	May—Sept.	1.85 M. per day.	B. and G. 7—14 years	—
Heringsdorf Children's Home	34	June—Aug.	45 M. per month, 1.50—3 M. extra for adults	B. 3—7 years G. 3—14 years Division for adults	—
Gross-Horst	100	,,	1.75—2 M. per day, free funds	G. 8—14 years	—
Kolberg, Altstadt Children's Home	—	—	4—5 M. per day	B. and G. 4—18 years	—
Kolberg, Jews' Hospital...	122	May 24—Sept. 30	30—60 M. per month	B. and G. 7—15 years	—
Kolberg, Silvah Children's Hospital	205	May—Oct.	1.60—2.70 M. per day	B. and G. 2—14 years Division for adults	—
Kolberg, Emperor and Empress Frederick Summer Home	150	June—Oct.	Free	B. and G. 7—14 years	—
Kolberg, Brandenburg Children's Hospital ...	144	,,	1.65—1.50 M. per day	B. 5—12 years G. 5—14 years	—

Kolberg Deep, Children's Seaside Home ...	33	June—Sept.	45 M. per month, including travelling expenses	B. 5—9 years G. 5—12 years	— —
Kolberg Deep, Pomeranian Lenzheim... ...	75	May—Oct.	About 30—45 M. per month	B. 7—9 years G. 7—14 years.	—
Gross-Müritz, Frederick Franz Home... ...	130	,,	100 M. per 6 weeks for well-to-do, 75 M. per 6 weeks for poor	B. and G. 4—14 years	—
Neukuhren, Empress Augusta Victoria Home	20	June—Sept.	50 M. per month	B. and G. and women	—
Priwall, nr. Travemünde, House of the Society of the Holiday Settlement, Lübeck	110	June—Aug.	Free	B. and G. 7—10 years	Slight affections.
Rewahl, Crown Princess Cecilia Seaside Home	100	June—Sept.	50 M. per month	B. G. and adults	—
Rosengarten, nr. Altdamm	42	—	5—30 M. per week	B. and G. 6—14 years	—
Rügenwaldermünde, House (for Charlottenburg)	40	June—Oct.	1.75—2 M. per day, Free beds	B. 8—14 years	—
Stolpmünde, Children's Hospital (for Charlottenburg)	—	May--Sept.	1.50 M. per day	B. and G. 3—14 years	—
Timmendorf Beach, Olga Home	54	June—Sept.	45 M. per month, including travelling expenses; also free	G. only 7—14 years	— —
Zinnowitz	25	—	—	B. and G. alternately	—
Zinnowitz, Home for the Young	70	—	40 M. per week	B. 3—15 years G. 3—16 years	—
Zoppot, Children's Hospital	140	May—Sept.	15 M. per week	B. 4—14 years	—
AUSTRIA.					
Cirkvenice, Ladislaus Children's Home ...	—	Whole year	60 K. per month, also free	—	—
Lussingrande, Maria Amalia Asylum	34	,,	—	—	Scrofulosis and rickets.
San Pelagio, nr. Rovigno, Grand Duchess Maria Theresa Seaside Home	380	,,	—	B. and G. 3—12 years	Scrofulosis and rickets. Tuberculin treatment
Valdoltra	240	,,	—	—	—
Insel Grado, Crown Princess Stephanie Seaside Home	320—350	July—Aug.	—	B. and G. 5—14 years	Slight forms of scrofulosis.

FRANCE.—Arcachon (Dep. Gironde) with 2 Homes, 260 beds; Banyuls-sur-Mer (200 beds); Berc-sur-Mer, on the Englisn Channel, with 5 Homes, over 2,000 beds; Cape Breton (120 beds), on the Bay of Biscay; La Croisic (250 beds); Giens, nr. Hyères (150 beds); Hendaye (592 beds); Pen Bron (300 beds), nr. Croisic; Saint Pol-sur-Mer (420 beds), Dep. du Nord; Saint Trojan (200 beds), on the island Oléron; San Salvador (200 beds), on the Mediterranean Sea; Zuydcoote (1,000 beds), on the Belgian frontier. All the above open the whole year. Further Cannes (formerly Dollfus Asylum, 50 beds); Cette (Alpes maritimes), with 3 Homes and nearly 1,000 beds; and a number of institutions with under 100 beds.

In Berc-sur-Mer (Pas de Calais), Malo-les-Bains, and Royan there are several homes for children of well-to-do parents; per day 3—8 francs.

ITALY.—Palermo (180 beds); Porto d'Anzio (200 beds); on the Mediterranean Sea, Via Reggio; these are open the whole year. Further, Alghero (80 beds), in Sardinia; Bagnoli, in the Province of Naples; Bocca d'Arno (130 beds), nr. Pisa; Celle Ligure, nr. Genoa, with 3 Homes and 1,000 beds; Cesenatico (120 beds); Falconara (110 beds); Fano (350 beds); Fontespina (110 beds); Giula Nova (150 beds), on the Adriatic Sea; Loano (250 beds), nr. Genoa; Porto Corsini (80 beds); Porto San Stefano (180 beds); Riccione, with 4 Homes and 1,250 beds; Rimini, with 4 Homes and more than 600 beds; Sestri Levante (160 beds), nr. Nervi; Venice (450 beds); Via Reggio, with 2 Homes and about 470 beds; Voltri (300 beds), nr. Genoa; further, numerous relatively smaller hospitals.

ENGLAND.—On the south coast, Bournemouth (72 beds); Brighton, Millfield (100 beds); St. Leonards (103 beds). Rhyl (250 beds), in North Wales. In the County of Kent: Herne Bay (134 beds); Broadstairs, with 5 Hospitals and 600 beds; Margate, with 4 Hospitals and 500 beds, amongst the best arranged. Eastbourne (340 beds), on the coast of Sussex; Felixstowe (128 beds); Folkestone (147 beds); New Brighton (100 beds); St. Annes-on-Sea (154 beds); St. Margaret's Bay (250 beds); Scarborough (103 beds); Silloth (105 beds); Southport (110 beds); Withernsea (106 beds), &c.

RUSSIA.—Alupka and Yalta in the Crimea; Windau in Kurland; Arensburg, on the coast of Ösel Island; Assern; Neubad and Bilderlingshof, on the Gulf of Riga; Budak; Chadshibei and Odessa, on the Black Sea; Haspol, Sestrorczk, Högsand and Worms on the Gulf of Finland; Oranienbaum in the Russian Government of St. Petersburg.

HOLLAND.—Scheveningen, Domburg and Oost-Capelle, on the Island of Walcheren; Katwijk aan Zee and Nordwijk aan Zee in the Province of South Holland; Loosduinen, nr. Scheveningen; Zandvoort and Egmond aan Zee in the Province of North Holland; Wijk aan Zee.

BELGIUM.—Blankenberghe, Ostend, Middelkerke, Venduyne-sur-Mer and Villa d'Uytkerke, nr. Blankenberghe, Heyst-sur-Mer, Villa Westende.

DENMARK.—Juelsminde and Odder, on the east coast of Jütland; nr. this Buddesminde; Refsnaes and nr. this Bakkely, Kolding, Frederiksberg, Hellebaek; not far from this Munkerup, Gilbjaerg, Snogebaek on the Island of Bornholm.

SWEDEN.—Skelderviken on the Cattegatt, Styrsö, nr. Gothenburg, Apelviken and Hälsan in Antnäs, nr. Bigdea.

NORWAY.—Blekóen, nr. Christiania, Fredriksvaern on the Skagerak, Hageviken, nr. Bergen, Vikan, east of Drontheim.

SPAIN.—Chipiona, not far from Cadiz, San Vicente de la Barquera, La Coruna, Santander.

PORTUGAL.—Carcavellos, not far from the mouth of the Tagus; Gelfa, nr. Caminka; Outao at the mouth of the Sadun; Parede in the Province of Estremadura, Figueira da Foz, Oeiras, Trafaria.

GREECE.—Oropos, on the Gulf of Eubœa.

RUMANIA.—Tekir-Ghiol, on the Black Sea.

TURKEY.—The Island Antigoni, on the Sea of Marmora, the summer station of a hospital.

NORTH AMERICA.—Cape May, in Pennsylvania; Beverly Farms, in Massachusetts; Atlantic City (founded by Philadelphia); Vinthrop, nr. Boston; Barth, nr. New York; Hospitals of Baltimore, swimming hospitals in Rockaway (New York) and on Lake Michigan (Chicago).

ARGENTINA.—Mar del Plata.

In Germany, in 1876, on the island of Norderney, a deaconess' institution was founded, which took in scrofulous children amongst others. In the year 1881 Fr. Beneke succeeded in founding a "Society for Children's Convalescent Homes on the sea coasts of Germany," by the instrumentality of which, in 1882, the Empress Frederick Hospital was opened in Norderney, and in the following year a children's convalescent home in Wyk in Föhr, &c. Later the "Society for Children's Convalescent Homes on the Sea Coasts of Germany," by the energetic endeavours of Ewald and Baginsky, has devoted itself to the foundation of seaside hospitals with such success that now forty seaside homes with 3,415 beds are open to patients. From 1885 to 1898, 27,000 children were cared for.

School Sanatoria.

If we wish to attain anything thorough we must break away from the idea of a four to six weeks' treatment. For real success, as a rule, a long course of treatment is necessary from several months to one or two years. With delicate children it is not only desirable, but necessary, that they should enjoy the hygienic and climatic advantages of mineral and sea sanatoria for several years. But joined to this there is the justifiable objection that such children, in the years when they are most capable of development, are removed from their school education and fall behind their companions of the same age. It is therefore a pressing necessity that there should be provided a larger number of such institutions in which regular instruction can be given.

The combination of the treatment with instruction is also desirable, and even demanded, for psycho-therapeutic reasons, for the child should not think about its disease more than is absolutely necessary. He should not be conscious that his development is different from that of other children, so that the mark of a separate existence, a special bodily inferiority, and special need of care should not be stamped on his impressionable nature, as this may have an adverse influence on him for his whole life.

We have already emphasized elsewhere the enormously beneficial arrangement of forest schools (see p. 319).

Up to the present we know of the following school sanatoria :—

(A) In Inland Places.

Place	Sort of Instruction.	Price	Number and Age of Scholars.	
			Boys	Girls.
Open-air School, Hohenlychen in the Uckermark	Instruction in housekeeping and gardening	—		
Agnetendorf in the Riesengebirge, Elise Höningers boarding school	High School subjects National School teaching, housekeeping	—	6—12	6—20
Bad Berka in Thüringia	[1] "Realschule" Progymnasium, Realgymnasium	1,800 M. including board and instruction	For boys	
Trüper's Educational Home and Sanatorium for the young, Jena	Reform School to lower second class, house-keeping school for girls, elementary practical branches, gardening, &c.	About 600 M. per ¾ year	In separate houses each 12—16 pupils	
Haus Bartelsruh, Lauterberg in Hesse	"Realschule" ...	—	—	—
Private Children's Home. Rothengelde Spa, in the Teutoburger Forest	School in the Institution	5 M. per day		
Michendorf Children's boarding school, nr. Berlin	Individual instruction and education	—		
School Sanatorium, Friedericianum, Davos-Platz, Switzerland	Elementary classes, lower classes, 6th—1st classes, Real and Gymnasium classes	2,500—3,000 Fr.		
School Sanatorium, U. Aegeri, Canton Zug, Switzerland	Instruction for people's and middle schools	160—250 Fr. per month, according to instruction		

(B) On the Sea Coast.

School Sanatorium, Borkum, North Sea	Curriculum up to upper 2nd class inclusive	1,480 M.	For 65 boys	
Dr. Gmelin's North Sea Pedagogium, Föhr	Progymnasium and "Realschule"	800 M. for term (4 months) including board, instruction and treatment	For 100 boys and girls	
North Sea School Sanatorium, Westerland-Sylt	Up to 1st class ...	150—210 M. per month, exclusive of instruction	For boys of 5—18 years and girls	
Martha Elsehaus Children's Nursing Home, Swinemünde, on the Baltic	—	—	14	18
Hubertusberg Private Home for Children, Zinnowitz, on the Baltic	Private School ...	—	6—15	6—16
Holiday Settlement, Lübeck, on the Privall, nr. Travemünde	—	Free	100	
Forestry, Mellneraggen nr. Memel	—	—	10—14 24 6—14	

[1] Gymnasium = better class school, in which classics are taught. Realschule = high school, in which modern languages are taught instead of classics.—Translator.

H.—RESULTS IN MINERAL AND SEASIDE CONVALESCENT HOMES.

The cures which have been made in mineral and seaside homes are all the more valuable as statistics relating to the possibility of curing scrofulosis have hitherto been wanting.

We take a few records from the statements of some consecutive periods :—

Place	Treated	Percentage of Cures	Percentage of Improvement[3]
MINERAL BATHS.			
Sulzbach[1]	610	78·9	
Hall,[2] 1856—1896	7,147	63·0	33·2
Hall,[3] 1856—1896	10,219	46·2	51·0
1896—1906	4,578	68·2	29·5
Jagstfeld,[4] 1861—1876, 1878	3,102	16·6	64·6
Jagstfeld,[5] 1876 and 1878	416	9·1	71·1
SEASIDE PLACES.			
S. Pelagio,[6] 1888—1898	1,945	68·2	—
Rovigno, 1898	442	71·5	18·6
Berc-sur-mer,[7] 1869—1882	4,962	70·7	3·2
Refsnäs	499	44 3	50·5
Norderney, 1882—1883	175	37·1	57·1
Norderney, 1882—1884	297	93·3	
Wyk, 1882—1884...	254	95·7	
Gr. Müritz, 1880—1884	108	96·3	
Lido	9,686	34·3	60·4
Porto d'Anzio	5,271	15·6	79·2
Margate,[8] 1876—1878	883	68·6	27·3
Fano, Rimini, Sestri[9]	1,623	64·2	25·1
Venice (Ospizio Marino,[10] 1868—1879 ...	7,277	37·0	58·3
Voltri, 1865—1875	1,578	34	65
Palermo, 1874—1876	499	52	47
Loano, 1872—1875	1,084	47	48
1878	406	24	50

[1] According to Monti.
[2] Only scrofulous patients, those treated several times only counted once.
[3] All taken in are counted.
[4] According to Uffelmann.
[5] Only scrofulous patients.
[6] According to Monti.
[7] According to Brauer.
[8] According to Uffelmann. The total of cured, improved, and not improved, &c., 888.
[9] Cured and considerably improved.
[10] Inclusive of those only bathing.

I cannot concur in the conclusions frequently drawn from some of these records; the figures, for several reasons, must be accepted with caution. For one reason, in many of these institutions the numbers include syphilitic, rickety and anæmic children, even if only a small proportion; as long as an exact separation is not possible, the percentage of cures cannot be strictly identified with the idea of cures of scrofulosis.

Again, the patients in different institutions are not alike in the form and severity of their scrofulosis; a hospital with a surgeon at its head, and therefore with many severe surgical cases in the third stage, naturally cannot show such good results as one with chiefly slight cases; a conclusion cannot, therefore, be drawn as to the capabilities of the institution, or the place, or the methods.

Also the division, according to age, which is not without influence on the total result, differs according to the rules respecting the admission into different institutions.

The nursing, the possible and real length of the stay, and using to the full the factors for cure, are different. Some institutions are provided with all medical and hygienic comforts, others must do the best they can with what is strictly necessary. As I have proved in a tour undertaken to study this question, sufficient attention is not paid everywhere to spending a long time in the open air. To draw comparisons, in spite of this, from the mere figures of the total results between certain institutions or between mineral and sea-bathing places, betrays ignorance of the fundamental rules of statistics.

A better foundation for statistical comparisons is offered by the records which classify scrofulosis, according to the form it takes; individualizing statistics may become especially valuable with the accumulation of material, in which each case is shortly described, on a few important points, such as the excellent records kept in the institutions of Pelagio and Sulzbach, which were initiated and conducted by Monti.

On the following page we give the percentages of cures. The figures do not in the least pretend to be scientific statistics, but only present a general view of the cures in different scrofulous affections; foundations are, up to the present, wanting for statistics free from all objection and drawn up from a large number of figures.

It is a pressing necessity that all hospitals should arrange their statistics and annual statements on a plan in which the chief points and details correspond, as has been done, for instance, in the before-mentioned institutions of Pelagio and Sulzbach, for years, so that valuable statistical material may not be lost, but by being summed up may afford large and useful figures which will enable comparisons to be drawn. With the exception of the small number of separate affections which are subject to chance, statistics of cures will always suffer from the fact that certain authors give to the conception of "cure" a hazardously subjective expansion and talk of curing catarrh of the apex of the lung (!) in 33,

(The upper figures give the number treated, the under figures the percentage of cures.)

	Scrofulous derangements of nutrition	Scrofulous habitus	Affections of: Skin	Mucous membranes	Eyes	Ears	Nose	Glands: Hyperplasia	Glands: Tuberculosis	Glands: Other affections	Periostitis	Caries	Caries of vertebral column	Coxitis	Fungous inflammation of joints	Arthritis (tubercular)
SEASIDE BATHING PLACES.																
S. Pelagio	123 78·9		91 78		123 87	5 80	40 90	290 85·2	230 81·7		30 73·3	622 60·6	137 33·6	132 36·4	122 59·9	
												1331 81·0	357 36·3	301 55·1		
Sestri Levante			54	53				40		29			21			
Berc-sur-Mer											1267 67·6				1186 70	
			462 53						137 35				141 20			
Venice			94 7		51			137				40				38
Loano			34 28		41			31·4				25				13
Banyuls 1888—1896 ...					60 86·3											
2 French hospitals (Leroux)			70·0		47·0	68·0							95 35·8			
10 French hospitals (Armaingaud)														52·0		
Fredrikvaern (Sinding-Larsen)														89 83·1		
Windau (Hopfenhausen)													31 38·5	25 44·0		
MINERAL BATHING PLACES.																
Sulzbach	185 92·4		11 90·9		50 90		8 100	72 84·6	61 83·6		3 66·7	95 71·6	28 25	35 84·9	62 72·6	
Rivanazzano			38	57				33		18			28			
Hall (All received)		169 65	1380 59·7	265 69·8	1987 76·2	180 41·1		2073 42·2					3587 25·2			
Those treated several times only counted once		133 82·7	1113 74·1	230 89·4	1787 85·1	145 51		1550 56·8					2147 42·2			
HIGH LEVELS.																
Leysin													91 73·0			

48, 60 days! A firm grasp of this conception is a *sine quâ non* for statistics that are to be of any use.

Another difficulty in drawing comparisons arises from the very different length of the duration of the treatment.

Some institutions can extend the treatment—from a medical point of view the only proper treatment—according as they think it is necessary or that there are hopes of improvement.

On an average in Hall (Upper Austria) the treatment lasted 66 or 50 days (1856 to 1895); in Sulzbach (1897), 96 days; (1898), 89 days; for many children, 702, 858 or 949 days, and so on; in Pelagio, for the cured, 100, or 300 to 500 days; in the greatly improved, 20 to 100 days; for many children, 488, 531, 556, and 612 days, &c. In Berc-sur-mer (1869 to 1882), on an average in :—

Multiple affections	562	Affections of the hip-joint ...	426
Affections of the knee-joint ...	542	,, ,, ear	422
,, ,, wrist	488	,, ,, skin	416
,, ,, bones	482	,, ,, eyes	405
,, ,, ankle-joint ...	471	,, ,, elbow-joint ...	370
,, ,, vertebræ ...	470	Ozæna	354
,, ,, shoulder-joint	462	Lymphadenitis	342

Other institutions only keep the children four to six weeks, and naturally achieve less good results, though the work is none the less valuable.

A better judgment as to the success of the cures may be formed by comparing the time of treatment in the following table which I have drawn up from Häberlin's records.

Neither from these tables nor from any other records we possess can it be shown in a conclusive manner that mineral or sea baths are more efficacious, one than the other, in combating scrofulosis, or that either merits preference. It must be stated with reference to this that on both sides an unwarranted local patriotism is displayed in the many attempts to prove one more efficacious than the other.

For instance, when Häberlin in a table (*loc. cit.*, p. 97) contrasts 85 per cent. cured in seaside hospitals with 23 per cent. cured in mineral bath stations, even if he acknowledges on the next page that the usually longer stay in seaside hospitals must be taken into account, there is an evident source of error, for to avoid a false interpretation he should properly have added that in mineral bathing places, to achieve cures of about 30 per cent., the patients with scrofulous affections of the skin had only been treated for 30 days, whilst the cures of about 8 per cent. achieved in seaside places took over 400 days, therefore were treated thirteen times longer.

RESULTS ACCORDING TO DURATION OF TREATMENT

Organs of Skin and Sense.

Disease	Number of cases	Average time of treatment	Cured per cent.	Improved per cent.	Place of treatment
Scrofulous Eye and Ear Affections ...	607	**28**	18·8	77·7	Sooden on the Werra (Sippel)
Skin and Mucous Membranes ..	202	**30**	29·7	60·7	Dürkheim on the H. (Kaufmann)
Skin and Eye Affections	31	**45**	67·7	3·2	Celle Liguria (Bertarelli)
Skin, Mucous Membranes, &c. ...	740	**50**	71·0	24·0	Wyk (Häberlin)
Conjunctivitis, Lichen Scrofulosus, Otitis media	33	**56**	63·7	14·8	Sulzbach-Ischl (Prochaska)
Prurigo, Tubercul. cutis, Scrofulosis of Ears and Nose	102	**93**	56·3	34·6	Sophia-Stichting (Mol, 1907-08)
Scrofulosis	30	**114**	—	90	Katwijk (D. v. Dorp, 1908)
Lupus, Keratitis, Otitis, Skin Abscesses, Scrofulosis	66	**120**	78·7	33	Sahlenburg (Treplin)
Eye Affections, lymph. Keratitis, Blepharitis, mostly simultaneously with Rhinitis, Pharyngitis and slight Glands	263	**132**	100	—	San Pelagio (Monti, 1888—1906)
Lupus, Prurigo. Eczema with Tuberculosis, general Scrofuloderma, Psoriasis	184	**164**	96·8	—	San Pelagio (Monti, 1888—1906)
Skin, Mucous Membranes, Eyes, Ears, Nose, Lupus, Eczema, Tubercular Ulcerations	60	**213**	90·0	—	Juelsminde (Hoff-Hansen)
Eczema, Lupus Vulgaris, Scaly Skin Ulcers	1905	**264**	92·3	6·3	Refsnäs (Schepelern, 1875—1907)
Eczema with deep affections of Skin and Mucous Membranes and swellings of the glands, various affections of the skin	13	**265**	85·0	—	Berc (Cazin)
Eczema, Eyes, Ears, Nose, Pharynx, Lupus, intra-muscular Tuberculosis	178	**275**	83·7	6·0	Friedriksvaern (Sinding-Larsen)
Ozæna	11	**354**	54·5	9·0	Berc (Cazin)
Skin Scrofulides, Mucous Membranes, Nasal Pharynx, Eyes, Ears	—	**413**	61·0	25·0	10 French Sanatoria (Armaingaud, 1887—1905)
Skin Scrofulides, Lupus	106	**416**	78·0	3·0	Berc (Cazin)
Otorrhœa	33	**422**	73·0	12·0	Berc (Cazin)

Glands

Scrofulosis of the Glands	212	**28**	21·7	74·5	Sooden on the Werra (Sippel, 1905—1908)
Scrofulosis of the Glands	283	**28**	9·5	85·8	Dürkheim in the Hardt (Haufmann, 1902—1908)
Scrofulosis of the Glands	20	**91**	60·0	35·0	Sophia-Stichting (Mol. 1907—1908)
Scrofulosis of the Glands	69	**100**	56·2	4·9	Sulzbach-Ischl (Prochaska, 1907—1908)
Swelling of the Glands	550	**115**	98·5	0·2	San Pelagio (Monti, 1888—1892) 1906—1908)

GLANDS—*continued*

Disease	Number of cases	Average time of treatment	Cured per cent.	Improved per cent.	Place of treatment
Tuberculosis of Cervical Glands ...	33	**120**	83·0	10	Sahlenburg (Treplin, 1907—1908)
Scrofulosis of the Glands	118	**210**	72·0	26·0	Berc Hôpit., Mar. (Bergeron, 1861—1868)
Scrofulosis of the Glands	120	**261**	71·0	21·0	Fredriksvaern (Sinding-Larsen) 1892—1900)
Glands of Neck and Lower Jaw, multiple glandular swellings	1293	**335**	76·0	3·0	Berc Hôpit., Mar.
		380	68·4	3·0	(Cazin, 1885)
Scrofulosis of the Glands	105	**338**	9·00	—	Juelsminde (Hoff-Hansen, 1907—1908)
Swellings of the Lymph Glands of neck and back of neck	—	**345**	74·0	25·0	10 French Homes (Armaingaud)
Swelling of the Lymph Glands ...	1482	**449**	75·4	—	Berc Hôpit., Mar. (Cazin, 1885)
Swelling of the Lymph Glands ...	320	**479** cured **192** improvement **58** same condition	75·0	18·0	2 French Homes (Leroux)

BONES AND JOINTS

Tuberculosis of Bones, Cartilage and Joints	141	**28**	17·0	83·0	Sooden on the Werra[1] (Sippel)
Diseases of Bones and Joints ...	192	**28**	21·4	64·1	Dürkheim in the Hardt (Kaufmann)
Diseases of Bones and Joints	253	**91**	70·7	10·3	Fredriksvaern (Sinding-Larsen)
Coxitis	89	**91**	83·1	2·2	Fredriksvaern (Sinding-Larsen
Various Caries, Coxitis, Gonitis ...	115	**247** Abt.	41·9	7·8	Sulzbach-Ischl (Prochaska)
Fungous Joints	95	**300**	71·6	16·8	San Pelagio (Monti)
Ostitis	159	**316**	—	16·4	2 French Homes
		562	71·1	—	(Leroux)
Coxitis, old suppurating fistulæ with caries of the heads of the joints	301	**335**	55·1	18·6	San Pelagio (Monti)
Tumour albus	137	**419**	—	24·1	2 French Hospitals
		724	56·9	—	(Leroux)
Affections of Bones and Joints ...	1117	**462**	63·7	5·1	Refsnäs (Schepelern)
Mal de Pot	95	**466**	—	25·3	2 French Hospitals
		971	35·8		(Leroux)
Coxalgia	115	**547**	—	23·5	2 French Hospitals
		829	45·2		(Leroux)

[1] Severe cases not accepted.

Further, we see clearly from the tables that the longer the treatment continues, so much the more considerably does the percentage of cures rise. All experienced physicians agree unanimously that with a short course of four to six weeks it is only in the rarest cases that anything satisfactory or lasting can be achieved, either in a mineral or sea bathing place. The looks may be improved, the weight increased; but as a rule, when the children return to their unhygienic and wretched conditions of life, that which has been gained is soon lost.

"The child returns to the hospital the following year," says Spitzmüller, "more wretched and worse than it ever was. Fresh ulcers form on the margins of the old scars, fresh suppuration, fresh swellings of the glands, operations are again performed and physic administered—a discouraging labour of Sisyphus—the real difficulty of our professional work."

This unsatisfactory limitation, which in cases that are at all severe cannot lead to thorough and lasting success, is often the doctor's compromise with the gratification of the philanthropists, who open their pockets so much more willingly when they see many children sharing the benefits, many cured (!).

The restriction is not only sad for the children, but also from a purely financial point of view very serious, for when the apparent gain has passed off there is seen to be no return for the expense incurred during the short treatment, and the money is partly thrown away (see also Salge, Lennhof, Wluitbeck and Spitzmüller). We doctors must therefore educate the people up to the idea that the treatment is not to be carried on to satisfy the philanthropist's love of fame, but for the immediate need of the poor sick children.

A definite rational struggle against tuberculosis and scrofulosis makes it the bounden duty of every large municipality not only to choose one or other of the means of combating the disease, but by all the different means, such as milk provision, care for mothers and infants, crèches, kindergartens, forest recreation places, forest schools, mineral baths, or seaside hospitals to be prepared to meet the requirements, which are often widely different, so as in each case to be able to follow the method of treatment promising the greatest success, and therefore the method which is financially the most profitable. Small towns must band themselves together for this end, so that money shall not be needlessly wasted or (which is more to be feared) that nothing may be done.

In Germany, the Government authorities for Home affairs have repeatedly proclaimed that the public care of the poor is one

of the tasks which their position imposes on them: to give to children's hospitals that form of care which, in the opinions of the doctors, is the acknowledged necessary means of treatment (Lohse). French law gives a similar power for placing such patients in institutions (Häberlin). In Austria no such law exists.

I.—SALT BATHS AT HOME.

If a patient cannot leave his home to visit a mineral or sea bathing place, salt baths in the house may be resorted to as a makeshift. It is uncertain whether these artificial mineral and sea baths are equivalent to the natural baths in their pharmacodynamic effect; therapeutically their effect is not nearly the same. Their inferiority is partly due to the faulty manner in which they are administered, and to the conduct of the patient and insufficient care, in consequence of which we find they are more exhausting, but chiefly to the want of other factors, the combination of which so considerably increases the effect of the baths, *viz.*, removal from the usual environment and a lengthened stay in pure good air, the change of climate and diet, &c. The importance of these factors goes so far that patients whose home is in a mineral watering place are sent to others, for it is a lesson we have learnt by repeated experience that in strange places much better success can be attained than in the accustomed home surroundings.

For the preparation of artificial baths, bath salts from the different mineral springs which are sold are added for the ordinary warm bath water. Of these, preference is given by many to those rich in chloride of sodium and chloride of magnesium, for reasons given on p. 332. Also those of Arnstadt, Kreuznach, Oeynhausen, Reichenhall, Salzuflen, Wittekind, and others. Sea-salt, salt-cake, and the cheap Abraum salt of Stassfurt, as well as the dear and inconvenient mother lyes, are also used.

The quantity of salt added is regulated according to the concentration desired; to decide how many kilograms of bath salts must be added to make the bath the required strength, multiply the quantity of litres which the bath holds by the figure of the desired percentage, and divide by 100, *e.g.*, if we wish to prepare a 3 per cent. bath in a bath containing 350 litres, $\frac{350 \times 3}{100}$ or 10·5 kilograms bathing salts are necessary. If we wish to add a mother lye, we reckon to every kilogram of salt three times the quantity of about 30 per cent. mother lye.

For the mode of use of artificial baths, the strength, duration and number, the same rules apply as for natural baths (see p. 338),

the proper quantity must be judged by exact observation of the patient.

Carbonic acid baths may be prepared at home according to the method of Zucker, Sedlitzky, and others, but they do not contain so much CO_2 as in the bathing establishments or spas, where they are mostly prepared according to Keller, Raydt, and Kiefer.

CHAPTER II.
MEDICINAL TREATMENT.

IODINE.

Amongst internal remedies (if we except cod-liver oil, which we have come to know more as an auxiliary of nutrition than as a medicine) iodine takes the first place.

It is suitable for the phlegmatic, relatively strong flabby children, and especially those suffering from scrofulous glands, whilst for thin children with larger tuberculous foci it may easily be harmful; the excessive value attributed to it in former times is due perhaps to the frequent mistaking of hereditary syphilis for scrofulosis; in the former disease it was certainly most successful.

In cases of disordered digestion and nutrition, and with symptoms of iodism, cold in the head and iodine conjunctivitis, it must be discontinued; if strong doses of iodine be given there must be intervals in the treatment from time to time.

The natural remedies, though weakest in iodine, are the mineral waters containing iodine, which are not only drunk at their source, but are also exported (see p. 341).

The artificially prepared iodine soda salt solution (with 1·3 iodine soda), and iodine lithium solution (with 0·9 iodine soda) in one litre, prepared by Ewich, contains more iodine.

Iodine is also given according to the old prescription of Lugol in three solutions:—

	Solution 1	Solution 2	Solution 3
Iodine	0·045	0·06	0·075
Potassium iodide ...	0·10	0·12	0·15
Distilled water ...	250·00	250·00	250·00

M.D.S. At first two-thirds are to be taken daily, later the entire solution; immediately before use to be sweetened with sugar. The weakest solution is to be taken for the first two weeks, then the medium solution, for about four weeks, and later, if necessary, the strongest solution.

The following prescriptions are more usual:—

℞ Iodine ... ... 0·3-0·5
Potassium hydro-iodat. ... 1·0
Distilled water ... ... 100·0
Peppermint water or simple syrup ... ... 20·0

M.D.S. A dessert-spoonful three or four times a day (Henoch).

℞ Sodium chlorat. ... ... 3·0
Sodium hydro-iodat. ... 2·0
Distilled water ... ... 180·0
Peppermint water
Simple syrup ... āā 10·0

M.D.S. Four tablespoonfuls to be taken daily (for poor practice).

Iodine is, without doubt, a most valuable remedy in many cases of scrofulosis. In recent years, and for some time previously, especially favourable action on tuberculous processes has been attributed to it (see Cantini). Turmann-Leonardo believe they have demonstrated specific action on tuberculous tissue from potassium iodide injections. According to Grünberg, in conjunction with mercury recommended by Avelino Martin, good results are obtained in the treatment of affections of the nose and pharynx. Wright gives 0·013 mercury succinamide thirty times in sixty days, and repeats after a pause of three weeks (fourteen days of this time with potassium iodide, seven days without any medicine), finally changing to half the dose.

The disagreeable metallic taste, the injurious later effects, such as disturbances of digestion, cold in the head, irritation of the pharynx and rashes, prevent its continued use. To avoid these, or at least to reduce them, organic combinations of iodine have been used in later years, by which the body is not so quickly saturated and absorption goes on more gradually. These preparations fulfil their purpose in a measure. In scrofulosis the following have proved of value :—

Iodomenin [an organic iodo-bismuth combination (potassium iodide, 0·06 per tablet), highly recommended by Cassel, Friedmann and others, and without dyspeptic consequences], for older children of 6 to 10 years of age, one tablet three times a day; for infants from 8 to 10 months old, half a tablet three times a day. Iodival (47 per cent. iodine), 0·1 gramme three times a day, or 0·3 gramme every three hours, in tablets. Combinations of iodine and albumin : Iodoglidine (an iodine vegetable albumin, but not very constant), in tablets; for adults, two to six tablets (0·05 iodine); for children, half a tablet two or three times a day, half to one hour after meals. Iodalb-acid (a preparation of iodine albumin, soluble in water), for adults, 3 to 5 grammes daily, in wafers; or as tablets, for children, ½ to 3 grammes three times a day. The Eigon preparations of Dieterich, Alpha-eigonnatrium (iodine albumin and sodium) and Beta-eigon (iodine peptone), both containing 15 per cent. of iodine, as tablets (0·5 gramme), and especially with extract of malt in three different strengths; weak (0·0045 iodine), medium (0·045 iodine), strong (0·45 iodine), in one tablespoonful. Sajodin, introduced by v. Mehring, the good effect of which has often been confirmed.

Iodotannate, in the form of Nourry's iodinated wine or syrup (one tablespoonful contains 0·05 gramme iodine and 0·1 gramme tannin); for children, one teaspoonful twice during meals. Iodipin, introduced by Winternitz (a chemical combination of iodine and

sesame oil, in tablets 0·5 [equal 0·065 potassium iodide]; adults, two to four tablets three times a day; children, ½ to ⅓ tablet, according to age).

Iodipin (25 per cent.) is also used as an intramuscular injection of 5 to 15 c.c. Personally, in two cases with a gluteal injection of 10 c.c. after lengthened use in debilitated syphilitic persons with phthisis, I have noticed that it was not absorbed, but induced very serious abscesses; smaller doses were in other cases borne well.

Iodine is also given with cod-liver oil (iodine 0·05 with 30 grammes cod-liver oil), one to two teaspoonfuls morning and evening, and where anæmic, chlorotic and atonic conditions have to be battled with the combination of iodine with iron is especially favoured (see below).

IRON.

Anæmic conditions appearing before or after scrofulosis are an indication for the administration of iron.

The natural iron waters—Pyrmont, 0·077 per 1,000 iron; Driburg, 0·074 per 1,000 iron; Schwalbach, 0·084 per 1,000 iron—frequently suit better than all others and are free from dyspeptic effects; to preserve the teeth they should be sucked through a glass tube and the mouth afterwards rinsed. Salad and raw fruit must be avoided during iron treatment.

Of older remedies much liked by children and which are still in use I would mention ferrum lacticum: for instance, ferri lactici 10, vini gentian. 600, Sig., a wineglassful every morning (Jobert de Lamballe); the tinctura ferri pomata 10 to 30 drops or more daily, or ferri carbon. sacchar. 5, pulv. aërophor.[1] 50, one teaspoonful three times a day, or ferrum pyrophosph. 0·1 to 0·3 or 0·6; also the tinctura ferri composita Athenstädt, for children, a teaspoonful to a tablespoonful three times a day before food.

A very pleasant preparation is ferrum cit. effervescens, half to one teaspoonful three times a day in a wineglass of sugar and water (Ewald).

A prescription much liked is:—

℞ Lipanin
Extr. maltæ ... ... āā 50·0
Calc. carb. præcip. ... ... 2·0
Ferri carb. sacch. ... ... 5·0
D.S. A teaspoonful three times a day (Monti).

Also the liquor ferri albuminati, ½-1 teaspoonful two or three times a day; and the old-fashioned Blaud's pill for bigger children.

[1] Sodium bicarbonate and tartaric acid.—Translator.

The older preparations of iron often upset the stomach, with pain and even sickness after a few days. In recent years the following iron albuminous preparations have been much used, and have the advantage of being easily absorbed and assimilated. Fersan (an organic iron phosphate preparation), half a teaspoonful twice a day, at noon and evening, stirred into milk, chocolate or meal foods, also in pastilles; for children, three to four pastilles of 0·25 each (pastilles of 0·5 each for adults) three or four times a day before food; it is also much liked in the form of fersan malt extract, fersan cocoa, and fersan chocolate pastilles. Gehe's triferrin (an organic compound of phosphoric acid and iron, according to E. Salkowski), in powders or chocolate tablets of 0·3 triferrin, three times a day before or after meals, is especially suitable in stomach affections on account of its insolubility in the juices of the stomach; also Gehe's triferrol (triferrin in solution), a teaspoonful three times a day, also very valuable in lymphatic constitutions, according to Reichelt. Klopfer's ferro-glidine (a compound of iron and vegetable albumin), for children half to two tablets daily (each tablet containing 0·025 Fe). Boehringer's ferratin, for children once or twice a day, for adults three or four times a day, 0·5 gramme in powders or tablets, or (especially for children dissolved as ferratose) one tablespoonful three or four times a day for adults—children half that amount—after meals.

Stroschein's spinol may also be mentioned (vegetable iron), 5 to 20 drops three times a day, for children up to 10 years of age. Spinolum siccum, one tablet three or four times a day; also Dolles's aromatic iron milk.

The following are of value: Gude's manganese iron peptone, one teaspoonful twice a day for children up to 12 years of age, diluted with milk. Dietrich's iron manganese preparations (0·6 per cent. iron, 0·1 per cent. manganese), found by Schwabe very valuable, especially in scrofulous affections of the eye. Liq. ferri manganese peptonate, one teaspoonful three times a day before or after meals. Keysser's liq. ferro mangan. pepton, given by Ascher, especially in scrofulous eczema and enlarged glands, one teaspoonful three times a day in milk. Rieche's mangan. iron peptonate, one teaspoonful three or four times a day in cold milk. Hæmaticum (Glausch, aromatic iron manganese elixir), one or two teaspoonfuls in milk three times a day after food.

Of the large number of so-called blood preparations which are administered with success in scrofulosis, we will specially note: Hæmatogen Hommel: for infants, one to two teaspoonfuls in milk, not too hot; for older children, one to two dessert-spoonfuls.

Sanguinal (Krewel), in use for some years: one to two pills three times a day; for scrofulous glands, pil. sanguin. cum iodo. Bioferrin, introduced with success by Siegert (containing much hæmoglobin): 5 to 10 grammes for a child 1 year old, 10 to 20 grammes for a child from 2 to 10 years old. Bioglobin (an iron blood preparation), one teaspoonful three times a day for children. Perdynamin (an organic iron albumin preparation, combined with hæmoglobin). Eubiose (a glycerine-free concentrated hæmoglobin). Hæmatin albumin (Finsen). Hæmatopan (Pfeuffer or Nardi). Hæmol, hæmogallol, hæmatopan (a dried blood preparation with 40 per cent. malt extract). Roborin (a blood albumin preparation). Sicco (Schneider), an organic iron manganese preparation.

The combination of iron with iodine is very suitable. The syrup of iodide of iron is very famous:—

℞ Syrupi ferr. iodidi ... ... 15·0
Syrupi simpl. ... ... 50·0
Aeth. acet. ... ... 1·0
M.D.S. ½-1 tablespoonful three times a day.

℞ Pot. iodidi ... ... 2·5
Ferri. sulph. ... ... 2·0
Morph. hydrochlor. ... ... 0·06
Solve in aq. cinnam. ... 30·0
Liq. aurant flor. ... ... 200·0
M.D.S. 1 tablespoonful two to three times a day (Lebert)

℞ Ferr. pulv. ... ... 1·5
Iodi. puri. ... ... 2·5
Aq. dest., gtt. nonnull. tere adde
Sacch. albi
Sacch. lact. ... ... āā 2·5
Rad. alth. pulv. ... ... 5·0
M. f pil. centum, obduc. c.
Sol. bals. tolut. æth.
D.S. 1-3 pills three times a day (Clarus)

Of newer preparations the following have proved useful: Iodoferratin (Boehringer), in tablets, one or two three or four times a day, and especially in the soluble form as iodoferratose (0·3 per cent. organic combined iron, and 0·3 per cent. organic combined iodine), which has done good service in scrofulosis, according to the experience of Manasse and Bardach (Kreuznach), in original bottle, one tablespoonful three or four times a day after meals; half that amount for children. Iron sajodin, in tablets, one tablet three to four times a day after meals, or as iron-sajodin and cod-liver oil, 5 to 10 c.c. three times a day; for adults, 10 c.c. four times a day after meals. Iodofersan, in pastilles: for adults, six to nine pastilles a day; and for children, two or four a day (pot. iodide, 0·025; fersan, 0·25).

Remedies also in use are: Rachisan (cod-liver oil, iodine, lecithin, nuclein, iron, mannit), one dessert-spoonful three times a day. Iodella (Lahusen, iodine iron, cod-liver oil), one teaspoonful after food, increasing to two to three dessert-spoonfuls a day.

In the administration of iron preparations, as in the use of

iodine, great attention must be paid to the digestive organs; generally they must not be taken on an empty stomach, and if they disagree must be discontinued.

ARSENIC.

Arsenic, the old-established and helpful remedy of our pharmacopœia, must be used with caution in tuberculosis and weak conditions; it is much prescribed in the form of tinct. arsenic (Fowler's solution), which, however, often does not suit:—

℞ Liq. arsenic Fowleri ... ... 5·0
Tinct. ferri pomat. ... ... 25·0
D.S. 5-30 drops two or three times a day, increasing by degrees (Lebert),
Or liq. potassii. arsen. aq. cinnam. āā, 3-6 drops three times a day.

Of natural arsenical iron waters the Guber spring is especially used (0·37 ferric oxide in 0·061 anhydrous arsenious acid in 1,000 parts by weight (Ludwig), rising from a dessert-spoonful twice a day to a tablespoonful three times a day, for about six weeks, then an interval). Levico, Roncegno and Dürkheim are also frequently used.

Disturbances of digestion and other toxic symptoms, which frequently appear after the use of inorganic arsenical compounds, require correction, and this may sometimes be found in organic compounds of arsenic. Recently these have been preferred in conjunction with the arsenical waters, so that Arsan (Klopfer), a combination of arsenic with glidine (half to two tablets for children daily after meals) is recommended. Each tablet contains 0·002 arsenic, combined with vegetable albumin. The combination of arsenic with the albumin preparations already mentioned is much to be recommended. Arsenferratin (Boehringer), in tablets ($\frac{1}{6}$ per cent. iron and 0·06 per cent. arsenic), one to two tablets three times a day; and arsenferratose (0·3 per cent. iron and 0·003 per cent. arsenic), first tried by Laquer and Bardach in scrofulosis, one to two tablespoonfuls three times a day, half that dose for children. Arsentriferrin (Knoll), 16 per cent. iron, 0·1 per cent. arsenic, 2·5 per cent. phosphorus, according to Teubert especially useful in itching scrofulous skin affections, and in glandular swellings (see Mosse and others), one tablet three times a day (one tablet contains 0·05 gramme iron and 0·0003 gramme arsenic. Arsentriferrol, three tablespoonfuls three times a day (equivalent to one tablet), for children one dessert-spoonful. I have frequently observed that it suits well when

Fowler's solution and arsenical waters cause indigestion. Arsenregenerin, arsycodile clin. are other preparations.

As already mentioned, we possess no specific remedies for scrofulosis; it is true many have been recommended, but the certainty of their effect leaves much to be desired, and the causative connection between their application and an improvement is still neither assured nor explained.

The chief are: Creosote, cinnamic acid, and tuberculin. To avoid repetition I shall limit myself to the essentials here, and refer my readers to my "Tuberculose," second edition, chapter on "Therapeutics."

CREOSOTE.

Of the so-called chemical remedies creosote is of chief importance, Sommerbrodt having observed favourable effects from it in pulmonary tuberculosis, recommended it for tuberculous glands, and then for all forms of tuberculosis; he gave one drop three times a day to children under 7 years of age in milk, rising $\frac{1}{2}$ to $\frac{3}{4}$ to 1 gramme daily in eight or ten days; to children over 7 years of age, rising to 3 grammes daily (capsules, 0·1 creosote, with cod-liver oil, not balsam of tolu).

Although it has not established itself as an antibacillary remedy by my experiments on animals, I rely upon it and its derivatives in scrofulosis.

It has not only very favourable action on more than half the cases of catarrhal conditions of the mucous membranes, but frequently exercises an undeniably beneficial influence on glandular, bone and joint affections, besides which it sharpens the appetite, often removes obstinate diarrhœa associated with scrofulosis, and furthers nutrition generally.

One is best guided (as is often the case in medical matters) by the success in individual cases. If the scrofulosis gets better with the use of creosote, then it is given for a longer period; but if after about two months use there is no improvement, or should toxic symptoms appear (as shown by the urine), or digestive troubles, or irritation of the kidneys, the remedy must at once be given up, and one of the many derivatives so widely advertised may be tried.

Creosote and all its preparations should not be taken on an empty stomach; the daily dose is 1 to 2 grammes, increasing gradually; in febrile cases 0·2 to 0·5 gramme, or 1 to 2 drops, three times a day in milk.

℞ Ol. jecor. aselli ... ... 10·0
Pulv. gummi arab. ... ... q.s.
Aq. destill. ... ... 90·0
Ut. f. emulsio adde
Creosoti ... ... 1·0-1·5
Aq. menth.
Syr. simpl. ... ... āā 5·0
D.S. 1 tablespoonful three times a day (for infants—Monti)

℞ Ol. amygd. dulc.
Creosoti ... ... āā 15·0
D.S. 5-10 drops two to three times a day in 30 grammes milk (van der Vloet).

℞ Creosoti ... ... 1·0-1·5
Glycerini ... ... 60·0
Syr. ribis ... ... 40·6
Ol. menth. ... ... gtt. 20
D.S. 2-3 tablespoonfuls daily in a glass of water.

Guaiacol is now more used than creosote, or derivatives from the two are used, especially creosotum carbonicum (creosotal) and guaiacolum carbonicum (Duotal), which, as a rule, are well digested, and apparently hardly differ from creosote in therapeutic value.

℞ Guaiacoli puri ... ... 1·0-2·0
Aq. destill. ... ... 180·0
Alcohol ... ... 20·0
D.S. 1 teaspoonful twice a day in a glass of water (Sahli, Monti)

Creosotal, a viscid, dense, yellow fluid, has proved itself of much value in the numerous experiences of the various authors. Heubner and Huht have, like myself, recommended it for years. It is given to children, beginning with two drops and rising carefully by one or two drops; eight, and then ten to twenty drops, according to age (adults, 2 to 5 grammes in gelatine capsules) quarter of an hour after meals, in warm sweetened milk, or in broth, or powdered sugar, or (according to Hock) in cod-liver oil.

℞ Creosotal ... ... 3·0-5·0
Ol. jecor. aselli ... ... 100·0
Saccharini ... ... 0·05
D.S. For children under 1 year 0·15-0·50, also 1 teaspoonful of 3 per cent. to 2 teaspoonfuls of 5 per cent. cod-liver oil, older children 0·5-1·5 grammes a day.

℞ Creosotal ... ... 5·0
Vitelli ov. unius
Aq. cinnamon ... ... 70·0
D.S. 2-3 tablespoonfuls (children 1 teaspoonful); 1 tablespoonful = 1·0 creosotal (Rabow)

Sometimes duotal (powder) is digested better; for children 0·1 (to 0·5 to 0·7) gramme three times a day; for adults 1 (to 2) gramme, gradually increasing.

Of other derivatives, eosote (creosote valerianate); geosote (guaiacol valerianate), two to fifteen drops in gruel three to five times a day; and solveol may be mentioned.

Thiocol, a derivative of guaiacol soluble in water, is much liked, and I had favourable experience with it in phthisis soon after its introduction, which further use has confirmed (dose, 3 grammes three times a day). In practice amongst children it is

especially used for scrofulous patients in the form of sirolin, which tastes nice (one teaspoonful several times a day). It is also recommended by Soltmann, Salge, and many others. For practice amongst the poor, Roche's sulfosote serves as a substitute (sulfosote = creosotsulphacid potassium), an original bottle of 150 grammes contains 50 grammes pure creosote (for children, one to two teaspoonfuls; adults, three teaspoonfuls).

The following deserve mention: Bronchitin (compounded of guaiacol sulphacid potassium, thicol, with extract of thyme), one to three teaspoonfuls in milk after meals, especially useful in scrofulous catarrh. Histosan (guaiacol-albuminate), as syr. histosani one teaspoonful three times a day; or as chocolate tablets, four to six daily; or as powder, 0·5 gramme three times a day; children less, according to age. Guaiacose and guaiacol-somatose one teaspoonful after meals. Sanginal pills, with guaiacol, after Krewel's prescription.

OTHER REMEDIES.

Mercury, antimony (Hufeland); folia juglandis reg. (Negrier); chloride of potassium, and chloride of barium, gold (Prevost, Lallemand, and Legrand); bromine, Plummer's powder (Lebert); cinchona bark, with a little calomel (Fothergill, according to White); baldrian, male fern and digitalis were formerly used in scrofulosis.

TUBERCULIN.

Amongst the curative agents used to remedy the products of bacteria, tuberculin demands chief mention; it is no very pleasant task to follow the changes in the opinions respecting this remedy, and the constant expressions for and against its use.

The large and medium doses which were used immediately after its discovery for immunizing purposes had, even in some severe cases, incontestably surprising effect. Some of my patients at that time (in the year 1890) and some whose disease was rather far advanced, enjoy to-day, after twenty-two years, the best of health; amongst these I would instance a Hungarian official with acute phthisis, and a temperature which for weeks stood at 39° C., also the case of an artisan, and others. In other cases the doses then given produced no improvement; in the rest they undoubtedly did harm to the patients, and even led in a few instances to a strong reaction in the foci in the lungs, with the symptoms of œdema and a rapid death.

In consequence of these mishaps tuberculin treatment fell

more and more into the background, and soon was almost completely given up. During the last few years it has gone through a form of new birth, since Goetsch, and soon after, Bandelier and Roepke and others, recorded excellent results by the use of very small doses, increasing very slowly and avoiding any reaction, a method which Biedert and Ehrlich had already adopted in the first year of the use of tuberculin. Just as formerly unfavourable opinions prevailed, so later favourable opinions increased, especially among the medical officers of sanatoria, for whom the possession of a simple and useful method of injection had a doubly important significance in response to the impatience of many invalids, who might themselves help the treatment only by dieting and rest for many months. *Les extrêmes se touchent!* Instead of the mild, insidious, refined method so much prized, Schlossmann quickly resumed treatment with larger doses, the method which had formerly been condemned. He certainly begins with small doses ($\frac{1}{100}$ mg. and less), by which in cases of protracted reaction he continues for weeks to arrive at toleration, even for thirty times the same dose, until the body becomes accustomed to it, then he rises to higher doses, and his pupils, Engel and Bauer, according to whom "hitherto a wrong path had been taken in the therapeutics of tuberculosis by the use of small quantities of tuberculin," did not disdain in the further development of Schlossmann's method with children to inject the tremendous dose of 5 to 20 c.c. tuberculin, which surpassed by far the usual doses in the era of tuberculin, and which later was so much condemned.

Engel and Bauer endeavour to defend their rapid increase to large doses by the fact that only after the injection of large quantities of tuberculin (on an average 0·1 c.c.) an intense antibody formation takes place, which may be proved by complement formation in the blood, in the extent of which they recognize the standard for immunization against tuberculosis. They consider fever important for immunization, and therefore even try to provoke it. The formation of antibodies sinks rapidly after the treatment, but nevertheless remains at a relatively high degree of antibody content.

As showing success with this method, Engel and Bauer mention that "certain forms at least are quickly and easily made tuberculin-fast, and that such children live, and by further treatment with doses of 1 to 5 grammes enjoy excellent health."

Now the theoretical hypothesis of these proofs are of a very loose nature, for the therapeutic action of tuberculin depends on the assimilation of slowly increased doses, a gradually attained

insensitiveness of the body to tuberculous poison, a poison-fast condition.

But it is by no means proved that this insensitiveness to tuberculin goes hand in hand with the increase of immune bodies.

Neither have we any exact knowledge of the significance of the connection of the reaction of the formation of the complement with the cure of tuberculosis, so that Schlossmann's treatment cannot be supported in this connection (Rohmer, and see further in Bibliography). In spite of the highest degree of immunization, or poison-fast state, a curative action is in no way connected with it. For instance, in the early period of tuberculin treatment, I had under my care a moderately severe affection of the lungs which, with the exception of a reaction after the first injection, in spite of the rapid increase of doses, to even 1 gramme of pure tuberculin, did not react again. The patient returned home, to his complete satisfaction and my own, poison-fast and, according to the point of view of that period, "cured." Unfortunately, a fortnight later I received the announcement of his death, and the information that immediately after his return home he had high fever (? miliary tuberculosis); this undeceived me as to my supposed success in the treatment.

With respect to Schlossmann's success, Toeplitz is one of the few who begins with large doses, and has seen success follow them, remarking that the anatomical condition is less clearly defined, as we frequently have to do with tuberculosis of the bronchial glands, which (being deep-seated) cannot be physically examined, and thus leaves it an open question whether it is active tuberculosis which has been treated; besides, Schlossmann in the choice of his cases relied chiefly on the v. Pirquet reaction, which gives us no sure indication of the character and type of the infection, whether active or inactive, human or bovine (see also Engel and Bauer).

But we will let that question rest. In any case the further tests by others attained no results which encourage a continuation of the treatment. Heubner gave up Schlossmann's method after a few trials; he does not consider the enormous doses necessary in scrofulosis, and considers them highly dangerous in pulmonary tuberculosis (*i.e.*, undoubted tuberculosis).

In P. Rohmer's opinion the method might be carried out, for scrofulous symptoms showed clinical signs of healing with anatomical proliferation of connective tissue, but the further dispersal of the process was not prevented [was "perhaps advanced"—Author], and the general health adversely affected, so that for the future small doses were to be recommended.

Fuchs observed no single success after employing Schlossmann's method, but a partial aggravation and extension of the tuberculous process.

These large doses were considered unnecessary by decided supporters of tuberculin, such as Jochmann, who emphasized the danger of Schlossmann's method in pulmonary tuberculosis. Neumann noted the dangers of large doses with focal reaction near the spinal cord in spondylitis, also the appearance of serious dyspnœa (tuberculous asthma) which arose in some cases of tuberculosis of the bronchial glands, perhaps in consequence of this focal reaction (see also Minkowski and Czerny).

Therefore we, with most other authors, must reject the method of Schlossmann and Bauer and Engel under all circumstances.

No conclusive opinion as to small doses is to hand. A cautious tuberculin treatment with only small doses has in the present day found a tolerable number of followers amongst physicians, and is considered by many not dangerous and free from any harm (Loewenstein, Weicker, v. Ruck, Saathoff, and many others). Whilst, in the Congress in Vienna, most of the specialists in tuberculosis expressed themselves in favour of it, especially after experience in adults, the opinions at the French Congress were very diversified. What caution it is necessary to exercise in criticizing the success of treatment is shown by Lüdke's summary, according to which Möller in 600 cases attained success in 36·3 per cent. with tuberculin, and with only hospital treatment 10·9 per cent., whilst Schröder, with only hospital treatment, had 40·6 per cent. successes. Klemperer, Schelbe, and many others, come to the conclusion that certain proof of the curative effect of tuberculin has not yet been adduced, but Petruschky, the indefatigable champion of tuberculin treatment, defends it energetically, remarking that more especially in scrofulo-tuberculosis often only a treatment by stages extending over several years (say twice a year, and lasting for a few weeks at a time, during which ambulatory treatment can be given) attains the goal, but his method seems to have met with little approbation.

In my opinion it is not certain whether in these cases a fresh, slight bovine infection may not have occurred in the meantime, which might often happen to anyone with the numerous opportunities for infection, from milk, and even repeated infection, which would be sufficient to induce a positive reaction. Therefore I do not consider a revival of v. Pirquet's reaction an indication for the necessity either of treatment or a repetition of treatment as Jochmann, Kraemer and others believe.

Ganghofner, who communicates the results of seven scrofulous patients treated by tuberculin, was apparently satisfied with the success, but I and one of his reporters found the history of the patients by no means so convincing, and with respect to increase in weight, &c., quite within the bounds of what may frequently be attained in hospitals without tuberculin treatment.

Escherich, v. Pirquet, Jochmann and others also recommend, especially as regards tuberculosis and scrofulosis in children, tuberculin in the smallest doses and gradually increased. Aronade considers this treatment promising in bone and joint tuberculosis, but warns against its use in pulmonary tuberculosis, in which it often furthers the catastrophe of a spread of the bacilli. Philip and Zumsteeg saw improvement in tuberculosis of the glands, Biedert in bone and joint tuberculosis and eczema of the head, (as also did Smith, Philip and others), Laas in scrofulosis of the eyes, Krause in tuberculosis of the glands, using bacillary emulsion.

It is uncontested that phlyctenæ, blepharitis, eczema and the facies scrofulosa often pass off after tuberculin treatment, as is also noted by Epstein, Ganghofner, Heubner, and Escherich (see Diathesis, p. 51). But the frequent reappearance after a time makes the therapeutic value seem problematical. In treating cases which are not supported by sure clinical diagnosis, but in which the diagnosis is founded only on the tuberculin reaction, we run the danger of claiming imaginary success when, *de facto*, only an inactive healed focus, or perhaps a bovine infection healing of itself, was the cause, processes which did not need treatment. The fear that the diagnosis is not reliable is also shared by Pell and others. Czerny expresses his doubts in the most decided manner when he refers the apparently favourable results of Dautwitz with tuberculin treatment principally to the fact that Dautwitz chose the slightest cases for his treatment, that is to say, children suspected, but not proved to be tuberculous. In this, says Czerny, he follows the example of nearly all heads of sanatoria, whose principal desire it is to distinguish themselves by successes.

Therefore, taken altogether, it is certainly not a neglect of professional duty, as Goetsch thought it to be, if we do not employ tuberculin even in the earlier stages, for a sure proof has not yet been brought forward that success is not just as frequently attained without it. Although large doses have led in some cases to surprising cures in my experience—I had in the year 1890 over 400 cases under treatment—they are decidedly to be dreaded; only the smallest doses are to be used, which will

just slightly irritate the tuberculous tissue and excite it to inflammatory reaction—the chief healing factor—and yet which will not induce inflammatory transudation. Such treatment, which avoids every manifest local and general reaction, naturally spreads over many months, even years, and does not pretend to any astonishing success; even with a favourable course of the disease one must always allow the objection that the disease was cured spontaneously or by unhygienic measures taken simultaneously, and proof to the contrary will be difficult to produce. In many cases tuberculin may render valuable service as a medium for assisting other therapeutic remedies.

MODE OF USE.

In any case it is only to be used in the smallest doses of $\frac{1}{100}$ to $\frac{1}{1000}$ mg. to begin with,[1] and slowly, avoiding reaction as far as possible, watching closely the temperature and local phenomena, increasing the dose after a pause of about two or four days. In case of a reaction it must be discontinued until the reaction has entirely ceased, and then the same dose, or one slightly smaller, may be repeated. As the susceptibility to tuberculin varies even in the same patient at different times, and that within very wide limits, a fixed general rule is above all things to be avoided.

If the patient stands the reaction well the dose is increased slowly and cautiously to, at most, 0·1 gramme, only exceptionally higher. Salge and others consider 1 mg. the maximum dose.

Following the example of Sahli, who also recommends the smallest doses and avoiding reaction as far as possible, Beraneck's tuberculin is often used for early cases in which there is no fever; this is supplied in thirteen different solutions $\frac{A}{32}$, $\frac{A}{16}$, $\frac{A}{8}$, $\frac{A}{4}$, $\frac{A}{2}$, A, B, C, D, E, F, G, H.

The length of treatment extends over at least three to six months. If Beraneck's solutions are then found to suit the patient the injections may be limited to one per month, and are continued for a considerable length of time. The first dose is one division of the $\frac{A}{32}$ solution; for children one begins with $\frac{1}{4}$ division $\frac{A}{32}$, and for children under 6 years with one division of $\frac{A}{64}$ and $\frac{A}{256}$.

Personally I have often used Beraneck's serum without evidence of any harm to the patient.

Wallerstein has tried the most harmless application of tuberculin for therapeutic purposes. He applied it in the form of

[1] Rivière gives children up to 1 year $\frac{1}{12000}$ to $\frac{1}{3000}$; up to 5 years of age $\frac{1}{4000}$; older children $\frac{1}{3000}$ mg. tuberculin.

v. Pirquet's cutaneous reaction. He begins with one drop of ¼ per cent. solution, and waits till reaction has entirely disappeared; then he inoculates again with the same solution till no reaction takes place, then with ½ to 1 per cent. gradually until he has increased to about 5 per cent. Wallerstein mentions favourable results in six cases, some of whom suffered from scrofulosis. Finkelstein attained brilliant results in two cases of surgical tuberculosis.

Others, especially French doctors, prefer Denys's tuberculin. Recently Marmorek's serum has been warmly recommended by many, but with some reservation: Frey, Glaessner, Hemsted, Hymans and Polak, Daniels, Hoffa, Hohmeier, Horner, v. Huellen and Monod (who gives collective references to thirty-five authors), Postnikow, Petit, Preleitner, Schenker, Schnöller, Sikemeier, Straus and Thorspeken (who uses it in early cases for three months, in other cases for six to twelve months), Ullmann (who used it in scrofulous eye affections), Wein and Wohlberg (who gives it *per rectum* in the evening with a simple glycerine syringe, 5 c.c., and if it agree with the patient 10 c.c. for twenty-one days; after an interval of ten days the series is repeated). Rectal use is now generally preferred. Others, on the contrary, found Marmorek's serum to be sometimes without effect, and sometimes directly harmful (Bock, Ganghofner, Holmboe, Karo, Kaufmann, Köhler, Kroner and Szurek).

Spengler's preparation of immune bodies (I.K.) was highly praised for a time, and was also recommended in recent times by Benöhr and Hoffmann, Dresdner (in three cases), Gernzheim, Herzberg, Selter, Wallerstein and Westphal, while others speak very reservedly of it, or inform us of bad experience: Alexander, Exner and Lénk, Kerlé, Roth, Sarkloff, Schäfer, Simon, Szaboky, Weicker and Bandelier, Weihrauch and Weintraut.

With respect to v. Behring's employment of human bacilli for rendering children immune, N. Raw, taking for granted (which is certainly not tenable) that glandular and bone tuberculosis may be referred to bovine bacilli, and pulmonary tuberculosis to human bacilli, recommends human tuberculin for the treatment of glands, and bovine serum for human tuberculosis; Pottenger recommends the same.

Cantani's observation must also be mentioned, that tuberculous patients, after intensive treatment with iodine, react negatively to tuberculin, and with combined treatment of iodine and tuberculin soon accustomed themselves to enormous doses of tuberculin.

CINNAMIC ACID.

The treatment with cinnamic acid was recommended by Landerer for pulmonary tuberculosis and in the tuberculous form of scrofulosis, for tuberculous glands, bone and joint affections, and for lupus.

The sodium cinnamate "hetol," from Kalle's factory, Biebrich on Rhine (to be kept in coloured glass bottles, and filtered and sterilized before use), is injected in quantities of 1 to 5 per cent. in physiological salt solution into the vein of the elbow, which has been previously constricted with an india-rubber band, and disinfected with sulphuric ether and sublimate solution. The syringe is to be first disinfected, and washed out with a physiological salt solution; the cannula must be placed in 80 per cent. rectified spirit. The gluteal injection, which is less effective, was used by Landerer only in the case of very young children.

After noting the temperature for two or five days one begins with 1 mg. hetol injected every two or three days in the morning, increasing 1 mg. at every injection, in advanced cases increasing 0·5 mg. in a week. When 25 mg. is reached that dose is continued for two months, and after a return to 1 mg. the dose is increased more rapidly. After four or six months a two months interval is given. Excessive doses cause a rise of temperature and loss of weight. When the leucocytes amount to 1 : 300 an interval is indicated. There is a tolerably ample literature on the cinnamic method, many opinions are favourable, others decide against it; at any rate, at present it has almost gone out of practice, although the idea on which it is based appears rational, and healing processes seem to have been proved anatomically in animals (see Cornet, "Die Tuberculose," second edition, p. 1030)

SAPO VIRIDIS.

Friction with soft soap, recommended by Kappesser, takes a peculiar place in the treatment of scrofulosis. He noticed in a delicate boy, aged 9, after long continued rubbing in of soft soap for scabies that scrofulous symptoms which had before been treated with varying success (glandular swellings in the neck, inflammation of connective tissue, &c.) at last disappeared. As he observed that in other cases by the methodical use of soft soap involution took place after several months in extensive and deep-seated scrofulous foci, ulcers of the skin and mucous membranes, he may claim soft soap to be an effective remedy.

Richter, in 1846, had recommended washing with soft soap every evening for scrofulosis.

Haussmann soon confirmed the favourable effect in a few cases, especially in pure scrofulosis (and in an affection of the lungs (phthisis), of the pleura and perhaps of the mesenteric glands); Klingelhoeffer used it in advanced scrofulosis of the mesenteric glands. Senator convinced himself of the apparent effect of sapo viridis in furthering absorption of exudates of the pleura, pericardium, peritoneum and the synovial membrane, as well as in the remains of syphilitic suppuration of the lymphatic glands. Kollmann saw good results in caries of the tarsus, also of the sternum, and once in connection with pulmonary tuberculosis. Kormann observed "disappearance of scrofulous infiltrations with a rapidity hitherto unknown, considerable shortening of the course of scrofulous eczema, and an improvement in the infiltrations at the apices of the lungs" in scrofulous eczema, and inflammation of the eyes with infiltration of the glands. Hoffa has informed us of "wonderful successes" in greatly debilitated children with multiple bone and joint affections. Biedert also mentions results which were sometimes astonishing. The considerable improvement in appetite and nutrition and general health has been emphasized by many, and decided benefit has been stated, also in tuberculosis of the bronchial glands. For many years I have had favourable experience with the use of soft soap. After all this experience I can recommend the earliest possible application of soft soap, at any rate at the beginning of scrofulous symptoms.

The special mode of action has not yet been made clear. In general, sapo viridis—a combination of several fatty acids with potassium—when rubbed into the skin causes a loosening of the epidermis by means of the free carbonate of potassium contained in it, and—when there is some lesion of the skin—irritation of the connective tissues, which are rich in lymphatics (Husemann); a slighter effect is redness of the skin, and a stronger effect inflammation of the skin. Perhaps, too, the massage plays a certain part (see p. 411). Senator supposes that the potassium, which is the chief component of the soap, acts on the tissues as a liquefactor.

Kappesser's method is as follows: The ordinary brown soft soap is gently rubbed into the skin (twice a week before going to bed, about half to one and a half tablespoonfuls diluted with warm water) either with the hand or a soft woollen rag over the whole of the back, from the neck to the popliteal spaces, if the back should be erythematous the front is rubbed; the surface is then washed with warm water or bathed, the child is then dried and laid in bed. The localization of the disease is of no consequence

in deciding the site of the rubbing, but it may take place anywhere; for example, the breast in bronchial gland scrofulosis, the abdomen in scrofulosis of the mesenteric glands. Kollmann recommends sapo kalinus venalis with excess of potash; Hoffa gives the preference to this, too; with fussy patients, Senator adds ethereal oil and oil of lavender on account of the disagreeable odour. Some rub in every other day, some daily, some even twice daily. Others let the soap remain on the skin for from a quarter to half an hour; Kormann only allows it to be washed off next morning, and lets the patient wear two night-shirts to avoid soiling the bedclothes; the skin scales in three or four days, and becomes erythematous. He says he has not observed eczema. Some attribute good results from the simple addition of the soap to bath water. With adults more energetic measures may be taken on account of the harder skin.

Kappesser deserves great credit for giving us this method, as the treatment is easily employed anywhere, and so may be used even for the poorest.

When we use bacon fat, which has also been recommended, the whole of the body, with the exception of the head, is well rubbed and massaged with a cylindrical piece of bacon fat, 2 to 5 cm. thick and 10 cm. long, in the direction of the course of the large intestine. Kanzler praises this method in scrofulosis of the mesenteric glands. Its action is also put down to irritation caused by the particles of salt rubbed into the skin.

CHAPTER III.

LOCAL TREATMENT.

General treatment remains the basis of the therapeutics of scrofulosis, but our comprehension of the etiology of the disease leaves an important place for local applications. Far more importance is attached to the treatment of the separate foci of disease than formerly, when one only expected relief of symptoms and not effect on the causation of the disease. If the suppuration of the glands is not the result of a general dyscrasia, but the consequence of the immigration of bacilli, if the local changes in skin and mucous membrane are not put down to a disordered condition of the body fluids, but to external toxins, local treatment promises a success which will affect the actual course of the scrofulosis, especially the pyogenic form. We see daily how, with healing at the periphery and a cessation of the process of disease and of the further entrance of noxious germs, the irritated and swollen glands recover of themselves! In the tuberculous form local treatment at the point of entrance may at least prevent mixed infection, which under some circumstances is so dangerous.

A.—SKIN DISEASES.

ECZEMA.

Powdering with rice or wheat starch, with the addition of 1 per cent. red kaolin for colouring, or with amyl. oryzæ 90 per cent., pulv. irid. florent 10 per cent., has proved of value in weeping acute eczema. Lassar's paste, with or without salicylic acid, is also useful.

℞ Acidi salicyl. ... ... 2·0
Zinci oxyd.
Amyl. puri. ... ... āā 24·0
Vaselini flavi
Seu lanolini. ... ... 50·0
M. leniter terendo exactissime, f. pasta.

This drying paste, which is protective as well, is laid on the skin with a brush after any scab has been removed and the

pustules of impetigo carefully emptied without injuring the cutis. After the surface has been powered over it forms a white hard crust, under which the eczema heals. Or we may use zinc oxyd., amyl. trit. āā 5·0, or nosophen, talc. venet. āā 5·0. Impetigo may be treated, according to Escherich, with great effect by compresses of 3 per cent. perhydrol.

Multiple skin abscesses, after cleansing the surface with methylated spirit soap, should be opened and emptied, and covered with cotton-wool moistened with 0·2 per 1,000 sublimate solution, then with dry cotton-wool, and sealed with collodion in extensive eczema. Biedert recommends a decoction of oak bark 125 to 4,000 boiled down to 2,000; 100 to 200 put aside as a bath for a child, or an addition of a decoction of wheat bran (Pick), or bathing with permanganate of potash and afterwards powdered.

If there be great irritation and no excoriation, a spirituous solution of thymol ¼ to ½ per cent., carbolic acid ½ to 3 per cent., or menthol 1 to 3 per cent. is indicated, or else an ointment of tumenol or menthol.

With a dry skin Unna's zinc gelatine renders excellent service, for example:—

℞ Zinci. oxyd.
Gelatini ... ... āā 10·0
Glycerini
Aq. destill. ... ... āā 40·0

Rendered fluid in a hot-water bath, it is painted on thinly with a brush, and forms a flexible protective covering.

Dry eczema needs a more simple softening remedy, and is smeared over with ung. diachylon hebræ, or 10 per cent. boric ointment, or ung. Wilsonii (benz. pulver. 5·0, adip. suill. 160·0, dig. cole et adde zinci oxyd. 25·0), and if these ointments still irritate, with cod-liver oil, and covered with a bandage.

Unna's ointment mulls are very convenient, fixed with suitable bandages; *e.g.*, zinc oxide ointment mull, but especially the gutta-percha plaster mull, and the paraplast of Unna-Beiersdorf, such as zinc oxide or salicylic acid paraplast, which need no further fixing.

Biedert recommends compresses with 3·5 per cent. boric acid fixed with gutta-percha and bandages, and changed morning and evening.

With obstinate, torpid, scaly eczema preparations of tar are used, such as juniper tar.

℞ Ol. cadini puri (or ol. rusci, or ol. fagi) 2-10
Vasel. flav. s. ol. oliv. 20·0, then ol. cadini pur.

D.S. Applied twice a day with a brush, then powdered, and covered with a simple ointment mull.

As a precaution, it is better to put first a weak preparation on a small place, as now and then severe irritation is caused, or Unna's casein ointment is used, with an addition of 20 per cent. tar or less; with callous thickenings the tar is replaced by an addition of the same quantity of soft soap; besides this, the following is recommended in the squamous eczema of children :—

℞ Hydragyri præc. albi	1·0	℞ Bismuth subnitr.	10·0
Balsami. peruv.	5·0	Zinci oxyd.	2·0
Ung. Wilsonii ad. 30·0 (Saalfeld)		Glycerini	8·0
		Vaselini flavi.	30·0

In eczema which heals with difficulty, de Lange recommends painting with 5 per cent. watery solution of tannin.

In eczema of the hairy scalp preparations of tar agree in the early stage. The crusts and scabs are to be previously softened by repeated compresses of olive oil, or a combination of thymol (2) with olive oil (100), or the cheaper linseed oil, or with boric ointment, but especially sometimes with cod-liver oil, and removed with a comb laid flat. A hot washing daily, or every two or three days with fluid tar soap, or soft soap, or ichthyol soap, or sapo kalinus, and then covered with unguent diachyl. 80, ol. jec. as. 20, are sometimes useful. When tar is too irritating, Biett-Lassar's cinnabar ointment is used.

℞ Hydrarg. sulph. rub.		1·0
Sulph. sublim.		24·0
Olei bergamotti	gtt.	xxv
Vaselini flavi		75·0

M.f.ung. S. to be applied twice a day with a firm brush.

Plaster is less used on account of sticking to the hair.

In eczema of the face, Lassar's paste and ointment mulls are suitable, openings being cut for the nose, mouth and eyes; when necessary they can be varied by occasional powdering.

In eczema of the nostrils loose vibrissæ are removed, pustules if present opened, scabs softened with olive oil, rhagades cauterized with 5 to 10 per cent. solution of silver nitrate or the silver nitrate point, and then Hebra's ointment, or ung. hydrarg. præcip. alb., applied. Besides this we may introduce plugs of cotton-wool, with sublimate solution (1 to 1,000 two or three times a day for two hours—Schmiegelow), or menthol oil (10 to 100), or

℞ Acidum tannicum	1·0
Iodoli	2·0
Lanolini	10·0

is to be recommended, and the accompanying nasal catarrh must also be treated. In dry, scaly eczema the tannin vaseline ointment (5 to 10 per cent.) has proved of service.

For eczema of the auricle the powdering above described is used (to avoid blocking the meatus a plug of cotton-wool must be first introduced), which can also be placed in the eczematous ear passage laid on cotton-wool.

The violent pain of acute eczema may be relieved by applying linen rags soaked in ice-cold olive oil (Jacobson). In scaly eczema of the external meatus Schwartze recommends painting with 3 to 10 per cent. nitrate of silver solution, applying later white precipitate ointment. Naturally, if the lobes of the ear are affected no earrings may be worn.

For nose and ears the ointment mull is very convenient.

Eczema of the eyelids is treated with Lassar's paste or hydrarg. præcip. alb. (1 to 10 vaselini flavi) or tar ointment; accompanying conjunctivitis may be treated with sublimate solution (0·01-0·05 to 100) (Trousseau).

Arsenical preparations (see p. 375) internally appear to have a favourable effect, and phosphorized cod-liver oil as a disinfectant of the intestines (Pick). Zinc powder treatment is generally sufficient in intertrigo. Thioform is especially recommended by Fürst after dabbing with cotton-wool and a 3 per cent. solution of acetate of aluminium; also the chrysarobin ointment recommended by Pick (litharg. 10·0, ol. oliv. 40·0, chrysarobin 0·5) twice daily smeared on linen and applied does good; otherwise cauterizing with a 3 per cent. solution of silver nitrate is indicated.

Water applied to the skin by baths and washing does not generally agree with eczema.

A very detailed and excellent treatise on the treatment of scrofulous eczema is to be found in Pentzoldt-Stintzing's Handbuch, vol. ii, by Eversbusch, and in the German Klinik, vol. x, 2, by Klingmüller.

Of other remedies the following have proved useful: Sozoiodol in scrofulous affections of the scalp and scrofulous ulcerations (Hofmann), zeroform as a remedy forming a film over the surface is also useful in eczema of the nostrils (Berend and Fasano), vasogen as a vehicle is especially recommended by Friedländer in scrofulous eczema. Thioform renders good service in eczema of the face with scrofulous inflammation of the eyes, and naphthalan (Waldmann and Goldzieher).

Unna found good effects from ceramin soap (Töpfer) in scaly eczema of children, and still more in intertrigo and vesico-papular eczema and lichen urticatus.

In lichen urticatus Ruediger attained good results with irradiation daily for ten or fifteen minutes, focused behind the patient. Cedercrentz, on the other hand, recommends abstaining

from eggs, and preparations of yeast and calcium lactate, so much used in England; Saalfeld has seen strofulus disappear after the use of naphthalan.

Finkelstein's diet for eczema: Based on the acceptance of the theory that the whey salts in cows' milk influence eczema deleteriously, Finkelstein recommends a diet containing little salt.

Finkelstein's eczema food: One litre of new milk is curdled with one tablespoonful of essence of rennet and kept in a water-bath at 42° C. for half an hour and strained through linen; the cheese curd is made into a firm ball, rubbed through a hair sieve with half a litre of water, then half a litre of buttermilk is added.

Opinions differ as to the efficacy of food poor in salt. In eczema, Heubner, Langstein, Mendelsson and Geisler mention very good results, especially after continued use. Witzinger, in eight cases of over-nourished, flabby children, some with moist eczema, some with scaly eczema, had only one case decidedly successful. But the loss of weight was considerable, the general health deteriorated, in some cases the food did not agree with the patient for long. Kramsztyk observed improvement in four out of six cases, but relapse occurred, and in one obstinate case the condition only improved on a diet poor in fat (buttermilk) and by using tumenol ointment. Spiethoff and others met with no success.

Diet poor in whey and salts appears, therefore, to have had a favourable action in some cases, but shares this effect with every form of nourishment which reduces the weight of the body, for over-nourishment, if not the only causative agent of eczema in infants, is probably at least one of them (see also Moro and Kolb). Feer attained the same results with the scanty diet, poor in milk, introduced by him, with the addition of meal, excluding eggs and meat, and at a later age giving vegetable food. Eczema of the hairy scalp and face he considers to be especially suited for dietetic treatment, but eczema over the whole body with severe itching is less susceptible to it.

In any case, Finkelstein's diet may only be tried with caution in fat, flabby children who can stand reduction in weight, and the fall in weight must be kept within moderate bounds.

Marfan emphasizes the beneficial influence of a stay of four or six weeks in a mountain climate (1,000 to 1,500 metres above the sea) in eczema of infants. After a week the eruption becomes paler; after a fortnight only a few dry, scaly places remain; now and then it recurs at lower levels, but often the cure is lasting.

LUPUS.

Many surgical and chemical methods have been adopted for lupus, several of which lead to tolerably satisfactory results, both as regards cure and a good scar, provided the doctor possess the necessary skill, and both doctor and patient the necessary patience and perseverance.

Excision takes the first place. If made in really healthy tissue (localized by tuberculin injections) and helped by skin grafting recurrence will frequently not take place, according to the numerous experiences of Thiersch, Sänger, Helferich, Schwarze, Jarisch, O. Witzel, Sapeschko, Lang-Popper, Buschke, Schultze, and others. But unfortunately cosmetic considerations concerning extent and seat of the disease limit the employment of this method.

At the Lupus Conference, held in Berlin in 1910, Lang spoke very decidedly on the surgical treatment of lupus, supporting his views by the fact that of 308 cases treated by excision and skin grafting, 276 showed a lasting cure, amongst which were cases of lupus of the face larger than a five-shilling piece (see also Jungmann and others).

According to Volkmann, one may succeed in eradicating the lupus tissue tolerably completely with the sharp spoon; also with with the thermo-cautery or galvano-cautery. When of limited extent all diseased tissue may be removed at once; but with larger foci the probability is increased that several foci of bacilli, which have advanced singly into the healthy tissue, escape the visual means at our command, and only betray their existence months after by recurrence of the disease. In this case tuberculin renders valuable assistance by confirming lupus tissue, and later acting as a control. One disadvantage of the sharp spoon is the possibility of introducing bacilli into the healthy tissue.

The punctiform method of multiple scarification recommended by E. Vidal and Balmanns-Squire (by which hundreds of pricks are made close to each other) is suitable for non-ulcerating lupus; with purple margins which raise suspicion of recurrence, it leaves sightly scars and appears to have had good results, but is painful and tedious. According to Renouard, for instance, a lupus was scarified by Vidal for twenty-two months in 188 sittings (Leloir). Besides which, a certain danger cannot be denied in that by pricking, scarification and scraping the bacilli may be further disseminated, although proof may be wanting of the causative connection between later recurrence and scarification. Scarification also serves to improve the appearance of old scars

which have been caused by other means (Leloir). Jacobi has used fine galvano-caustic punctures, which have often proved of service in lupus of the mucous membranes.

According to Gärtner and Lustgarten, electrolysis can only be entertained for small infiltrations, especially in the face.

Chemical remedies used to destroy fresh formations in lupus are: Vienna paste, Cosme's arsenic paste (acid. arsen. 1·0, hydrarg. sulf. rubr. 0·3, ung. lenient. ad 30·0), formerly much used, and though painful, still recommended by Neisser and others, chloride of zinc points, chromic acid, carbolic acid, lactic acid (Mosetig-Moorhof), chrysophanic acid, and pyrogallic acid (5 to 20 per cent. ointment with orthoform), nitrate of silver point (Hebra and Kaposi), caustic potash point, which penetrates deeply, resorcin, ichthyol, salicyl creosote (changed every four hours and covered with impermeable zinc oxide plaster) (Unna), 1 per cent. creosolanin solution, and so on. Doutrelepont observed good results from sublimate compresses frequently removed (1 in 10,000 or 1,000). In these methods the healthy parts must be carefully protected by zinc oxide plaster mull.

Of other methods recommended in the treatment of lupus I may mention ferrichthyol, thiol, iodol (G. Mazzoni), isoform, 20 per cent., iodoformin and iodoformal, euguform (guaiacol with formaldehyde), guaiacol vasogen (for intra-nasal lupus), alumnol, naphthalan, and aristol soap (in ulcerating lupus), Buzzi's creosote soap, balsam of Peru, ergot extract soap in lupus scars, fibrolysin for the treatment of scars and for removing ectropion after lupus. Dreuw used crude hydrochloric acid (with chlor. ethyl or under chloroform). Bey recommends hydrochloride of quinine (an injection of 10 grammes 2 per cent. solution).

The effect of these remedies depends very much on methods of use suited to different individuals, the dose and so on, as well as on experience.

Veiel's method consists in applying pyrogallol ointment (10 per cent.) for several days to destroy the lupus tissue, and a 2 per cent. preparation to heal.

If I except the more recent methods (see below) besides excision (under narcosis or infiltration anæsthesia), the most advantageous method has proved to be a combined process of scraping and pyrogallic acid recommended by Jarisch, Lesser, Neisser and Blaschko, similar to that mentioned by Leloir, Neisser, and others.

The foci which are visible, and suspected places which may be rendered clearer by preceding tuberculin injection, or by the pressure of a lens, are scraped out with a coarse or fine spoon and

cauterized with Paquelin's cautery, a fine galvanic cautery being used for isolated nodules; a number of pricks may be made with a galvano-cautery in the periphery of the lupus nodules to limit the scar, then iodoform (aristol) is dusted on, or orthoform to deaden the pain, and a bandage with acetate of aluminium is laid over; in some cases on the following day a corrosive substance, especially pyrogallic ointment or lactic acid, is used twice a day for about five days till the parts become of a nut-brown colour.

By proceeding carefully we succeed in arresting the lupus for a long time, sometimes in healing it completely. To do this, of course, the patient must be kept under close control for a lengthy period, and if fresh nodules are found to spring up (as seen under pressure of a lens) we must proceed energetically and use the fine galvano-cautery. Unna rejects the use of the sharp spoon (see above) and Paquelin's cautery, and has recently given the following methods:—

For eight to fourteen days the lupus is cauterized on the surface with the green lupus ointment (acid. salicyl., liq. antimon. chlor., āā 2·0, creosote, extr. cannab. ind. āā 4·0, adip. lanæ, 8·0) or potash paste (potas. caust., calcar. ust., sapon. virid., aq. destill. āā). The cauterized surface is covered with the moist paste and zinc oxide plaster mull. Green lupus ointment is more suitable for dispersed lupus nodules, the corrosive paste for the sclerotic form, or for softening the intermediate tissue, as well as for the points of entry in the mucous membranes, and on them (the tongue for example). It is used daily or every two or three days.

After this, for four weeks caustic potash bandages are used (compresses of caustic potash 1 or 2 to 5,000); then follows for two or eight days a stippling process, small pieces of wood (such as a toothpick), finely pointed, which have been soaked for a quarter of an hour, or for several hours, in liq. antimonii chlor., are stippled with a turning movement into the deep foci which remain (the starting-points of recurrence), and which may be recognized by the diascope as dark brown spots; the points are cut off and the surface of the wound covered with mercury carbolic plaster mull. After forty-eight hours they are removed from the skin; for three or four weeks the potash treatment follows, then the stippling is repeated.

F. Prondfort mentions having seen good results from giving thyroid gland extract internally after scraping out the lupus (two cases!); Barbe praises painting with chlorphenol (monochlorphenol in a 20 per cent. alcoholic solution). The healing effect of erysipelas on lupus by inoculation of mild erysipelas mentioned

by Hallopeau, is styled by Besnier as transitory, and the therapeutic employment of it, quite rightly, as dangerous, for one cannot always be sure of being able to limit and cure such erysipelas when it has been intentionally induced.

I have sometimes had extraordinarily good results by treatment with old tuberculin, but there were also recurrences. Latterly Doutrelepont has spoken favourably concerning the use of tuberculin, and successes here and there (Wichmann, Litzner, Jeanselme and Chevalier) in erythema induratum have been communicated, but just as often failures (Gottschalk and others; see p. 382). Tuberculin is often employed by many as an auxiliary remedy in local treatment; van Hoorn says he has had better results with the T.R. preparations.

Tuberculin has also been employed externally. Unna used a tuberculin soap, and Verge recommends friction with 5 per cent. tuberculin ointment for one or two minutes, after which the part is covered with ointment on linen for twenty-four hours. He had, according to his own account, good results from this painful method.

Calomel injections are said by Bernstein and Tschlenow to have a favourable influence on lupus.

Holländer mentions a combined internal and external treatment for lupus of mucous membranes. One tablespoonful of 5 per cent. potassium iodide solution is given, and a quarter of an hour afterwards calomel is powdered on the spot, or a piece of cotton-wool impregnated with calomel is placed on it. Holländer informs us of excellent success (see Alexander).

Pfannenstiel tries to produce bactericidal bodies in the diseased tissue itself, and thus to start the cure; he attempts this by internal use of iodine and conducting ozone over the diseased nasal mucous membrane. The patient receives daily 3 grammes iodide of sodium in solution, divided into six tablespoonfuls, besides which a plug of gauze, free from starch, with H_2O_2 is introduced, and he is instructed to drop in hydrogen peroxide (oxydol Petri 3 per cent.) several times an hour with a pipette. Strandberg and Schaumann mention good results with this method.

As to more recent methods, for success, and especially for cosmetic results, light treatment with ultra-violet rays by Finsen's method is of chief importance. It is distinguished by the formation of a beautiful soft, almost invisible, scar; it is very tedious and costly, and can only be carried out in institutions especially arranged for it, and by well-trained attendants, conditions which exclude its use in many cases.

The use of Kromayer's quartz lamp is simpler in its use and cheaper, and is at the same time followed by good results in the verrucose and scaly form of lupus. It should be preceded by Finsen's illumination (Zinsser, Gottschalk and Heymann).

Holländer's method of hot-air treatment has proved of great use with the special apparatus of Holländer and Werther, and forms smooth, good scars. It is especially suitable for treatment of lupus of the mucous membranes, especially the nose, but also for lupus of the face and the extremities.

The Röntgen treatment is a decided advance, and is especially suitable in hypertrophic, highly infiltrated, intensely proliferating forms of lupus with much ulceration, but presupposes great practice and experience with respect to the dose to avoid doing more harm than good.

Whilst Schiff and Freund endeavour to avoid visible reactions by using hard tubes and short sittings, separated by an interval of several days, Kienböck, Kümmel, Hahn and others endeavour to create a slight, just visible, hyperæmic inflammatory reaction, with strong, medium soft tubes.

For severe cases, in which the epidermis and mucous membrane of the face are affected, although it has the advantage of forming tolerably good scars, Neisser considers this method too little assured against recurrence and goes on so far with the radiation that superficial necrosis appears, with which he has demonstrated lasting cure, even after observation continued for years. One disadvantage of this stronger method is that torpid easily bleeding ulcerations form, which, before they heal, often require treatment lasting for weeks and months, with compresses of boric acid and 3 per cent. acetate of aluminium, alternately with balsam of Peru, or protargol ointment. This limiting of the capability of regeneration seems to justify the warning of Gottschalk, Wichmann and others, with respect to large doses, to go only as far as erythema, and never to allow dermatitis and ulceration to occur (Lesser). The Röntgen method has also proved successful in lupus erythematosus.

Radium treatment has been very useful, especially for single nodules (Zinsser and others). Wichmann defends the employment of preparations of the highest activity, at least 500,000 units of uranium, by which he obtained good results in small lupus foci, and in lupus of the mucous membranes, with trained attendants and by the use of proper filtration of the rays which induce necrosis (Brays).

This is not the place to go further into these methods. The following may just be mentioned: Treatment of lupus with the

constant current (Philippson); fulguration with static electricity, which, according to Jacobi, has not proved of use; also subcutaneous treatment, with which Payr mentions success.

The more recent methods have the great advantage that they exercise a more or less selective effect, destroying the diseased tissue and sparing the healthy; a further advantage is a better scar formation than can be obtained with chemical corrosive remedies. Finsen's method fulfils this best. It is therefore especially suitable for lupus of the face, where ugly scars spoil the existence and life happiness of the individual, also in recent disease which has not ulcerated. With larger deeply penetrating foci a preceding treatment with Kromayer's quartz lamp, Holländer's hot-air method, or the Röntgen rays is to be recommended.

In many cases these methods are to be preceded by other processes, even pyrogallic acid treatment, in order to remove beforehand all that weakens the effect of the rays, so as to allow them to penetrate to the bottom of the proliferations.

The older methods, excision, arsenic, pyrogallic acid, &c., retain their value as preparatory methods, and also where an ugly scar does not matter so much, as on the trunk or extremities. To make a right choice in each case is a matter of experience, and success depends much on the further careful observation by which a fresh growth will be early recognized.

In lupus of the mucous of the nose it is especially important that a rational treatment should be begun before it has extended to the external skin. The removal of all diseased tissue with the galvano-cautery, under cocaine and adrenalin, and Holländer's method have proved very valuable in these cases (Gerber and Dresch); careful observation after treatment must be exercised (see also Alexander, Freund, Hübner, Jungmann, Moberg, Neisser and Meirowsky, Niederstein, Pforringer, Scholtz, Werther and Wichmann).

In recent years, in Germany, the systematic combating of lupus has been taken up by the Lupus Commission, in connection with the Central Committee for the combating of tuberculosis.

At first for instruction 110,000 copies of Hübner's work "On the Importance of Early Recognition in the Cure of Lupus," were distributed officially to clergymen, teachers and governing authorities, the school doctor was instructed by ministerial decree to give information of any case of lupus, and propaganda were made in the Press in connection with this matter, so useful to the public. The lupus patients registered at the central station were sent to the nearest lupus hospital for confirmation of the

diagnosis and, if necessary, to commence treatment, and the patients without means, whose disease gave hopes of cure, were helped. For this purpose 12,451 marks were spent on 121 patients last year (1910-11), and about 10,000 marks were spent on instruments. Besides the Lupus Commission (Berlin W. 9, Konigin Augustastrasse 11; President, Ministerial-Director Professor Kirchner), societies exist in Hamburg, Graudenz, Lauban, Liegnitz, which have the combating of lupus on their programme.

SCROFULODERMA.

Injection of iodoform ether (according to Vidal), or of naphthol camphor, or of chloride of zinc (Lannelongue) and pyoktanin have been recommended for scrofuloderma, but surgical treatment, with the knife, thermo-cautery, or curette, are of chief importance. Leistikow had a good result after daily injections of iodo-vasogen into the (caseated) scrofuloderma (Friedländer). Besides this, arsenic preparations may be employed internally.

In erythema nodosum alcohol-turpentine is, amongst other things, highly recommended.

TUBERCULIDES.

Lichen scrofulosorum, as well as tuberculides, requires only general treatment, nothing locally. Still compresses, or gentle friction with cod-liver oil, according to Vidal-Hebra, and the use of soaps containing cod-liver oil or tar, and treatment with chrysarobin, are advised as being suitable.

B.—DISEASES OF MUCOUS MEMBRANES.

RESPIRATORY ORGANS AND PHARYNX.

Amongst the most frequent and most important symptoms of scrofulosis are adenoid vegetations. As they induce a series of other diseases they must be attacked as early as possible. Nose douches are of little use, the best thing is radical removal.

The operation, which is simple in technique and not dangerous, may be performed on children 2 years of age and even younger, and is best done before the change of teeth, to avoid malformation of the jaws. It is all the more pressingly indicated the more secondary chronic rhinitis with its consequent symptoms begins to make itself troublesome, and breathing through the mouth favours bacterial invasion (with frequent sore throat); it must not be postponed when it has led to disturbance of hearing,

sleep, appetite, and development, or even threatens to lead to them (see Morse and Pfaundler).

The operation must be postponed in acute infectious diseases in the patient or those around him, and is to be entirely avoided with hæmophiles.

The removal of the pharyngeal tonsil must naturally be carried out with sterilized instruments (perhaps after a previous injection of cocaine), with the ring-shaped knife of Beckmann, Gottstein, Lange, and others, or with the cutting loop.

The removal under ether (Grünwald, Nadoleczny, Pfaundler, and Hecht) does not appear to be indicated either in younger or older children (over 4 years, Bresgen), neither is it suitable, as the whole operation hardly lasts a few seconds, and therefore the preliminaries of narcosis frighten the child more than the rapid operation. In the Belgian Oto-laryngological Society, in 1909, most of the specialists spoke against general narcosis as not completely excluding accidents.

Reaction symptoms after the operation must be combated by iced food and special care for two or three days, cold milk, avoidance of hot food, and a nose douche with boric acid continued for some time.

The thorough removal of the hyperplasia almost insures against recurrence (6 to 10 per cent.) and therefore goes very far to avoid scrofulosis.

After the operation one must convince oneself (by examination with the finger) that nothing has remained behind, severe bleeding points to half-severed pieces which are hanging in the pharynx and which must be removed.

With chronic rhinitis, at the beginning of the hypertrophic stage, injections by means of the nose douche, or spraying with tepid salt water, or 1 to 2 per cent. solution of bicarbonate of soda, or applications of a similar nature will, if persevered in, attain the desired end; the customary drawing-in of salt water has often induced catarrh of the middle ear. If of long standing astringents are blown in; for example, pure boric acid, or menthol and borax (1 : 10), or 1 to 2 per cent. sozo-iodol zinc, or sozo-iodol soda; later, argentum nitr. 0·1 or 0·5 to 10 of starch may be used (but as a precaution only on one side, on account of the severe reaction which sometimes follows); bismuth subnitr. (5·0 to 10 sacch. lact.), &c.; or douches of bicarbonate of sodium, borax, and sodium, āā 0·4, and sacch. alb. 1·0 to a tumbler of warm water are recommended.

Rhagades are treated with lapis mitigatus and boric ointment, scrofulous ulcerations with 5 to 10 per cent. protargol ointment (Müller).

I have found painting with Lugol's solution of service in avoiding any loss of smell.

The treatment of chronic nasopharyngeal catarrh is similar. If the avoidance of dust, the abstention from alcohol and hot spices, gargling with salt or alkaline water, do not attain the desired end, painting with glycerine of tannin 0·5 or 1 to 10, with argent. nitr. 1 or 10 to 100, and especially solution of iodide of potassium in increasing strength, is resorted to daily or every second or third day according to the reaction.

℞ Iodi. puri. ... ... 0·2 to 0·3 to 0·4
Pot. iodidi ... ... 2·0 ,, 3·0 ,, 4·0
Glycerini ... ... 10·0 ,, 10·0 ,, 10·0
Ol. menth. pip. gtt. iii.

Success is naturally conditional on making the application, not as frequently happens only to the mouth, but to the naso-pharynx and soft palate, which is often the seat of the chief changes; it must be applied with a bent brush, and thus cannot be left to the patient or those around him.

Professor Fasano speaks of really astonishing results with zeroform in scrofulous rhinitis. Ichthyol as an ointment has proved of service, especially in rhinitis with granulating crusts; it may also be used internally with aq. dest., equal parts, 3 to 10 drops two or three times a day. Chronic catarrh of the upper respiratory passages also proves very amenable to sulphur baths and sulphur water, *e.g.*, Weilbach 200 to 300 grammes internally, fasting, or mineral baths with pinol, have excellent effect.

Extensive thickenings of the nasal mucous membrane and hypertrophy of the turbinate bones are cauterized, after the instillation of cocaine, with trichloracetic acid (according to Kilian) diluted with one drop of water, the surplus acid neutralized by bicarbonate of soda, or they are burnt with the galvano-cautery, either by making three longitudinal furrows (which it has been proposed to rub with trichloracetic acid), or by pricks, which, after inserting the cautery needle may be pushed still further under the mucous membrane (the submucous method). The reactive swelling after the operation is subdued by dusting with acidi boraci 4·0, cocaini hydrochlor. 0·4, aq. dest. ad 200 for half a minute three times a day; the wound or the scab must be often disinfected by applying pure boric acid.

On account of deformity, often caused by the application of the galvano-cautery, its use is now generally replaced by radical removal of the turbinated bones.

Polypoid proliferations are removed with the cold or hot wire loop under cocaine.

Granulations of the pharynx are cauterized with the lunar caustic point, chromic acid (immediately neutralized with bicarbonate of soda), trichloracetic acid, or the galvano-cautery, which reaches more deeply under cocaine; the after treatment is the use of antiseptic gargles.

In hypertrophy of the tonsils the curved probe must be passed deeply into the lacunæ (according to v. Hoffmann's method) which must be opened and painted with tincture of myrrh and Lugol's solution. If, in spite of this, frequent recurrences of sore throat take place, together with respiratory or vocal obstruction, the tonsils must be removed by tonsillotomy, but, on account of the carotid which lies beneath, only the portion made to project beyond the palate by drawing out the tonsil is removed. The tonsillotome, provided with prongs, has the advantage that more can be cut away, but owing to the disadvantage that hæmorrhage is greater, many prefer to remove the tonsils with blunt-pointed knife without drawing them out of the cavity, and making the incision from below upwards; others, again, use the wire loop.

Spurting vessels are tied; parenchymatous hæmorrhage, which often occurs in anæmic or chlorotic patients, is stopped by compression, or touched with solution of ferripyrin or hydrogen peroxide, or even cauterized with the galvano-cautery (with care ! !) Nettelbrock has collected a hundred and fifty cases from the literature of severe hæmorrhage after tonsillotomy (Burach).

As a precaution, we should always have a Mikulicz's compressor ready to hand so as not to be at a loss should hæmorrhage arise.

A few years ago I performed tonsillotomy of the left tonsil on a woman of 35 who was not hæmophilic. Hæmorrhage occurred, in spite of ice, of painting with liquor ferri and pressure with plugs of cotton-wool soaked in it, and which continued, in spite of compression of the carotid, so that I prepared to tie the carotid from below (on account of tonsillotomy); after eight hours a long fainting fit put an end to the hæmorrhage.

Such sad incidents, which, fortunately, are rare, may make removal with the galvano-caustic loop preferable, in spite of the healing taking a much longer time.

Tonsillotomy is contra-indicated with hæmophilic patients, in acute inflammations, and at the time of epidemics of diphtheria or scarlet fever.

General narcosis is unnecessary on account of the slight pain and momentary duration of the operation.

To avoid severe reaction after the operation, cold beverages,

fruit, or artificial ice may be swallowed (I have referred in another place to my unfortunate experience with natural river ice given internally, which set up catarrh of the intestines and infection of the wound). Ice is laid on the neck, rest in bed for one or two days is ordered, and only cold fluid nourishment is given, milk and raw eggs, and (especially after every meal) the mouth is to be well rinsed with 2 to 4 per cent. boric acid, or diluted hydrogen peroxide to avoid infection.

The reproach of incompleteness made against tonsillotomy has a certain amount of justification, as the stump left behind frequently allows the entrance of germs, therefore complete extirpation has been recommended by many (Kopmann, Scherenberg, Langworthy, Sturmann, Finder, Kofler, and others). If this radical operation be limited to cases of constantly recurring severe inflammation and tonsillary abscesses (as in Herzfeld's cases), as well as confirmed tuberculosis, this point of view is to be considered, but I do not consider it justifiable to extend it much further, for example, to cases of simultaneous swelling of the neck glands (Crokett). For in the first place we often obtain a complete cure by simple tonsillotomy, that is to say, removal of the complaint; secondly, besides the technical difficulty of the operation of tonsillectomy, which is proved by the various instruments and methods recommended, and which would be the smallest ground for prevention, it has often been followed by severe hæmorrhage, which in Boston caused even twelve deaths in one and a half years. Also, it is not yet demonstrated whether the stump which remains has not some valuable function to perform. Therefore, taking everything into consideration from our present point of view, a certain reserve must in any case be exercised as to tonsillectomy.

In atrophic catarrh resulting from hypertrophy of the mucous membrane of the nose, often of fœtid character (ozæna), our first task is the removal of the foul-smelling crusts of the secretions and the scab. Gottstein's tampon serves this purpose. Gottstein's screw probe, armed loosely with a cotton-wool plug about the thickness of the little finger, is introduced with a spiral movement into the nose, and again removed by a spiral movement in the opposite direction, which leaves the plug behind. After a quarter of an hour to one hour or more it is withdrawn with the scab hanging on to it; the remains of the scab must be lightly washed away with about a litre of fluid (potas. permang. 0·1 to 1 litre, or 2 to 4 per cent. boric acid, or resorcin 1 to 300, or alumin. acet. tartar. ten drops to one teaspoonful of a 20 per cent. solution) added to a litre of water; in case of necessity it must be removed with the forceps. This douche must be first used daily, once a

day when improvement commences, and when the fœtid smell has disappeared a solution of common salt or Ems water may be used; in scrofulous ozæna, after removal of the scabs, dusting with calomel 2·0, hydrarg. præcip. rubr. 1·0, amyl. 15·0 has proved useful.

Numberless remedies have been recommended for ozæna, as is always the case with diseases which are the most obstinate. Recently Lavrand has praised friction with an ointment after the removal of necrotic parts (bism. sub. 8·0, vaseline 15·0, lanolin 15·0), which is introduced into the depths of the middle meatus of the nose by means of wool on the end of a probe; by others, thioform, with equal parts sacch. lactis, chinosol, Buzzi's sozoiodol soap, naphthalan (Berthold), sandalwood oil (santyl knoll, Menier), iodol (iodol cryst., acid. tannic, borax, āā 5·0. D.S.—A pinch three times into each nostril five or six times a day). Dionin has been often mentioned favourably (or an insufflation with iodine) (Stiel), while Dionisio and Ranazugi and Makie relate good results with Röntgen rays (quoted by P. Krause); by others paraffin treatment is recommended.

Pharyngitis sicca, troublesome on account of the sensation of dryness and the choking movements caused by the dry and firmly adhering secretions, is favourably influenced by inhalation or spraying with 2 per cent. warm salt water, also by painting with glycerine of iodide of potassium and iodine, or tinct. caps. ann., 1 or 3 to 50 of glycerine.

For chronic, and especially dry nasal and pharyngeal catarrh and various abnormal sensations, sometimes internal vibration massage recommended by Braun, Lacker, and others, has rendered very satisfactory service; this is best effected by means of an electric motor.

If carious teeth, sharp stumps or edges, or tartar erosions and catarrh are the cause of it or maintain it they must be removed.

Chronic catarrh of the larynx is treated by insufflation of zinc sozoiodol, or painting with glycerine of tannin 2 to 10 per cent., or nitrate of silver 1 or 5 to 100, and also by inhalation of salt or mineral waters, as in bronchial catarrh.

All catarrhs of the respiratory passages are favourably influenced by salt, soda and sulphur waters, which we order the scrofulous for other reasons.

The local treatment of all these chronic affections demands much time and patience, and it is better to call the attention of the patient or his relations to this fact from the first. They have also their limitation as to time; after painting for two or three months, an interval is not only a subjective benefit to the patient, but often furthers the cure in a surprising manner.

It must be taken as a matter of course (yet a point which is often neglected) that before every local application of medicaments the mucous membranes are cleansed from dried mucus, crusts, &c., by rinsing with tepid salt water, solution of soda (bicarbonate of soda), oil of almonds (or 3 per cent. solution of cresol-iodide), or by simply washing or spraying; it is not the mucus we want to paint, but the mucous membrane.

The diagnosis of retropharyngeal abscesses is confirmed by digital palpation; when fluctuation is present they are incised with a knife covered with sticking plaster, or enclosed in a metal sheath. To avoid the aspiration of pus the head is bent forward, and the child is laid on its stomach. On account of the vicinity of the internal carotid, the incision must not be made more than 3 or 4 mm. from the middle line. The after treatment consists in spraying the pharynx and gargling with 4 per cent. boric acid.

EAR.

The most frequent form of scrofulous affection of the ear passage is otitis media, the treatment of which varies according to its clinical form.

Acute inflammation at the beginning or during the course of otitis needs to be treated on general lines; rest, and if fever is present, rest in bed; confinement to the room during cool weather, and caution against taking cold; protection against damp and dust (by cotton-wool plugs in the ears), avoiding blowing the nose, so that the secretion shall not be forced into the ear and the diseased tympanum injured; energetic antiphlogistic treatment, according to the constitution of the patient, ice bags over the ear, or cold or moist and warm fomentations of plain water, or acetate of aluminium, or alcohol; two to six leeches in front of the tragus and over the mastoid process, intestinal derivatives, and aperients.

For the pain, repeated rubbing near the ear with 1 per cent. morphia ointment; at night and during the day, if there is any cough, morphia or sulphonal internally; instillation of 8 to 15 drops of a warm 5 to 10 per cent. solution of cocaine (with caution, as cocaine in the ear easily induces toxic symptoms, though these may be transitory, with giddiness and vomiting) (Jacobson); for troublesome sensations in the ears of a pulsating character, Lucae's prescription is useful:—

℞ Acid. hydrobrom. 10 per cent. ... ... 20·0

D. in vitr. nigr.

S. 20 to 40 drops three times a day, quarter of an hour after meals, to be taken in sugar-water.

If, in spite of this, the sensibility to pressure on the skin and swelling over the mastoid continue, or maybe high fever, violent headache, giddiness and other threatening brain symptoms occur, early paracentesis of the tympanum (by a puncture 3 mm. broad in the posterior lower quadrant) must be resorted to immediately. An early paracentesis has great advantages over allowing the abscess to burst; postponement may cause irreparable damage and even threaten life.

By emptying the abscess the troubles are, as a rule, rapidly, often immediately, assuaged; if not, the artificial or spontaneous opening is too small, or has not been made in the right place, or the flow of the discharge is hindered by granulations or a polypus, or the process has extended to the periosteum, the mastoid, or the brain. After the paracentesis, or rupture, the chief care is the free flow of the discharge, "and most careful cleansing and drying of the ear passage" (Haug). According to the quantity of secretion, the ear passage is cleansed once or twice daily with sterile cotton-wool and antiseptic gauze, or cotton-wool plugs are laid loosely in to soak up the secretion which has collected in the meanwhile; this the patient or parents must often renew with clean (!) fingers. In order that dried secretions shall not adhere the ear passage may be rubbed with boric vaseline (1 to 15), which at the same time prevents erosion by the pus. The ear must be covered with a pad of cotton-wool or a moist warm bandage; the flow is facilitated by lying on the side of the affected ear.

If the secretion does not cease after two or three weeks, or the flow is hindered on account of its viscid nature in addition, a 1 to 3 per cent. solution of boric acid must be sprayed along the outer ear passage gently by means of a sterilized syringe, the solution being at the body temperature. Once or twice daily the ear passage must be dried and plugs introduced; in cold, bad and windy weather the patient must remain in the room for at least an hour after the proceeding.

Immediately following the spraying, or instead of it, finely powdered boric acid may be blown into the ear daily, as long as the powder is dissolved in the secretion, otherwise at longer intervals. Only a small quantity must be dusted in, so as not to hinder the secretion when the perforation is small and granulations present; the dusting powder is to be avoided for the same reason.

Drops of absolute alcohol, 95 per cent., may be used daily, once or three times a day, and should be left in for five or ten minutes whilst the patient lies on the healthy ear; they have proved of great value even in fœtid conditions and for the patient's own use. The burning experienced at first soon ceases, but if it

continues the alcohol may be diluted with boiled water (1 to 3). The alcohol causes small granulations to disappear; larger ones must be removed with trichloracetic acid, or galvano-cautery, polypi with the wire loop. Instead of alcohol, or immediately after it, a solution of 2 per cent. hydrogen peroxide is very valuable.

Whether spraying, insufflation, or the drops be used, a sterile cotton-wool plug must be introduced afterwards, and changed when necessary.

In suppurating inflammation of the ear, besides the 1 to 2 per cent. sozoiodol zinc solution (Fasano), thioform, thigenol (Spitzmüller), chinosol, thiol (by plugs and friction round the ear with liquid thiol when there is pain) are recommended, and zeroform for scrofulous external otitis.

The local treatment must be continued as long as suppuration exists, with the accompanying danger of stagnation and decomposition. When the secretion ceases every unnecessary irritation by local treatment is to be avoided; only dry, clean plugs must be introduced as long as the perforation exists, as a protection against dust, cold and damp.

The secretion, which in ordinary acute cases ceases in from two to three weeks, lasts many months in the scrofulous, and the methods and remedies must be often changed. For example, we take, as a spray, a $\frac{1}{2}$ to 1 per cent. solution of common salt, or, to avoid fœtor, a 2 per cent. solution of carbolic acid; as a powder, powdered alum and 1 to 10 boric acid or iodol; for insufflation, a 2 per cent. solution of boric alcohol, or a 4 per cent. alcoholic solution of resorcin, or the iodoform emulsion recommended by Urbantschitsch, especially for tuberculous affections (iodoform, 10·0; glycerine 80·0; aq. dest. 20·0; gum tragacanth, 0·2).

The insufflation of air (by catheterization, Politzer's method, or Lucæ's dry douche) as an accessory for the removal of the secretion from the Eustachian tube is to be avoided as long as acute inflammatory symptoms exist. Only one or two weeks after the complete disappearance of the secretion, and when using the handkerchief causes no pain—perhaps sooner if there is great deafness on both sides (Jacobson)—may the air douche come into use, especially if the hearing is not improved in spite of damp, warm, absorbent compresses.

It is repeated daily, or every two or three days; if no improvement in hearing is found after about four or five weeks, an interval is advisable. Passive hyperæmia (by suction apparatus) has sometimes good results (Muck and others).

With coincident chronic rhinitis and adenoids the insufflation

of air may only be used after a careful douching, as otherwise infectious secretions may be forced into the Eustachian tube; it is best not to use it in ozæna.

When there are no acute inflammatory symptoms, when we have to do with pure chronic catarrh of the middle ear, the treatment is different.

Treatment by insufflation of air, naturally with the limitations necessary in rhinitis (see above) is of chief importance; it is said to relieve, at least temporarily, the troubles consequent upon the negative pressure in the tympanic cavity due to the blockage of the Eustachian tube, and the drawing inwards of the membrana tympani, deafness, &c.; and in conjunction with warm fomentations and massage it furthers the absorption of the exudations.

When in the moist form of this catarrh the exudations are not absorbed after one or two weeks (in spite of the air insufflations) on account of their copiousness and viscid state, and the power of hearing is not considerably and lastingly improved, a second paracentesis may even become necessary. The after treatment in this case is the same as above, only the opening by paracentesis is to be immediately followed by several insufflations of air (Politzer) to force the secretion through the incised opening, after which it is removed with cotton-wool or forceps.

As long as discharge continues the insufflation of air is given daily to keep the paracentesis incision open, and is continued until an improvement in hearing and an advancing increase of hearing at a distance is confirmed. But after five or six weeks a pause must be made; if the improvement is not maintained, the insufflations may be recommenced later.

When the discharge is very persistent and copious, Schwartze recommends neutral ammonia fumes, *in statu nascenti,* with Gomperz's apparatus; or turpentine fumes when it is scanty; warm water vapour from 37° to 50° C. may be passed through the catheter.

The prognosis of the dry form of catarrh, especially of a scrofulous nature, is far more unfavourable. In this form also air insufflation is the chief remedy for deafness and subjective sensations in the ear. If visible improvement is obtained by this means, it is to be used two or three times a day; if no improvement is obtained, or anything more than a momentary aggravation is noted, it must be left off. In this case the vapour of warm water, or ammonia, or ether, a few drops of a solution of 5 per cent. bicarbonate of soda, or a 3 per cent. aqueous solution of chloral hydrate is to be introduced into the cavity of the tympanum

by means of a catheter, or Delstanche's masseur du tympan, or some similar apparatus is to be used to prevent complete fixation of the auditory ossicles.

If a mastoid periostitis should have arisen in any form of otitis media on account of the retention of the secretion the cause of this must be removed, absolute rest, ice compresses or fomentations and morphia prescribed. If improvement does not take place immediately and fluctuation is detected, recourse must at once be had to free incision (Wilde's incision).

If the mastoid cells are the seat of suppurative inflammation, early scraping out of the mastoid process (in caries using the sharp spoon) is indicated. For operative measures and after treatment, see works on the subject.

In every chronic otitis the nose and pharynx must be thoroughly examined, and catarrh of either cured; adenoid vegetations especially are to be removed.

Caution must be exercised with regard to cold baths and cold douches to the head as long as perforations exist, diving is to be entirely avoided, the entry of water into the ears is to be avoided by cotton-wool plugs, or india-rubber ear caps.

EYE.

For eczema, see above.

In blepharitis cold compresses with sublimate solution (1 to 5,000) or lead lotion may be used, and where compression cannot be borne 10 per cent. boric ointment, or painting with 1-2 or 5 per cent. silver nitrate, and when necessary cauterizing with the nitrate of silver point, neutralized by common salt solution, is advisable. Loose lashes should be removed with care.

In conjunctivitis we paint with silver nitrate solution and apply calomel, especially in the phlyctenular form. In doing this it is best to remove the coarser grains from the brush by lightly knocking it, so that only a thin layer covers the conjunctiva like a veil. Eisenstein prefers finely powdered boric acid; it is softly rubbed in, and the irritation subdued by a 1 per cent. solution of cocaine. When the inflammatory symptoms have subsided yellow precipitate ointment (hydrarg. oxyd. flavi, 0·3; vaseline, 10) is introduced into the conjunctival sac with a clean glass rod, and is lightly rubbed on to the lids. Owing to the great tendency to recurrence, it is well to continue the treatment for some length of time after the cure of the inflammation. Axenfeld emphasizes scrofulous inflammation of the eyes as being frequently caused by diplococci (ascertained by examination of the secretion), which only heals after dropping in 1 per cent. solution of sulphate of

zinc three times a day for many weeks, and the use of zinc ointment, which is better than calomel.

Calomel, nosophen and yellow precipitate ointment, carefully prepared and fresh, are also suitable for keratitis. With small ulcers on the cornea suppurating at the base, instead of calomel, we may use warm fomentations of sublimate solution (1 to 5,000) three or four times a day for a quarter of an hour, or a sublimate bandage, but no lead lotion fomentations, as incrustations may form after them (Höltzke), or if the infiltration continue we may cauterize with a point of lapis mitigatus, or, according to Sylla (Dolschenkow), with 50 per cent. lactic acid. In phlyctenular keratitis, v. Hoffmann recommends ammon. sulphoichthyol. aq. destill. āā three times a day, 3 to 10 drops internally; for children, an increase of drops corresponding with the years of age; if further complications arise it is well to call in a specialist.

Photophobia and spasm of the lids are eased by drops of a 2 per cent. solution of cocaine three or four times a day, or by dipping the whole face for a few seconds in cold water, or an eye-bath. Only in cases of necessity may a few drops of a 1 per cent. solution of atropine be introduced; with children this may cause slight toxic symptoms. For eczematous conjunctivitis with photophobia 1 gramme argyrol to 40 vaseline is recommended.

Styes in the eyelids are treated in the usual way, with warm fomentations (of chlorine water), and then opened.

It is very important to treat accompanying nose affections rationally, as scrofulous eye diseases are often connected with them.

For further details, refer to vol. xxi of Nothnagel's manual (Schmidt-Rimpler).

I would also mention the recommendation of sozoiodol for phlyctenular conjunctivitis (Bjelilowsky), sanoform, and thioform in ulcerous corneal processes, naphthalan in scrofulous ophthalmia, iodol (1 to 2 per cent. iodol-vaseline ointment) in blepharitis ciliaris, fibrolysin for corneal opacity, dionin in scrofulous keratitis and photophobia, the powder being laid on with a camel-hair brush or in solution (Spitzmüller).

C.—AFFECTIONS OF THE GLANDS.

For the cure of scrofulous glands the preliminary condition is treatment, and if possible cure, of all affections which have established themselves on the skin and mucous membranes in the area of the sources of their vasa afferentia.

Non-tuberculous adenitis frequently heals spontaneously, even

without direct treatment when no fresh bacterial poison is superadded, and the old poison is gradually excreted by metabolism; *Cessante causa cessat effectus*. Thus we see, for example, that after removal of the tonsils, or carious teeth, all scrofulous symptoms will often disappear, though before they had withstood the most varied treatment (Jessen, Dobisch).

But when, besides the scrofulous poison, pus cocci have entered the glands they may, when of weak virulence, have their existence prolonged for an indefinite period, and the swelling of the glands may be thus maintained and further areas become affected by their independent growth. In these cases of chronic non-tuberculous adenitis the healing process may be induced and hastened by external means, the so-called separate treatment.

For this purpose the old remedies—painting with iodo-potassium glycerine, or the stronger iodine tincture weakened by equal parts of tinct. gallar., which irritates more—enjoy greater esteem than they deserve; iodobelladonna ointment (potassium iodide 2·0, extr. belladonna 4·0, vaseline 15·0) and the ointment with a plaster for bronchial glands, applied alternately to the sternal and intrascapular regions for three days, have been recommended by Variot.

The newer preparations of guaiacolvasogen are preferable; friction with iodovasogen, or 20 per cent. creosotevasogen, 25 to 50 per cent. iothion ointment, recommended by Frey,[1] are stated to have given good results. Salocreol frictions and paintings have been especially praised by Gnezda, of the Leyden Clinic (8 to 20 grammes per day); naphthalan has also proved serviceable, as has been confirmed by many; creosotfukol has been applied and continued for some months (Hecht).

Mineral-water fomentations, iodine water (according to Haller) sometimes have a favourable effect, or fomentations of sea water, which must be filtered, as otherwise it tends to produce eczema. With an irritable skin inclining to eczema covering with zinc vaseline under compresses is to be recommended (v. Bergmann). The indications for mineral and sea baths, and soft soap treatment for such cases have been treated of above.

Massage, electricity, faradization, electrolysis, Genzmer's ignipuncture—to afford the caseous matter a way of escape—have established themselves in the treatment of these affections.

Injections of tincture of iodine (5 to 30 drops) into the

[1] Frey orders a piece of 50 per cent. iothion ointment, the size of a pea, to be rubbed on the skin with a glass spatula until it is absorbed (5 to 15 minutes); before the next rubbing the skin is to be cleansed with ether soap.

diseased parenchyma, according to Demme, Richelot and Bradley, and 3 per cent. carbolic acid (10 to 20 drops), according to Hueter, Schüller's 10 per cent. iodoform ether and Demme's subcutaneous discissions are to-day generally abandoned. Ortiz sometimes obtained healing or improvement after injections of naphthol camphor three or four times a day with intervals of ten to fifteen days.

Good results are reported by Bergonié from the Röntgen rays, both with superficial and deep-seated tuberculous glands; with caseated glands, as well as with suppurative and discharging glands, the success (according to P. Krause) is very slight, though now and again the fistulæ disappear. Recently longer application of the Röntgen rays has been recommended, even to the production of slight erythema of the skin. Belot, Bergonié, Barjon, v. Gardiner, Pfahler, Ferrand and Krouchkoll, Hayes, and Wetterer mention good, sometimes brilliant results, in which a favourable cosmetic appearance is also noticed; Mahat has obtained cures in non-suppurating glands by high doses, and sittings at long intervals, in two-thirds of the cases after two or three months; other reports are less satisfactory, especially the occurrence of general miliary tuberculosis, or the further spread of the tuberculosis has often been observed after the radiation of tuberculous glands (Steinwand, Gemari [quoted from Krause], Caccia and Francioni) and complications from severe fibrinous pleurisy (Quadrone). Great care is especially necessary with suppurating glands. Wilms emptied caseous matter and pus from a small wound, and then obtained a very good scar by Röntgen radiation. Heliotherapy also brings about good results in tuberculosis of the glands (see pp. 330 and 342).

Domenici and Cheron mention having obtained improvement and cure of chronic glandular swellings by laying silver tubes containing radium sulphate in the tuberculous tissue.

We must also just mention the recommendation by Bernheim of dioradin (radio-active iodomenthol) for tuberculosis of the glands.

If in the further course another invasion of bacteria of high virulence should induce active inflammatory symptoms, generally of an acute nature, at the periphery they are to be combated by antiphlogistic treatment, ice, and Leiter's cold coil. As soon as fluctuation can be detected and rapid inflammatory involvement of the skin takes place, an incision is to be made without waiting for spontaneous rupture; it must be made wide, especially when phlegmonous characteristics are present; besides this, care must be taken, on account of the youth of the patient, to avoid as far as

possible the chief blood-vessels, so as to have little bleeding, and in the deeper layers to make the preparatory incision with a blunt knife. By following the rules given under general surgical after-treatment the process soon heals after careful arrest of hæmorrhage by ligatures and pressure, with drainage when necessary; sometimes undermined necrotic edges of skin must be removed, and shreds of tissue or weak granulations must be treated with the sharp spoon.

Should the glandular tumour be, *in toto* or *in parte*, of a tuberculous nature, whether primarily or should it become so while under observation, besides the treatment at the periphery (point of entry), to avoid further infection it would appear the most rational course to eradicate the affected gland, root and branch, and with it the germ of severe consequent conditions, in view of the frequent further dispersal of the bacilli which have entered not only to other groups of glands, but also to the lungs, the bones, and in the form of miliary tuberculosis over the whole body.

Hueter is most strongly in favour of total extirpation. With tumours the size of a walnut, he says the surest remedy is "not iron in solution, in mixtures, but iron in sharpened form—the knife," and if in twenty such cases operated upon only a single one would have developed miliary tuberculosis without operation, that would be reason enough for performing it, especially as with the nineteen others the cure is attained more rapidly than without operation. Poulet, Most, Bouilly, Chrétien, Marfan, Treves, and others, are also advocates of total extirpation, and have obtained apparently good results with it (see also Syms, Much, and Beyer). O. v. Angerer recommends total extirpation most warmly.

The statistics brought forward, as proof of favourable lasting success, are for the greater part as good as worthless, but so are also the statistics to the contrary, which are intended to represent the evils of extirpation.

When the statistics brought forward in support of extirpation give the ultimate result of 127 out of 297 cases treated, and other statistics brought forward against its use only give the ultimate result of 48 cases out of 128 extirpations, no opinion can possibly be based on this. For only vague surmises can be formed of the remaining cases, which form more than half, nearly two-thirds of the total; the patients may have withdrawn themselves from control because they felt too well, but just as probably because they were covered by the cool turf! It is quite uncertain how they would have altered the result if they had been reckoned, perhaps they would have changed it to the opposite.

Certain practical doubts have been urged on principle respecting total extirpation, though it appears theoretically justifiable. v. Bergmann sees a danger in the often unavoidable hæmorrhage "to which children, under 10 years of age especially, react very sensitively," and to which badly nourished scrofulous children fail completely to react; also there is the impossibility in the case of extensive swelling of removing all the caseous matter and so excluding the frequent starting-point of suppuration, of infection and the cause of repeated operations; lastly, the difficulty of arranging constricting bandages on the movable neck, as can be done on the trunk or extremities.

Recently Pottenger, Pilip and Albert Robin have expressed themselves against the removal of tuberculous glands, chiefly for the reason that glands out of sight might be affected, and therefore the extirpation of manifest glands would not be any protection against recurrence.

In further support of the conservative treatment up to a certain limit I should like to add what I have already emphasized before (pp. 127 and 220), that hardly any other organ of the body is in so advantageous a position for arrest of tuberculosis as the lymph glands, because, on account of the capsule which encloses it so firmly, the tuberculous toxin is often held in concentration, which suffices to irritate the periphery to an inflammatory limiting boundary. Frequently only very considerable causes, for example, inflammatory saturation after measles or traumatic irritation, is needed to mobilize the enclosed bacilli.

I cannot repress the suspicion that this traumatic irritation is not so very rare, and is even given by the too busy hand of the doctor, who, by repeatedly palpating to discover the situation of the gland and its size or fluctuation, often exercises too great pressure on the tense morbidly disposed gland, and so through the few outlets which remain open a few germs are sometimes pressed out and carried into new channels, unconsciously the further dispersal is thereby advanced. It is with difficulty that we come to a knowledge of the etiological connection, as it is only after weeks and months that the sad consequences are perceptible, and they are then put down to natural further dissemination. For this reason I would warn against any heavy massage, and especially against pressure bandages, which were formerly used with very serious consequences, and recommend that any pressure or squeezing which is not absolutely necessary be avoided during the operation.

That which has especially supported total extirpation, namely, the fear of infection of the lungs through the glands, appears after

our former statements (see p. 101), if not entirely unjustifiable, at least to be very much exaggerated, for in the cases where, with or after tuberculosis of the neck and other glands, pulmonary tuberculosis has appeared, as a rule, we have to do with a second independent infection of the lungs from outside, and arising from the same centre of infection as the cervical tuberculosis.

On the whole, therefore, we must not be too hasty with total extirpation, as we know that a considerable part of gland tuberculosis is caused by the bovine bacillus, the changes caused by which, especially in older children, retrogress spontaneously, and therefore surgical treatment, which is unfortunate if only from cosmetic considerations, appears frequently to be unnecessary.

These doubts are naturally increased when we consider the removal of the mesenteric glands, which is much more serious, but which might become necessary in the case of palpable tumours (see Stark, Edred Corner, and Thiemann).

According to v. Bergmann extirpation of the cervical glands is only indicated: (1) "When a single gland has grown to a considerable size." (2) "When one or more groups of glands resists general treatment and increases in size, as long as periglandular inflammation is not superadded." Under these conditions the gland may be lifted from its position; the operation is easy and not dangerous if severe hæmorrhage is not threatened by adhesions to the walls of the vessels.

In my opinion extirpation must be seriously considered when traces of softening are evident, but not if extensive adhesions are threatened, for it is just in the softening stage that the danger of the bacilli being carried further threatens most, and which, apart from a better scar, is earlier and more completely met by extirpation than by incision.

When abscess formation and demonstrable fluctuation occur the contents are aspirated with a syringe and 1·5 iodoform vasogen is injected, or an incision is made and the caseous mass and abscess membrane are scraped with a sharp spoon. Open wounds are covered with dermatol powder and gauze, or iodoform, or one of the substitutes for iodoform. In the case of fistulæ Rabl's proceeding may be employed, breaking off nitrate of silver filaments about the thickness of a pin into the fistulæ and letting them remain there after the surrounding parts have been thoroughly smeared with vaseline to avoid their being cauterized. I have convinced myself in a few cases that this method is productive of very favourable results.

The discussion of various points does not belong to the scope of this book; such are: The method of operation in extirpation

and incision; the line of the incision with a view to the scar; Dollinger's method of subcutaneous removal of the glands from the back of the neck; the lifting out of the gland; avoidance or ligature of vessels; the section of the internal jugular vein, which may become necessary; the connection of the facial branches with submaxillary glands; the principles of after-treatment. On all these points I refer to surgical manuals and to Angerer's treatise in Pentzoldt-Stintzing's Manual, vol. ii. Bier's congestion method has sometimes proved advantageous in after-treatment (see also Mohr).

D.—SCROFULOSIS OF THE BONES AND JOINTS.

In recent years, in scrofulo-tuberculous bone and joint diseases, as in tuberculosis of the glands, the conservative treatment claimed by Rabl and others, as the result of great experience and such as is practised in the largest hospital for scrofulosis at Berc-sur-mer, has gained more and more ground. Many only operate in isolated bone tuberculosis (Vogelmann). Hoffa, Bier, Klapp, Murphy, and many others favour it more decidedly. Garré admits an indication for operation on general grounds, when external circumstances do not admit of the use of other means of cure. Surgical treatment, resection and the sharp spoon are to be avoided as far as may be, unless septic mixed infection, hectic fever, or other evils collectively, imperatively demand such intervention. The most important points in treatment are a restful position, especially of the affected region of the body, fixation, immobilizing bandages or extension bandages to relieve the affected joint; in spondylitis a plaster-of-Paris jacket, or the Calot corset with gentle tightening (Rosenberger's cheap gelatine corset), and bandages for walking, which are a further development of Hessing's bandages, which permit the patient to exercise in the open air. It has been proved that by these means a large number of cases in which formerly resection would have been considered necessary have healed well, indeed, better than formerly.

Undoubtedly the method requires a long time and much care. Thus treatment for spondylitis in a plaster jacket extends over a year, and children with tuberculosis of the hip-joint may, when all acute symptoms have ceased often for a year or more, only move on crutches with a high boot on the healthy foot to save the diseased joint. But the results are very satisfactory, especially when mineral and sea baths, soft-soap treatment, climatic treatment, good nourishment, iron and cod-liver oil, &c., raise the general powers of resistance of the body at the same time; there-

fore such children are best sent away from the municipal hospitals to children's hospitals. Even when greater surgical interference appears necessary it is urgent that the children should be strengthened beforehand by a climatic and bath treatment.

The so-called anoperation is in very evil odour, as, unless all that is tuberculous is removed from the healthy tissues, a dispersal of the bacilli in the body may easily take place.

Acute abscesses are lanced, but cold abscesses are in general better only punctured so as to avoid as far as possible secondary infection, which is one of the chief dangers of surgical tuberculosis. Spondylitic abscesses, which Ménard and Goldmann especially note and which often lead to paralysis, must be opened.

The good repute in which 10 per cent. iodoform glycerine solution stands holds good in the case of fistulæ, cold abscesses and joint tuberculosis (Hoffa, Tietze, and Renard), and is only questioned by a few (Bowlby); a 10 per cent. iothion ointment is preferred by many (Hauser and others). In tuberculosis of the glands and joints Lannelongue, Calot, and others, inject guaiacol, creosote, iodoformol (or oil 60·0, ether 40·0, creosote 4·0, iodoform 10·0), as soon as the abscess is ripe, and before that, camphor-naphthol glycerine. Wreden also recommends naphthol camphor 1 to 2 per cent. (with 1 per cent. cocaine beforehand) for fistulæ and abscess cavities; or for interstitial injections, camphor-naphthol glycerine 1 to 2-5. Recently, instead of iodoform glycerine, injections of 1 per cent. trypsin (Fairchild Brothers and Foster) may be tried to induce digestion of the pus and to encourage the blocked absorption products to flow. The injection of 1 to 2 c.c. into the diseased tissues is given every six or eight days. Baetzner and Jochmann had good results with this in Bier's clinic in cases of severe bone and joint tuberculosis, as had also Kantorowicz, Borsécky and Turán, Schiller and others, while Bruning, Sohler and Brandes obtained less satisfactory results; sometimes joint tuberculosis with large foci and caseated lymphomata exclude the use of trypsin.

Carbenzym, carbon, trypsin as injection or as powder, for sprinkling wounds which heal badly, have proved useful, according to zur Verth, Falk, and Sticher.

Of more recent remedies for use in scrofulous bone and joint affections the following are recommended: sanoform, chinosol, sozoiodol salts, iodoformogen, iodofan, xeroform, thioform, perhydrol, alsol (lenicet), leucofermantin, &c., and soap injections (Delrez).

We have already referred above (pp. 330 and 342) to the good

results of sunlight radiation carried out methodically on the plan instituted in Leysin.

Treatment by active and passive hyperæmia, according to Bier, also renders good service in many cases with proper technique and selection; short periods of congestion, for one to two hours daily, until the appearance of a deep red acute form of inflammation shows itself, but without pain and œdema, with an interval of a week after three or four weeks, have proved very useful especially in fistulous and suppurating tuberculosis.

Deutschländer, Chaput (twelve hours' congestion bandage) and others emphasize the value of congestion. König warns against exaggerated expectations; Delbet, Rénon, Tuffier and Quenu have an unfavourable opinion of the method.

Successes are also recorded by Röntgen radiations in bone and joint tuberculosis (Freund, Gregor, Pavli, Béclère, Rudis-Jacinski, and others).

Recently intense radiation by Wilms's method (hard tubes, radiation of one hour, with prevention of the soft rays, by means of an aluminium filter) has been preferred. P. Krause warns against too energetic application, and expresses himself more in favour of smaller doses (about half the dose, sufficient to produce erythema, according to Kienböck) with repetition after fourteen days.

Denks and others record (in five cases) good results in bone tuberculosis by treating with strong Röntgen light according to Iselin's method in Bâle.

For the technique of each measure and for the method of operation for resection and amputation I must refer to surgical manuals (see also Correa, v. Dorp, Karewski, Klapp, Miller, Warren Low, Plate, Rosenberger, Sarfels, Schanz, Tietze, and Verneuil).

ABBREVIATIONS USED IN THE BIBLIOGRAPHY.

Allgemeine Wiener medizinische Zeitung	Allg. W. m. Z.
Alter Hygienische Rundschau	Alter. Hyg. R.
Annales	Ann.
Annales d'Hygiène publique et de médecine pratique	Ann. d'hyg. publ. et de méd. prat.
Archiv für Anatomie und Physiologie ...	A. f. Anat. u. Physiol.
Archiv für Augenheilkunde	A. f. Augenhlk.
Archiv für Dermatologie und Syphilis ...	A. f. D.
Archiv für Kinderheilkunde	A. f. Kdhlk.
Archiv für klinische Chirurgie	A. f. kl. Ch.
Archiv für klinische Medizin	A. f. kl. Med.
Archiv für Ohrenheilkunde	A. f. O.
Ärztliches Intelligenzblatt	Ärztl. Intelligenzbl.
Band	Bd.
Baumgartens Jahresbericht über die Fortschritte in der Lehre von den pathogenen Mikroorganismen	Baumg. Jb.
Beiträge zur experimentelle Pathologie und Therapie	Btr. exp. Path. u. Ther.
Beiträge zur experimentellen Therapie ...	Btr. z. exp. Path. u. Ther.
Berliner klinische Wochenschrift ...	B. kl. W.
Brauers Beiträge zur Klinik der Tuberkulose	Beitr. z. Kl. d. Tub.
Bristol Medico-Chirurgical Journal ...	Bristol Med.-Chir. Journ.
British Medical Journal	Brit. Med. Journ.
Bruns Beiträge zur klinischen Chirurgie	Btr. z. kl. Ch.
Bulletin de la Société française de Dermatologie	Bull. Soc. fr. de Dermat.
Comptes-rendus de l'Académie des Sciences	C.-r. Acad. sc.
Comptes-rendus de la Société de Biologie	C.-r. soc. biol.
Comptes-rendus de la Société Médicale des Hôpitaux	C.-r. soc. méd. hôp.
Dermatologische Zeitschrift	Derm. Z.
Deutsche medizinische Wochenschrift ...	D. m. W.
Deutsche Medizinalzeitung	D. M. Z.
Deutsche Monatsschrift für Zahnheilkunde	D. Mschr. f. Zhlk.
Deutsche Vierteljahrsschrift für öffentliche Gesundheitspflege	D. Vj. f. öff. G.
Deutsche Zeitschrift für Chirurgie ...	D. Chir.
Dissertation	Diss.
Fortschritte der Medizin	F. d. M.
Gazette	Gaz.
Gazette des Hôpitaux	Gaz. des hôp.
Gazette Médicale de Paris	Gaz. méd. de Paris.
Gerhardts Handbuch der Kinderheilkunde	Gerhardts Handb. d. Kinderk.

Heft	H.
Hygienische Rundschau	Hyg. R.
Jahrbuch	Jb.
Jahrbuch für Kinderheilkunde	Jb. f. Kdhlk.
Journal	Journ.
Journal of the American Medical Association	Journ. Amer. Med. Assoc.
Journal of Cutaneous and Genito-urinary Diseases, New York	J. of Cut. Dis.
Journal of Infectious Diseases	Journ. of Infec. Dis.
Journal de Médecine et de Chirurgie ...	Journ. de Méd. et de Chir.
Journal de Médecine vétérinaire ...	Journ. de m. vét.
Journal médicale de Bruxelles	Journ. med. de Bruxelles.
Klinischer Band	Kl. Bd.
Klinisches Jahrbuch	Kl. Jb.
Klinische Monatsblätter für Augenheilkunde (Zehender)	Kl. M. f. Aughlk.
Korrespondenzblatt	Korr.
Korrespondenzblatt für Schweizer Ärzte	Korr. f. Schw. Ä.
La Médecine Moderne	La méd. mod.
Medical News	Med. News.
Medical Record, New York	Med. Rec.
Medical Times	Med. Times.
Medizinische Klinik	Med. Kl.
Mitteilungen aus dem kaiserlichen Gesundheitsamt	M. kais. G. A.
Monatshefte für praktische Dermatologie	Mh. f. pr. D.
Monatsschrift für Kinderheilkunde ...	Mtschr. f. Kdhlk.
Münchener medizinische Wochenschrift	M. m. W.
Nouvelle Iconographie de la Saltpêtrière	Nouv. Iconogr. de la Salpêtrière.
Pédiatrie pratique de Lille	Pédiat. prat. Lille.
Practical Medicine	Pr. med.
Prager medizinische Wochenschrift ...	Pr. m. W.
Prager Vierteljahrsschrift für die praktische Heilkunde	Pr. Vj.
Progrès médical	Progrès méd.
Revue	R.
Revue de médecine de Paris	R. de m. Paris.
Revue mensuelle des Maladies de l'Enfance	Rev. mens des malad. de l'enf.
Revue de la Tuberculose	Rev. de la Tb.
Rivista di Clinica Pediatria	Riv. di Clin. Ped.
Sammlung klinischer Vortrage (Volkmann)	Samml. kl. Vortr.
Semaine médicale	Sem. méd.
Société médicale des Hôpitaux	Soc. méd. des hôp.
Therapeutische Monatshefte	Th. Mh.
Die Therapie der Gegenwart	Th. d. Gegenw.
Tierärztliche Wochenschrift	Tierärztl. W.
L'Union médicale	Un. m.
Verhandlungen der pathologischen Gesellschaft	Verh. d. path. Ges.
Vierteljahrsschrift für Dermatologie und Syphilis	Vj. f. D.
Vierteljahrsschrift für die praktische Heilkunde (Prag)	V. A.
Virchows Archiv	V. H.
Virchow-Hirsch, Jahresbericht über die Fortschritte der gesamten Medizin ...	Pr. Z. f. Hlk.
Wiener klinische Wochenschrift ...	W. kl. W.
Wiener medizinische Blätter	W. m. Bl.
Wiener medizinische Presse	W. m. Pr.
Wiener medizinische Wochenschrift ...	W. m. W.
Zeitschrift für Hygiene und Infektionskrankheiten	Z. f. H.
Zeitschrift für Hygiene	Z. f. Hyg.
Zeitschrift für klinische Medizin ...	Z. f. kl. M.

Zeitschrift für Ohrenheilkunde	Z. f. O.
Zeitschrift für diätetische und physikalische Therapie	Z. f. diät. u. physik. Ther.
Zeitschrift für Tuberculose	Z. f. Tb.
Zeitschrift für Zahnheilkunde	Z. f. Zhlk.
Zentralblatt	Zbl.
Zentralblatt für allgemeine Pathologie und pathologische Anatomie	Zbl. f. a. Path.
Zentralblatt für Bakteriologie und Parasitenkunde	Zbl. f. B.
Zentralblatt für Chirurgie	Zbl. f. Ch.
Zentralblatt für Gynäkologie	Zbl. f. Gyn.
Zentralblatt für klinische (innere) Medizin	Zbl. f. kl. M.
Zentralblatt für Laryngologie	Zbl. f. L.
Zentralblatt für die medizinischen Wissenschaften	Zbl. f. m. W.

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