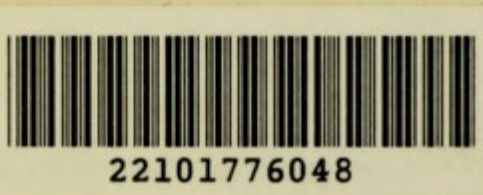
Ringworm in the light of recent research : pathology, treatment, prophylaxis / by Malcolm Morris.

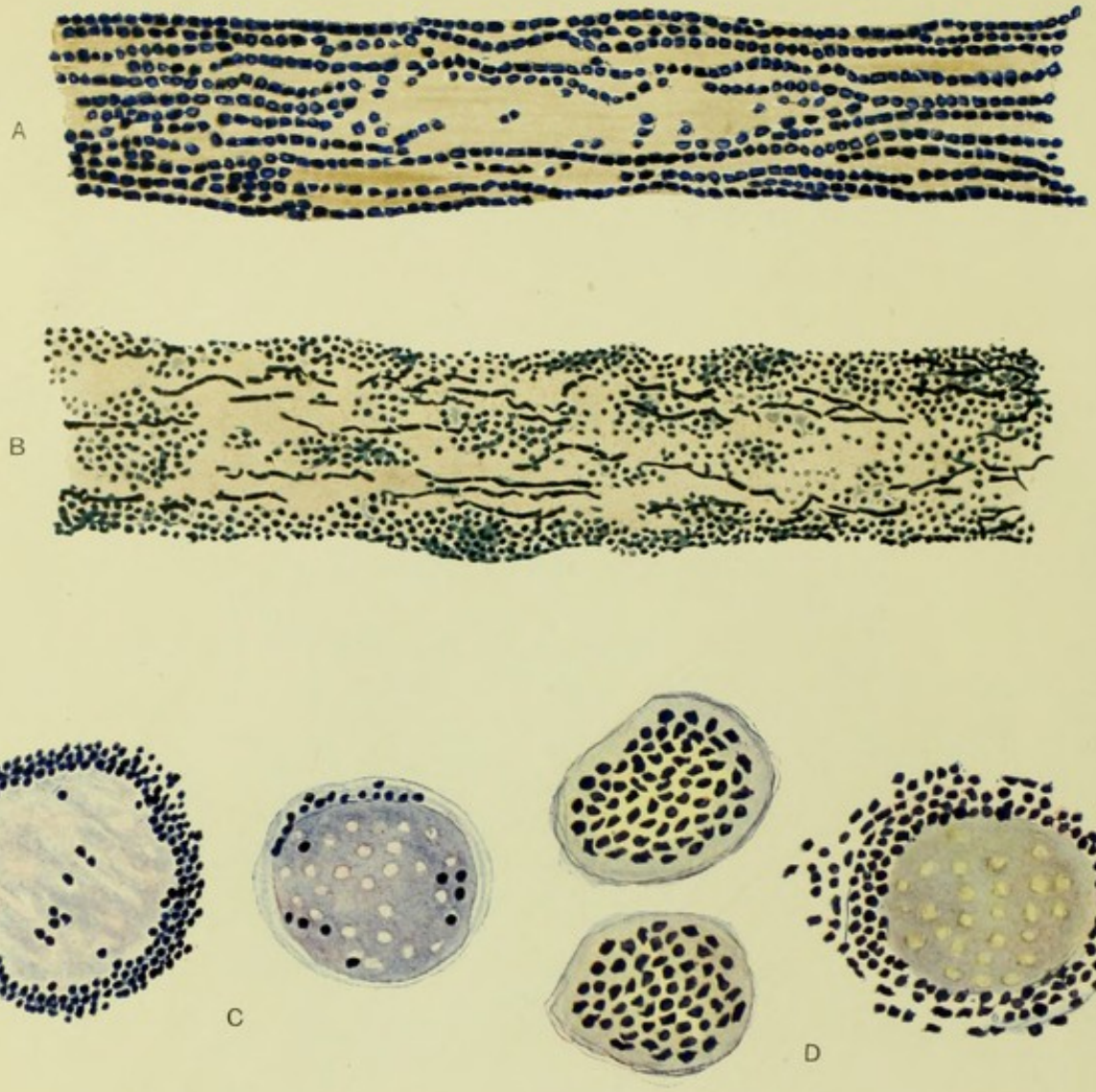
RINGWORM

IN THE LIGHT OF RECENT RESEARCH

MALCOLM MORRIS



RINGWORM.



Pinxit M. Colhoun.

[*Frontispiece.*

A. Large-spored ringworm in hair (stained).

B. Small-spored ringworm in hair (stained).

C. Transverse section of hair with small-spored ringworm (stained).

D. Transverse section of hair with large-spored ringworm (stained).

E. Scraping from ringworm of body (stained).

RINGWORM

IN THE LIGHT OF RECENT RESEARCH

PATHOLOGY—TREATMENT—PROPHYLAXIS

BY

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WITH TWENTY-TWO MICROPHOTOGRAPHS AND ONE COLOURED PLATE

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PREFACE.

THE present volume is an expansion of a paper read at the last meeting of the International Congress of Dermatology which was held in London in 1896. On that occasion I was one of those invited to open a discussion on the question of "Ringworm and the Trichophytons." My position is the same as it was then. While holding that the plurality of the ringworm fungi is an established scientific truth, I think that the infinite series of species which M. Sabouraud asks us to accept is still nothing more than a *jolie hypothèse*—if I may use a famous phrase applied by another eminent Frenchman to a different matter. Till conclusive proof has been supplied it will be wise to suspend judgment.

It has been my aim in the following pages to present the reader with a concise account of recent work in the etiology of Ringworm, giving the main results and indicating the general trend of thought, without perplexing him with needless details. In dealing with treatment, I have not only described the methods which I have myself found useful but have culled freely from the experience of others; in short, I have striven rather to be practically helpful than to make a vain show of originality in a field where everything has been tried and most things have been found wanting.

Of the microphotographs which illustrate the work, I may,

perhaps—as they are not my own handiwork—be allowed to say that they excited the greatest admiration at the International Congress of Dermatology held in London in 1896, and at the Annual Meeting of the British Medical Association held in Montreal in 1897. M. M.

8, *Harley Street, W.*

February, 1898.

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CHAPTER I.

INTRODUCTORY.

"RINGWORM" has been a familiar word in our language for centuries;* but till a time within the memory of many practitioners still living there was the greatest confusion as to its meaning, even in the minds of those whose business was the study of disease. In the speech of the people the word was used to denote any cutaneous affection in which the lesions were arranged in rings; and, indeed, any "tetter" or skin disease of whatever kind.† In much the same way the word "teigne" was used in France by the vulgar, as Ambroise Paré tells us, to designate any disease in which "the scalp looks ragged and red, as if gnawed by the moths that eat up garments." Medical writers, on the other hand, described the disease which we now call ringworm—as far as they recognised it at all—under learned-sounding names, either meaningless, or implying clinical or pathological affinities that had no existence. The word "tinea" was used by Guy de Chauliac and other mediæval writers as a generic term for a number of diseases, and the distinctive epithets, such as *ficosa*, *favosa*, *furfurosa*, and so forth, by means of which they sought to indicate the several species, do not give much help towards

* Skeat ("Etymological Dictionary," *sub voce*) gives a reference to Levins's "Manipulus Vocabulorum," published in 1570.

† Bailey ("Etymological English Dictionary," sixth edition, 1733) defines ringworm as "a tetter, a disease." "Tetter" is explained to mean a humour accompanied with redness and itching—a ringworm.

their identification. In the early part of the present century Alibert made an elaborate classification of tineæ, in which ringworm finds a doubtful place under the name of *teigne granulée*. Willan replaced the word tinea, as "being a term of no authority, and probably of Arabic origin," by *porrigo*, which, though meaning nothing in particular, had the authority of Celsus. Bateman, adopting this "classical appellation," made a genus Porrigo, which he defined as "an eruption of straw-coloured pustules, concreting into yellow or brownish crusts, or cellular scabs." One of the six species included within this comprehensive definition was, "Porrigo scutulata, scalled head or ringworm of the scalp." Bateman's account of the disease is not very clear. His view of its etiology was that it "seems to originate spontaneously in children of feeble and flabby habits, or in a state approaching to marasmus, who are ill-fed, uncleanly, and not sufficiently exercised." He was aware, however, that it is propagated by contagion, "both to the other parts of the head of the individual affected, by the conveyance of the matter from the diseased to the healthy parts," and to other children by the frequent contact of heads, but more generally by towels, combs, and caps. "Whence," he goes on to say, "the multiplication of boarding-schools appears to have given rise to an increased prevalence of this disease among the more cleanly classes of the community at the present time."* In A. Todd Thomson's posthumous work on diseases of the skin it is stated that "ringworm was little known in this country until the commencement of the present century, when some children infected with it came from India, after which it appeared in several boarding-schools, and was afterwards extensively and rapidly propagated by contagion."† The statement here made, that ringworm was imported from India, is interesting in relation to the geographical distribution of the parasites which cause the disease, a point that will be touched upon later in connection

* "Practical Synopsis of Cutaneous Diseases," eighth edition, edited by A. Todd Thomson, 1836, p. 210.

† "A Practical Treatise on Diseases Affecting the Skin," completed and edited by R. O. A. Parkes, London, 1850, p. 122.

with the question of the varieties of the affection occurring in different countries.

That in France, too, ringworm was little known until comparatively recent times is apparent from the fact that it was first clearly described as a distinct clinical entity by Mahon in 1829. He gave it the appropriate name of *teigne tondante*, from the cropped appearance of the affected surface. He recognised its contagious nature, but regarded it as a hereditary constitutional disease. In the earlier editions of Cazenave and Schedel's work on diseases of the skin, first published in 1828, no mention was made of ringworm of the scalp, and it was not till 1847 that a brief account of it was introduced into the fourth edition. Cazenave states that he first recognised the affection in one of the large schools of Paris in 1840; he gave a detailed account of it under the name of *herpes tonsurans* in his treatise on diseases of the scalp, which appeared in 1850—when the disease was said to be "quite common" in France. Of the etiology of the disease he had nothing more to say than that it "often appears spontaneously in children and persons of a lymphatic habit, and who are badly clothed and fed; but the most frequent cause is contagion."

Yet already staring him in the face, had he had but eyes to see, lay the solution of the riddle. Favus, which had been confused with ringworm by the old writers, had, in 1839, been shown by Schönlein to be due to the action on the skin of a special fungus (*achorion Schönleinii*); and in 1844 another cryptogamic fungus was found by Gruby in Paris and by Malmsten in Stockholm to be in constant relation to certain forms of ringworm. In 1843 Gruby had minutely described another fungus, which he called *microsporon Audouini*, as being the cause of "porrigo decalvans." It is clear, however, that by this term he meant the affection which we now know as ringworm of the scalp. This error in terminology misled dermatologists for half a century, until M. Sabouraud independently rediscovered the parasite which had been described by Gruby, and proved beyond

possibility of dispute that ringworm may be caused by more than one species of fungus.

The work of various investigators who have helped in the elucidation of the etiology of ringworm will be set forth in the following chapters in sufficient detail to show the development of scientific opinion on this point, and thus make the present position of the question more easily understood.

CHAPTER II.

ETIOLOGY.

THE PARASITIC THEORY.

The credit of the discovery of the cause of ringworm must be given to Gruby. It is true Malmsten described the fungus which is the agent in the production of one variety of the disease, but Gruby, with the very inadequate means of research which microscopic workers had at their command fifty years ago, discovered the principal types of parasite which are now generally recognised as the exciting causes of ringworm. Gruby, in fact, anticipated by half a century the essential points in the discoveries of M. Sabouraud which have so greatly modified our notions of the etiology of the affection. M. Sabouraud's results have been reached quite independently, and it was only after his work was practically completed that he became aware that another explorer had been over the same ground before him. With a generosity too rare among scientific investigators, he called attention to the work of his forerunner, which Gruby's contemporaries had misunderstood and the world had since almost forgotten. It may, indeed, with tolerable safety be assumed, that dermatologists of the present day for the most part know Gruby's work mainly through the full analysis of it given by M. Sabouraud.*

A brief account of Gruby's investigations will not be out of place here. In 1842 he presented to the Académie des Sciences a paper "On a Species of Contagious Mentagra resulting from the growth of a new Cryptogam in the Roots of the Hairs of the Beard in Man."† In it he described a cryptogamic fungus which infests the human beard, establishing itself within the hair sheath,

* See *Les Trichophyties Humaines*, Paris, 1894, p. 12, *et seq.*

† "Comptes Rendus de l'Académie des Sciences," t. xv.

and causing a disease the distinctive characters of which had not then been determined with sufficient precision.

"The microscopic examination of the hair shows that all its dermic portion is surrounded by cryptogams, forming a vegetable layer between the sheath and the hair itself, in such a manner that the hair is contained in a sheath exclusively formed of cryptogams like a finger in a glove. . . . They take origin in the hair follicle and in the cells of which its sheath is composed, and they pass upwards to envelop the portion of the hair situated in the skin." This fungus is the *trichophyton megalosporon ectothrix* of Sabouraud.

In 1843, Gruby presented to the Académie des Sciences another paper entitled, "Researches on the Nature, Seat, and Development of Porrigo Decalvans or Phyto-alopecia."*

After describing "porrigo decalvans" as "an affection characterised by rounded patches covered with white scurf and small greyish scales, with falling out of the hair," he goes on to say: "Microscopic examination shows that the hairs are surrounded by a vegetable covering to a distance of 1 to 3 millimetres above the level of their exit from the skin. This sheath is formed by cryptogams felted together so as to make a sheath around each hair. The spores are generally rounded, sometimes oval, and measure from $\frac{1}{1000}$ to $\frac{5}{1000}$ of a millimetre in diameter." To this species of fungus, Gruby gave the name of *microsporon Audouini*, in honour of Audouin, whose researches on muscardine (a disease of silkworms, caused by a cryptogamic fungus, *Botrytis Bassiana*) had been the means of directing attention to the parasitic plants which destroy the living tissues of animals. The microsporon Audouini alters the structure of the hair to which it attaches itself, making it friable, so that it breaks on being bent. Nothing but this fungus is found on the affected surface of the scalp, there being no vesicles or pustules, nor any sign of inflammation, thickening of the epidermis, or other pathological change. Gruby suggested that the disease should be placed in the "new" class of

* "Comptes Rendus de l'Académie des Sciences," Paris, t. xviii.

vegetable parasitic diseases, beside favus, phytomentagra (sycosis), and thrush. He proposed to call it phyto-alopecia. The fungus, in his opinion, had a close analogy to the cryptogam found in the disease already referred to, which he described under the name of phytomentagra, in which the fungus is found between the hair and the sheath. The chief distinction is the seat of the fungus, which in mentagra is placed in the hair follicle and around the root (ectothrix), while in "phyto-alopecia" it is placed around the aërial portions of the hair (microsporon Audouini). He further notes that the spores in the latter fungus are smaller than those of the other. He therefore concluded that "porrigo decalvans" was a contagious disease of vegetable origin, and that the proper manner of dealing with it was to destroy the vegetable parasite which had hitherto resisted all empirical modes of treatment.

Gruby's description shows plainly that the disease he was dealing with was a form of ringworm. The term "porrigo decalvans," which he applied to it, was used by Bateman to designate the condition which we now know as alopecia areata, and in this sense it was understood by dermatologists. How Gruby came to make such a mistake is not clear; his view, probably, was that the alopecia areata is the last stage of this particular variety of ringworm. The result of his wrong use of the term "porrigo decalvans" was to send other investigators off on a false scent. They hunted for the parasite which he described, in cases of alopecia areata, and, of course, did not find it on the patches smooth and polished like a billiard ball, ringed about by perfectly healthy hairs, characteristic of that disease. Hence the *microsporon Audouini* was declared to be a myth, and Gruby's work was relegated to the limbo of exploded errors.

In a later paper* Gruby described a third fungus which he had found in cases of tinea tonsurans (herpes tonsurans of Cazenave). In hairs from affected patches microscopic examination showed that their structure was full of cryptogams, which take

* "Comptes Rendus de l'Académie des Sciences," t. xviii., 1844.

origin in the interior of the root of the hair in the form of a group of round spores. From these spores proceed articulated filaments; as they grow, these filaments creep upwards in the interior of the hair in a direction parallel to their longitudinal axis. As the hair grows, the cryptogams inside it also grow, till it emerges from the follicle, the quantity of spores increasing to such an extent as entirely to fill the interior of the hair, the structure of which becomes hardly recognisable. The hairs usually break at a height of two to three millimetres above the level of the skin.

Gruby adds: "The cryptogams which constitute tinea tonsurans differ from those which constitute phyto-alopecia [small-spored ringworm] to such an extent that it is impossible to confound those two diseases. Their very situation, their development, and the relation which they bear to the structure of the hair also differ."

The points of difference indicated by him may be summed up as follows: The cryptogams of tinea tonsurans are arranged in chains like rows of beads; they are relatively large; they fill the interior of the hair; and they take origin from its root. The fungi of "phyto-alopecia," on the other hand, are extremely small; they are attached to the outer surface of the hair, and form a true sheath around it; they develop on the outer surface of the hair outside the follicle.

Nothing could be more explicit; and to Gruby therefore belongs the credit of having established the plurality of the fungi concerned in the production of the polymorphic affection which we call ringworm. The fact that a misconception as to the meaning of a term should have prevented the recognition of so important a discovery for half a century has in it a moral of universal applicability in medical research, and assuredly not least in the study of diseases of the skin — the necessity of looking at things and taking heed not to be misled by names Had the numerous investigators who failed to confirm Gruby's observations looked at what he described and not at what he misnamed, they would doubtless have seen what he saw.

One of Gruby's fungi, however—the one which he described as being associated with the form of ringworm designated *teigne tondante* by Mahon and *tinea tonsurans* by Cazenave—was discovered independently by Malmsten of Stockholm in 1844.* The Swedish investigator called his parasite *trichophyton tonsurans*. A similar fungus was described by Hebra in 1845. For many years after that, however, there was much confusion, not only as to the nature of the fungus, but as to the part played by it in the etiology of ringworm. In 1850 we find Cazenave warning dermatologists against "the illusions of micrography," expressing scepticism as to the existence of any such fungi except the achorion Schönleinii, and, even in the case of that parasite, denying the presence of any "pathogenic properties in the mysterious atoms."† Owing in great measure to the influence of Bazin's teaching, the parasitic origin of ringworm gradually became the orthodox doctrine of dermatology. Cazenave in France and Erasmus Wilson in Great Britain continued to hold heretical opinions on the subject, and died, scientifically speaking, impenitent.

But though the trichophyton tonsurans was accepted by clinicians as the exciting cause of the affection, the scientific investigators were far from being agreed as to the nature of that fungus. Some held that it was one of the common moulds. Hebra and Neumann maintained that it was identical with the *penicillium glaucum*; others that it was a spore formation of *aspergillus*; others, again, that it was *mucor mucedo*. Grawitz considered that the parasites causing ringworm, favus, tinea versicolor, and thrush were identical, or, at any rate, modifications of one common species.

The credit of demonstrating that the trichophyton is a fungus by itself, "totally distinct from the common fungi whose spores infest all the objects by which we are surrounded," belongs to

* Müller's Archiv, 1848.

† *Traité des Maladies du Cuir Chevelu*, quoted in *Dict. Encyclop. des Sciences Méd.*, sub voce *Teignes*, t. 95, p. 220.

Thin.* He cultivated it successfully in various media, and particularly on meat gelatine, by the method introduced by Koch Duclaux† succeeded in cultivating the trichophyton in fluid vegetable media, with the result that aërial fructification took place.

For some time it was believed that all forms of ringworm were the work of one and the same fungus. In 1891 it was suggested by Furthmann and Neebe‡ that more than one parasite was concerned in the production of the disease. The real originator of the doctrine of the plurality of ringworm fungi is, however, M. Sabouraud, whose investigations have thrown an altogether new light on the etiology of the affection. An account of his earlier researches appeared in 1892,§ but they were afterwards greatly extended, the results being embodied in an important monograph published in 1894,‖ and repeated, with some slight modifications, in a communication presented to the International Congress on Dermatology, held in London in August, 1896. As only brief summaries of M. Sabouraud's work have so far appeared in the ordinary sources of information accessible to the bulk of the profession in the United Kingdom, I have thought it well to set forth the main points in his teaching in some detail in the following chapter.

* *Proceedings of the Royal Society*, No. 217, 1881, and *Pathology and Treatment of Ringworm*, London, 1887. Certain experiments made by myself in conjunction with Dr. Henderson a year or two subsequently to the publication of Thin's paper (see *Journ. Royal Microscop. Soc.*, April 11, 1883) led me to conclude that the fungus producing ringworm was the penicillium. Subsequent researches have, as will appear later, led me to abandon this opinion.

† Soc. de Biologie, January 16, 1886.

‡ Monatsh. f. prakt. Derm., 1891, No. 11.

§ Ann. de Dermatologie, November, 1892.

‖ *Les Trichophyties Humaines*, Paris, 1894.

CHAPTER III.

ETIOLOGY (*continued*).

SABOURAUD'S DOCTRINE.

In the present chapter the results of M. Sabouraud's researches are described as far as possible in his own words. The author has simply endeavoured to give a faithful exposition of the French investigator's teaching, reserving the expression of his own views for a later chapter.

NAKED-EYE INSPECTION.

Careful naked-eye examination of a large number of cases of ringworm in which the appearances have not been modified by treatment, enables the observer to divide them into three classes:

1. Those in which the hairs to a height of two to three millimetres beyond the orifice of the follicle are clothed with a scaly sheath which looks like a prolongation of the epidermic lining of the follicle; the affected patch is strewn with greyish and ash-coloured scales (parasitic pityriasis alba).

2. Those in which the hairs are broken off short and present no trace of a sheath, and in which the affected patch is clean and free from scales.

3. Those in which not only the hair but the epidermis is affected. The hair has a sheath, but this does not extend beyond the deeper portion and thus is seen only on the epilated hairs; the epidermis is the seat of various lesions of an inflammatory and suppurative character (impetigo, folliculitis, kerion).

MICROSCOPIC EXAMINATION.

Microscopic examination reveals further differences in these three classes. In the first of them the scaly sheath with which part of the aërial portion of the hair is seen to be covered, is

formed of very small spores irregularly scattered about like the stones in a mosaic; the fungus lies *around* the hair, the tissue of which appears to be normal, only the surface being eroded. In the second the fungus is seen to lie altogether *within* the hair; the spores are considerably larger than those in the first class, and they are arranged in regular chains. In the third class, a sheath surrounding the deeper portion of the hair is seen to consist of spores, also relatively large, and arranged in regular chains; but the fungus lies *outside* the hair between the dermic portion of the shaft and the wall of the follicle. To the small-spored fungus M. Sabouraud first gave the name of *Trichophyton microsporon;* the two others being called *Trichophyton megalosporon, endothrix* or *ectothrix*, according as the fungus lies inside or outside the hair. Subsequently, however, he was led to separate the small-spored parasite from the Trichophytons and place it by itself; he looks upon it as a fungus as distinct from the Trichophytons as these are from the fungus of favus.

We have thus, according to him, three great varieties of ringworm, two of which are of trichophytic origin, while the third is caused by a parasite of a different species, the *microsporon Audouini.* The last-named fungus is the cause of from 60 to 65 per cent. of all cases of ringworm of the scalp met with in France, the *Trichophyton megalosporon endothrix* being accountable for the rest, except those in which suppurative processes (notably kerion) are present.

CULTIVATION.

These conclusions are confirmed by the results of cultivation on various media, which prove that the disease formerly known as human trichophytosis is separable into two distinct pathological entities—one caused by a small-spored fungus, the *microsporon Audouini*, the other by a large-spored parasite, the trichophyton; and further, that true trichophytosis is a process which may be caused by several parasitic species or varieties, each of which on suitable culture media has special and distinctive characters.

Cultures of the small-spored fungus are always identical, but this by no means holds good as regards the large-spored parasites. Cultures from the same case, or from cases originating from the same source, as in "family contagion," however numerous, are identical; but in a series of cases of trichophytic ringworm of various origin, the differences are so great as to suggest a difference in the species of the fungus causing the disease. Indeed, according to M. Sabouraud, it is rare in any two cases to find the same species of trichophyton. The plurality of species may, it is suggested, explain the remarkable diversity of lesions, the only feature they have in common being their circinate outline. "Trichophytoses resemble each other because their causal parasites are analogous, but they differ because these are not identical."

In each case of ringworm one species of fungus is responsible for all the lesions wherever situated. Further, in all cases occurring in the same family the disease is the result of the presence of one and the same parasite.

CLINICAL APPLICATION.

The clinical application of M. Sabouraud's doctrine may be summed up in the following propositions: (1) The small-spored fungus (*microsporon Audouini*) is the cause of the forms of ringworm which are refractory to treatment and last an indefinite time; (2) the forms of ringworm caused by the *Trichophyton megalosporon endothrix* do not, as a rule, exceed one year in duration; (3) those due to the *Trichophyton megalosporon ectothrix* are benign, and can be cured in two or three months. M. Sabouraud therefore holds that the affection caused by the *microsporon Audouini* is not a trichophytosis at all, but a distinct disease to which children alone are subject, and which in them attacks only the scalp, and is extremely obstinate. He suggests that this form of ringworm should be called "Gruby's disease."

Trichophytic ringworm also attacks children, but it does not spare adolescents, nor even adults; in the latter, however, it is

confined to the skin and nails, whereas in children the scalp is invaded as well as other parts of the integument. Both varieties of trichophytosis (endothrix and ectothrix) may be seen anywhere on the body except on the chin, which is strictly preserved for ectothrix.

ORIGIN OF THE TRICHOPHYTONS.

As regards the origin of the fungus, M. Sabouraud has satisfied himself that certain species of trichophytons of the "ectothrix" type are transmitted to human beings from animals—horse, cat, dog, etc.—on which the parasite finds a soil suitable for its growth. Although all the trichophytons which he has so far found on animals are of the "ectothrix" variety, he points out that it does not follow that all the ringworms caused by that type of parasite are of animal origin. Nor because the Trichophyton endothrix has not been found in animals, is it safe to conclude that all of that species are exclusively human. Among the "ectothrix" trichophytons there is a special variety originating from the horse, which yields characteristic white cultures. Its most marked property clinically is that it is pyogenic. In man it attacks the scalp, the beard, and the hairless skin, causing in each of these situations characteristic inflammatory and suppurative lesions: in children, kerion; in the beard, trichophytic sycosis; and in hairless parts, the agminated perifolliculitis, hitherto looked upon as a distinct affection.

EXCEPTIONS TO THE SPECIFICITY OF THE TRICHOPHYTONS.

M. Sabouraud admits certain exceptions to the law which he claims to have established—viz. that, on the one hand, the polymorphism of cutaneous trichophytoses is due to the multiplicity of trichophytons, and, on the other, the identity of the multiple lesions in the same patient is due to the identity of the parasite which causes them. Thus the same patient may present a typical sycosis of the beard and trichophytic rings, not of the nature of

folliculitis, on the skin — that is to say, the same fungus may cause in the same case suppurative and non-suppurative lesions. Again, the species of trichophyton which comes from the horse, and which is normally pyogenic, causing kerion, etc., may be found in the lesions of simple tinea circinata. Lastly, there is sometimes found in a form of trichophytosis of the beard very closely allied to sycosis a species of trichophyton which does not cause suppuration, showing that a species not normally pyogenic may become so. Facts such as these are extremely rare, but they are in contradiction to "the law of the specificity of the trichophytons."

M. Sabouraud seeks to explain them by the variable virulence of the fungus, and, in the case of the beard, by the depth of the anatomical elements of epidermic nature (infundibulum of the hair). He does not think that either the special reaction of certain integuments or secondary (cryptogamic or bacterial) infections have any effect in determining the objective form of trichophytic lesions.

GEOGRAPHICAL DISTRIBUTION OF TRICHOPHYTONS.

As regards geographical distribution, M. Sabouraud thinks it probable that large-spored trichophytons belonging to the same botanical family are scattered all over the world in all latitudes, but that at points very distant from each other the species of this family are not everywhere the same. He looks upon the parasite of *tinea imbricata* (Manson) as a large-spored trichophyton, differing little from the species found in animals in Europe. In a form of ringworm contracted by a Frenchman in the Soudan, he discovered a special trichophyton entirely distinct from all the species known to him.

M. Sabouraud throws out the hypothesis that the trichophytons may not be merely parasites of man and animals, but may have a separate existence in nature as saprophytes. If this be true, contagion might be derived from any substance on which the fungus could grow. He was able to cultivate the "ectothrix"

of the horse on mould, decaying wood, grain, etc., and he holds that, if his experiments do not prove that the fungus does exist in nature otherwise than as a parasite, at any rate, they show it to be possible that it may do so.

BOTANICAL CLASSIFICATION OF TRICHOPHYTONS.

As regards the botanical classification of the trichophyton, M. Sabouraud points out that in the parasitic state it exists only in its mycelial form, without producing external spores, and that the spores in regular chains which it presents are false, or mycelial, spores; hence it is impossible to classify it mycologically according to the forms which it exhibits in lesions, and for that purpose it is necessary to bring about its fuller development by culture on artificial media. Biologists have not yet succeeded in definitely classifying the trichophyton. Following Duclaux, M. Sabouraud is inclined to place it among the mucedinous mould fungi, near Botrytis, but with certain points of difference.

CLINICAL CHARACTERS OF TRICHOPHYTIC RINGWORM.

Of cases of *trichophytic* ringworm, 72 per cent. are, according to M. Sabouraud, caused by two species of large-spored parasite. Of these, 30 per cent. are caused by a trichophyton endothrix with fragile mycelium, and give an acuminated culture on the medium; 42 per cent. by a trichophyton endothrix with resistant mycelium, giving on the same medium a crateriform culture. Clinically, there are certain characters common to all varieties of the large-spored parasite. These are: (1) A quickly evanescent raising of the epidermis in the form of a small ring with slightly reddened scaly border which precedes the invasion of the hair. (2) When the hair is fully attacked, the scalp in the affected patch is usually clean. (3) The hair itself is invariably short (two to three millimetres above the follicular orifice), swollen to twice the size of healthy hair, and bare—*i.e.* without investing sheath. It must be borne in mind that this description holds good only for cases in which no treatment whatever has been applied.

(4) Another character, though not constant, is pathognomonic when it is present, as it mostly is. This consists of secondary inoculations on the hairless skin (especially on the neck, the lobe of the ear, the outer angle of the eye, the cheek, etc.). This "accessory trichophytosis" (*trichophytie accessoire des teigneux*, as Besnier calls it) consists of tiny lenticular maculæ, very slightly raised and dotted with minute red points on the surface.

The process caused by these two trichophytons respectively may be summarised as follows: (A) *Large-spored parasite with fragile mycelium, giving acuminated cultures.* Ringworm which speedily disappears and is followed in twelve to fifteen days by sudden loss of hair on the patch; this stage generally escapes notice. The hairs are broken off sharp, the bare patch being irregular in outline, the skin within the denuded area being smooth and healthy, but thickly dotted with black points like comedones; these are the stumps of the diseased hairs. Recovery takes place from the border towards the centre; the black points disappear owing to the stump being thrown off; a new crop of hair appears, and the cure is complete in three to six months. In children this form (*tondante péladoïde bénigne*) affects the scalp, and both in children and in adults it may attack the hairless skin alone (tinea circinata). Epilation in this form of ringworm is difficult; the roots are twisted at the follicular orifice, like the hairs in the epidermic cones of keratosis pilaris. The spores have a moniliform arrangement, and those in the same chain have no cohesion, the mycelial filaments being very fragile. (B) *Large-spored parasite with resistant mycelium giving crateriform cultures.* This form is more frequent on the scalp, and less so on the skin than that just described. Its chief naked-eye characteristic is the sparseness of the hair stumps; this is due to the fact that many are broken off within the follicle. The patch is generally more or less circular, and measures from one to one and a half inch in diameter; there are often several secondary patches. The hairs are bent, as in green-stick fracture, each in a different direction. The epidermis looks perfectly healthy. In

addition to the two types which have been described, a limited number of other species are found from time to time; M. Sabouraud is inclined to think that they may be of animal origin, thus constituting exceptions to the rule that trichophyton endothrix is exclusively human. At present they are little more than pathological curiosities.

Trichophytoses of animal origin are rare, and their clinical features are so various that a typical description is impossible. The fact that a case of ringworm presents abnormal features is suggestive of an animal origin. Every ringworm in which folliculitis, however slight, or suppurative or inflammatory lesions of any kind, spontaneously occur, M. Sabouraud believes to be the result of animal contagion. If the large-spored parasite forms a sheath around the root of the hair and its follicular epidermic covering, it is certainly of animal origin. The most common of these trichophytons is one which comes from the horse; it gives white cultures and produces kerion. All the trichophytoses caused by the "ectothrix" parasite are remarkably benign, and the disease does not last more than three months.

RINGWORM OF THE BEARD.

Trichophytoses of the beard are divided by M. Sabouraud into two classes, according as the process affects the epidermis alone or the hair. The former are quite superficial and are so easily cured that they are of no practical importance. They are really cases of tinea circinata, accidentally affecting a hairy part. The same thing is sometimes seen on the eyebrow. Trichophytosis of the beard—*i.e.* when the hair is attacked, is divided clinically into three classes: (1) In which there is deep circinate dermatitis—sycosis; (2) in which the dermatitis is slight, moist, and disseminated; and (3) a dry form in which there are pointed projections of the follicle, resembling ichthyosis pilaris. The first of these is caused by the pyogenic trichophyton of the horse, giving a white culture, the second by a special trichophyton giving a yellow vermicular culture—this, also, M. Sabouraud has

seen on the horse; the third by a trichophyton giving a pink culture—this he believes to originate from birds. In eighteen cases of trichophytosis of the beard, the first of these parasites was found in eleven, the second in four, the third in three. Microscopic examination shows that the fungus is always outside the hair (ectothrix). He concludes that trichophytosis of the beard originates directly and exclusively in inoculation, mediate or immediate, of animal trichophytons.

TINEA CIRCINATA.

The species causing trichophytosis of the skin are more numerous, hardly any two cases showing the same. M. Sabouraud classifies them as follows: (1) Secondary from trichophytic ringworm of the head (*tricophytie accessoire des teigneux*); here the parasite is of the same species as that responsible for the primary affection, namely, trichophyton endothrix of human origin. (2) Suppurative forms caused by pyogenic trichophytons giving white cultures of animal origin, especially from the horse, and constituting about one-third of all varieties of tinea circinata. (3) Dry serpiginous forms, very rare, usually affecting the neck in adults, characterised by reddish, excoriated papules arranged in festoons, extending over a large surface and often lasting years; they respect the hairs, though they may attack the epidermis of hairy regions; they are of animal origin and, microscopically, show a vast number of broad, mycelial branches with rectangular spores, arranged with perfect regularity. Besides these, there are atypical forms; indeed, according to M. Sabouraud, the number of species of large-spored animal trichophytons with which man may accidentally inoculate himself is "unlimited."

TRICHOPHYTIC RINGWORM.

He sums up his conclusions in the following propositions: (1) Besides the "endothrix" trichophytons of the child which cause in it *tinea tonsurans*, and both in it and in the adult, a small number of the forms of *tinea circinata* which are met

with, there exist very numerous cryptogamic parasites of the same order and of the same botanical family, which cause the greater part of the cutaneous trichophytoses seen in the human subject. These are ectothrix trichophytons of animal origin. (2) A large number of these species belong to the group of pyogenic white-culture trichophytons. A few others go to form the first elements of groups not so well defined. Outside these groups, again, there are species which are so rarely found on man that they cannot at present be assigned to any group.

NON-TRICHOPHYTIC RINGWORM.

This disease is caused by a small-spored parasite which is not a trichophyton. Here, again, the lesions should be examined before their appearance has been altered by treatment. The hair, which is unbroken, has a greyish sheath extending some three millimetres beyond the orifice of the follicle; after a time it breaks about six or seven millimetres from the follicle, and the sheath crumbles into ash-coloured scales, which cover the surface. The hairs are discoloured, greyish, and all lie in the same direction; they are so loose that a score or so can be pulled out at once with the fingers. The epidermis appears to be attacked after the hair; the characteristic lesion is the deposit of scales, but occasionally there are two concentric red rings enclosing a small bistre-coloured area, the whole looking something like a cockade. The disease is peculiar to the scalp of children (being rarely met with after the age of eight); it never gives rise to tinea circinata, sycosis, or ringworm of the nails in the adult. After a time the lesions change in character; the scalp becomes more or less atrophied; fine lanugo hairs cover the surface, but fresh patches may form, and even where there are no distinct patches the fungus is still to be found on some hairs. This is the most frequent form of ringworm (of 200 cases taken at random, 120 will be of this kind); it is also the most contagious. It always ends in complete recovery, though it may last for years. To the naked eye the distinguishing features of this form, as compared with

trichophytic ringworm, are: the hairs are not broken off short, are close together, are not swollen, and have a greyish sheath enveloping the part nearest its point of emergence. Under the microscope the hair looks as though covered with glue and powdered over with fine sand. The small spores, which are in great abundance but not in contact, form a continuous sheath round the hair, but do not penetrate into its substance; only its cuticle and its edges are eroded. By crushing a hair freed from its sheath of spores, very fine mycelial threads will be seen. Whereas the trichophyton endothrix grows in the direction of the hair, the small-spored parasite grows from the aërial portion of the hair downwards towards its root. From the trichophyton ectothrix, the microsporon Audouini can be distinguished by the size of the spores, but chiefly by their not being arranged in regular chains.

GENERAL CONCLUSIONS.

M. Sabouraud sums up his doctrine as follows: (1) Under the common name of *tinea tonsurans trichophytina* have hitherto been confounded two diseases, absolutely and completely distinct, and of almost equal frequency, which have nothing in common but the fact that each of them attacks the hair. (2) One of these is really caused by the same cryptogamic parasites that cause trichophytoses of other parts. It deserves, therefore, to preserve its name of trichophytic tinea. (3) The other, which he proposes to call by the name of Gruby, is caused by the microsporon Audouini, and this parasite is not a trichophyton.

At the meeting of the International Congress of Dermatology, held in London in 1896, Sabouraud exhibited a series of 300 cultures, the fruit of five years' work. The paper which he read on that occasion may be taken as representing his mature opinions on the relation of trichophytic and other fungi to ringworm. The foregoing summary of his views may therefore be usefully supplemented by a few points from this paper.

He defined a trichophyton "provisionally" as a fungus (1) giving rise on the human skin to a circinate lesion; (2) existing

in the lesion only under two cryptogamic forms—(*a*) mycelial filament, (*b*) mycelial spore (endospore); (3) never attaining in the lesion which it produces to any form of external sporulation; while (4) in artificial culture it always gives rise to grape-like formation of external spores; (5) easily cultivated at low temperatures (15°–20° C.); (6) in artificial cultures assimilating hydrocarbons, and especially sugars, in large quantity. Proper conditions of culture being observed, trichophytic hairs, scales, fragments of nails or pus from the same individual, or from several individuals who have derived the disease from the same source, will constantly yield like cultures. On the other hand, cultures from a series of cases not having a common origin will show a considerable number of species of trichophytes botanically different. If the investigation is continued over a period of three years or longer, new species will be found indefinitely. All these species, however, belong to the same cryptogamic family, *sporotrichum botrytis*, which is characterised by the grape-like fructification of external spores. However often they are sown, the trichophytes will, provided the technique be uniform and accurate, preserve their distinctive characters. He concludes: (1) that there are several parasitic fungi which can produce in man the group of symptoms connoted by the term "trichophytosis"; (2) that the number of these fungi is considerable; (3) that they belong to the class of *mucedines* known by the name of *sporotrichum* of Link and Saccardo.

The "pure endothrix" trichophyte (of which there are several species) is peculiar to children, and is accountable for the great majority of school ringworms in Paris. The "pure ectothrix" trichophyte (of which there are also several species), on the other hand, is rare, and is found on the ass, the calf, and the horse, as well as on man. There is also a large class of trichophytes which not only form an outer parasitic bark around the hair-root, as the "ectothrix" fungus does, but which penetrate to a greater or less depth through the cortical layer of the hair; to these the term "endo-ectothrix" may be applied. Of this "endo-

ectothrix" variety there are numerous species, many of which are certainly of animal origin. Sabouraud asserts that all trichophytes which have been proved by direct culture to be derived from animals assume in the human hair the "endo-ectothrix" or "pure ectothrix" appearance. Therefore, whenever a parasite of either of these types is found in an adult, the possibility of its animal origin should be borne in mind.

In general terms Sabouraud states that in France one-tenth of the trichophytic ringworms of the child, nine-tenths of the trichophytoses of the skin, all trichophytoses of the beard, and all onychomycoses are caused by "endo-ectothrix" or "pure ectothrix" trichophytes, all of which are probably of animal origin, and a large number of which have been proved to be so. A classification of trichophytic species will be possible only when in each country the majority of the local trichophytes is accurately known. The pathogenic effect of different trichophytes varies, some being pyogenic, others not. Further, the virulence of the same parasite may vary under different conditions, and the virulence of certain species may vary in different countries.

In addition to the various forms of ringworm caused by trichophytes of one species or another, there is a form caused by a non-trichophytic fungus, the microsporon Audouini (see p. 20). This affection, according to Sabouraud, is the only human mycosis in which the parasite passes through its complete cycle in the parasitic state.

Lastly, Sabouraud states that cases are met with in France presenting circinate lesions similar to those of trichophytic origin, but caused by fungi which on culture are found to resemble in their mycological characters the favus parasite. In man these fungi give rise either to rings exactly similar to those of trichophytosis, or to a typical kerion. They never produce the scutula characteristic of favus. Inoculated in animals they cause a peculiar abscess from which the fungus can be extracted in a pure state. In all cases of this kind hitherto noted, the direct animal origin of the parasite has been established. Are these

cryptogamic species trichophytes yielding faviform cultures? Or are they favus fungi causing trichophytoid lesions? From a consideration of all the facts, Sabouraud concludes that they are true species of favus, giving rise in man to lesions clinically trichophytic in character, of which culture alone can show the true nature.

CHAPTER IV.

ETIOLOGY (*continued*).

Researches of other Workers: Bodin, Fox and Blaxall, Leslie Roberts, Mibelli, Rosenbach, Krösing, Ullmann, Waelsch, Palagatti, Ducrey and Reale, Unna.

THE publication of Sabouraud's investigations has had the result of stimulating a number of other workers to pursue the same line of research. A brief review of the work that has been done in this field during the last two or three years will serve to show just how far our knowledge of the etiology of ringworm extends.

E. Bodin* has carried out a series of investigations on the ringworm parasites that infest the horse, and their power of producing similar affections in man. He found on the horse a microsporon very closely allied to the small-spored fungus which causes the obstinate ringworm of children. This parasite causes the disease known as "contagious herpes" in foals, and it is inoculable in man, giving rise to erythematous rings on the skin resembling the cockade-like lesion described by Sabouraud. Bodin records a case of accidental inoculation. Experimental inoculations, however, only give rise to a scaly slightly red patch, from which the parasite disappears in a few days.

Bodin thinks it possible that the microsporon of the horse may also cause ringworm of the scalp in human beings, but admits that he has no evidence in support of this hypothesis. At the London Congress, Sabouraud stated that the microsporon frequently causes "contagious herpes" in foals, and that the structure of the parasite found on the foal is identical with that met with on the child. He asserted positively that the

* "Les Teignes Tondantes du Cheval et leurs Inoculations Humaines," Thèse de Paris, 1896.

parasite can be transmitted from the animal to the human subject.

As regards the trichophytes, Bodin agrees with Sabouraud that the characteristic of those of animal origin is that they are situated outside the hair (ectothrix); on the other hand, in human trichophytoses, the parasite is exclusively endothrix and never invades the follicle. He points out, however, that the word "ectothrix" is not to be taken in its strict etymological meaning; it denotes merely that the parasite is situated in the follicle outside the hair, but it does not mean that parasitic elements do not at the same time infiltrate into the interior of its substance. In the cases of equine trichophytosis which he has examined, the diseased hairs contained at their edges mycelial chains in greater or less abundance, so that the parasite was "endo-ectothrix." Trichophytes of equine origin have, therefore, a habitat at once intrapilar and circumpilar. This modification of the view originally held by Sabouraud has now, as has been seen, been accepted by that investigator. The special character of all trichophytes of animal origin is to be "endo-ectothrix" in situation, and to have irregular spores. The clinical characteristic of human trichophytoses of equine origin is that they cause a deep lesion in the form of suppurating folliculitis, rapid in evolution, and tending to cause scars. Bodin classifies the trichophytons of the horse in two groups: (1) Ordinary, in which reproduction takes place by conidian fructification like bunches of grapes (*Botrytis*). (2) Faviform, in which the reproductive elements resemble those of favus. Of the latter he describes two varieties which he has found in the horse—one giving brown, prominent, and irregular cultures, the other giving grey cultures. Each of these is inoculable on man, and Bodin gives particulars of several cases in which the contagion was actually conveyed. Both parasites caused in man lesions of kerion character, the brown culture producing on the scalp and skin dome-like swellings covered with points of suppurative folliculitis; the grey, circinate vesiculo-pustular lesions on the skin.

Bodin's researches have led him to the conclusion that there are fungi which produce in man and in animals a disease indistinguishable from trichophytosis, but which, mycologically, are more allied to the parasite of favus than to trichophyton. On the other hand, favus fungi which produce the characteristic scutula also produce circinate lesions (*favus herpeticus*). While, therefore, he does not deny the individuality of the two groups —trichophytosis and favus—he thinks it impossible at present to draw a hard and fast line of demarcation between the two. As has been seen, Sabouraud also now holds that parasites presenting all the mycological characters of favus can produce lesions similar to those caused by trichophytes.

Sabouraud's doctrine has been accepted in Great Britain by Jamieson,* Adamson,† and, with certain differences on minor points, by Colcott Fox and Blaxall.‡

At the London Congress, Fox and Blaxall stated that the results of a clinical, microscopic and cultural examination made by them of more than 400 consecutive cases of ringworm of the scalp and beard, and of herpes circinatus of the skin, agreed generally with those of the French investigator. In London, the microsporon Audouini, in their experience, caused from 80 to 90 per cent. of all ringworms; the trichophyton endothrix scarcely 4 per cent.; while the "ectothrix" or "endo-ectothrix" was responsible for the rest. Trichophytosis of the beard seemed to belong to the "ectothrix" group. The great majority of ringworms of the skin (herpes circinatus) associated with tinea tonsurans depend, according to them, on trichophytes. The points on which they differ from Sabouraud are the following:

(1) Lesions of the skin accompany invasion of the scalp by the microsporon more often than is stated by Sabouraud.

(2) His description of the mycelia of microsporon Audouini in the hairs is incomplete in several respects.

(3) He is too positive in his statements as to the point where

* *Brit. Med. Journ.*, Aug. 20, 1893 ,p. 470. † *Brit. Journ. Derm.*, July and Aug., 1895.
‡ *Brit. Journ. Derm.*, July, 1896.

the hair is attacked by the parasite; nor do they believe that the hair is attacked before the epidermis.

(4) As regards trichophyton ectothrix, they find that the hairs themselves are the most frequently invaded.

(5) To obtain cultures comparable to those of Sabouraud, they found it necessary to use the same maltose as he employed.

(6) Contrary to what is stated by Sabouraud, it seemed to them that the trichophyton cultures had a duration of life longer than three weeks, and sometimes it was prolonged for a year.

(7) They differ from Sabouraud as regards the mycology of the fungi. They only found the pectinated spore-bearing hyphæ of the microsporon Audouini in submerged fructifications. Its aërial fructifications show spores similar to those of endothrix and ectothrix.

(8) Lastly, in the microsporon Audouini they found chlamydospores, as in ectothrix, but not in endothrix.

As regards the microscopical characters of the cultures, Fox and Blaxall cannot subscribe to Sabouraud's classification of the endothrix and ectothrix fungi as members of the botrytis family or sporotricha, because of their tendency to form irregular masses of spores ("grape formation"), and of the microspora as an independent family. They consider that the microspora and the trichophyta all belong to the same family, and that their fructification is developed on a similar plan.

On the other hand, Sabouraud's views have been severely criticised by Leslie Roberts,* who approaches the subject from a different side. He insists that the morphology of the fungi is a matter of altogether secondary importance compared with their physiology. He rejects the anatomical, and still more the cultural, test. The real criterion of a trichophytic fungus, in his opinion, is the degree to which it is capable of digesting horny or keratine tissues. Experiments made by him showed that the digestive or keratolytic action of a given specimen of trichophyton was unequal

* *Brit. Med. Journ.*, Sept. 29th, 1894, and *Journ. of Pathology and Bacteriology*, August, 1895.

in respect to different hairs; more pigmented hairs resisted longer than those containing less pigment. Similar results were obtained with certain species of aspergillus. Leslie Roberts thinks it probable that the keratolytic ferment is not an enzyme, but an organised ferment, or zyme. The process of solution is a physiological rather than a chemical one. He is inclined to recognise two varieties of keratolytic action—namely, the kind which destroys cuticle and cortex simultaneously, and that which digests the cortex, leaving the cuticle of the hair, or dissolving it at a later period. Out of forty consecutive cases of scalp ringworm seen in his private and hospital practice, in twenty-two both cuticle and cortex were destroyed, and in eighteen the cortex only. As a rule, however, the proportion of the cuticle- and cortex-destroying fungi to the others is, roughly, as two to one. His cuticle- and cortex-destroying variety appears to correspond to Sabouraud's microsporon Audouini, and his cortex-destroying fungus to Sabouraud's true trichophyton. Leslie Roberts does not, however, accept Sabouraud's view that tinea tonsurans is a definite disease of two types, produced by distinct classes of fungi. The essential bond between all trichophytic fungi is, he holds, their keratolytic action. He objects to what he considers an arbitrary separation of the cuticle- and cortex-destroying fungus from the other members of the same group. He also holds that the division of the large-spored fungi into "endothrix" and "ectothrix" varieties is unwarranted; he himself has reported observations which show that the "endothrix" fungus may, in different circumstances, become an "ectothrix" vegetation.

Leslie Roberts sums up his conclusions as follows: That there exists in the lowest orders of plants, destitute of chlorophyll, an extensive and natural group of fungi whose distinguishing feature is their ability to *digest* horny tissues, probably by means of a ferment; that this keratolytic group includes favus (achorion), the various kinds of trichophytons, and some aspergilli, and probably many others not yet identified; that

there are at least two natural distinctions observable in the purely trichophytic fungi—namely, a kind that digests both the cuticle and the cortical substance of the hair, and a variety that digests the cortical substance first, leaving the cuticle unaffected, or attacking it at a later period.

Mibelli,* of Parma, in a series of twenty-eight cases of ringworm (scalp, 18; beard, 7; tinea circinata, 2; nails, 1) failed to find the small-spored fungus in a single one, nor had he met with it in a large number of cases seen at Sienna and Cagliari. He concludes that the parasite does not exist in certain parts of Italy. Specimens obtained from Sabouraud convinced him of its existence and confirmed him in his belief that he had never seen it before. His own cases gave two distinct kinds of cultures: a violet-red in twenty cases, and a yellowish-white in the remainder. Hence Mibelli admits the plurality of trichophytons. He found that his violet-red fungus could produce the most diverse clinical forms; this is in contradiction to Sabouraud's doctrine that there is an absolute correspondence between each trichophyton and a particular group of clinical phenomena. His observations further seemed to him to afford reason to doubt whether Sabouraud's two types, "endothrix" and "ectothrix," really always indicate the former to be of human, the latter of animal, origin.

J. F. Rosenbach, of Göttingen,† has made a series of researches on the diseases caused by trichophytons, particularly those forms in which the process spreads under the skin. In a series of thirteen cases of ringworm (six of the suppurative nodular form, seven of superficial circinate form) he found no fewer than seven varieties of trichophytes which he considered sufficiently distinct to deserve special names. He named them as follows:—

Trichophyton holosericum album.
„ fuscum tardum.

* "Ann. de Dermatologie et de Syphiligraphie," 3 série, t. vi., p. 733.

† "Ueber die tieferen eiternden Schimmelerkrankungen der Haut und deren Ursache," Wiesbaden, 1894; and Intern. Congress of Dermatology, held in London, August, 1896.

Trichophyton planum fusolargum.
„ plicans fusisporum.
„ farinaceum album polysporum.
„ candidum endosporum.
„ propellens leptum.

In making cultures, Rosenbach used peptone agar bouillon for the first colonies, then potato, and, lastly, Sabouraud's maltose peptone was employed for the progressive developments of the different cultures.

His results have not, as far as I am aware, been confirmed by any other investigator. Indeed, he has worked in such complete independence of other labourers in the same field that it is not altogether easy to appreciate his results. Some, at least, of his conclusions appear to me to rest on an utterly insufficient basis of experiment. Rosenbach holds that his own experiments make the plurality of the ringworm parasite very probable, but I agree with Von Düring* that his observations do not supply any proof that these moulds are the exciting agents of deep suppuration of the skin. As regards the relation of particular varieties of fungus to particular forms of disease, Rosenbach believes that one and the same trichophyton may sometime produce superficial lesions, sometimes deep suppurative processes, just as one and the same coccus may cause a furuncle, an osteomyelitis, or a fatal pyæmia. He says that the trichophyte is itself pyogenic, and the co-operation of other organisms is not necessary to produce the clinical appearances of deep suppurating trichophytosis. Rosenbach thinks that the statement of Sabouraud as to the transmission of ringworm from animals to men must be accepted with reserve.

Krösing,† of Breslau, as the results of numerous experiments, has arrived at the conclusion that Sabouraud's division of the trichophytons into megalosporon and microsporon is not warranted; the size of the spores is very variable in the same fungus and in

* "Arch. f. Derm. u. Syph.," Bd. xxxvi., Hft. 1, u. 2, August, 1896.

† "Weitere Studien über Trichophyton-Pilze," Archiv für Dermatologie u. Syph., 1896 (Sonderabdruck).

the same culture. He thinks the attempt to distinguish trichophytons by microscopic examination, as made by Furthmann and Neebe, is barren in results, in view of the diversity of the organs of reproduction and fructification in one and the same culture, and of their inconstancy at different periods. The naked-eye comparison of cultures made in conditions as similar as possible can alone allow of this differentiation. Culture on potato is the most characteristic and, therefore, the best for this comparison. Cultivated on this medium, the fungi are divisible into three groups: (*a*) With dry powdery deposit and brown staining of the potato at the edge of the culture; (*b*) without staining of the potato; (*c*) with white downy deposit without staining of the potato. The same fungus may cause both deep and superficial affections (sycosis and tinea circinata). There are suppurations which are caused only by trichophytons. It is at present impossible to conclude from the clinical aspect of a ringworm what fungus has caused it.

Ullmann* agrees with Krösing that from one disease only one fungus, which is the exciting cause thereof, can be obtained. He thinks Krösing's choice of the culture on potato as the basis of a radical division of trichophytons somewhat arbitrary, inasmuch as in certain forms, cultures on agar and malt, and on peptone agar, are as characteristic as those on potato. He agrees in the main with Krösing's conclusions as to the effects of the fungi. As regards the results of inoculation in animals, the diseases induced have not always been similar to the corresponding affections in man (ringworm of the scalp, nodular purulent trichophytosis†) from which the fungus was obtained. In general. they consisted in a simple desquamation with falling out of the hair, and the process was never accompanied by suppuration. The fungi were in the hair follicles and the epidermic scales, generally isolated and few in number, seldom in chains; they never penetrated into the interior of the hairs.

* German Congress of Dermatology, 1895.

† ? Kerion.

Waelsch* also holds with Krösing, that it is not possible to differentiate specific forms of ringworm as due to distinct species of fungi. He maintains that the trichophyton grows not only in the hair, but in the hair follicle. By its growth it gives rise to inflammation in and around the follicle, the degree of inflammation depending on the anatomical peculiarities of the part, being most intense in the region of the beard where the subcutaneous tissues are loose and the blood supply is abundant. Owing to the density of the subcutaneous tissues, the scalp does not present conditions favourable to deep inflammation. Pus cocci have no share in the inflammation produced by the trichophyton. From the biological point of view, Waelsch says that in the manner of their growth and in the conditions of their existence generally, the fungi present the greatest variability. On the one hand the fungus possesses the property of preserving to the most remote generations the characters acquired during its saprophytic stage of development. But, on the other hand, it adapts itself very rapidly to the new soil, and reacts very appreciably to slight modifications of the nutritive substratum. The culture of one and the same fungus on artificial media may, therefore, in certain circumstances yield in the later generations very different cultures, which, if further cultivated, may come to be mistaken for different species. But, again, the transformation of cultures of different fungi may obliterate differences in their growth which would apparently have justified a rigorous separation of these fungi up to the point when their identity of nature became evident.

Palagatti† also agrees with Krösing that it is impossible to pronounce solely from the appearance of a lesion by what particular fungus it has been caused, inasmuch as different fungi can produce different clinical forms of disease.

The same view was expressed by A. Ducrey and A. Reale to the International Congress of Dermatology, held in London in

* Archiv f. Derm. u. Syph., 1896, xxxv., 23.

† "Monatsh. f. prakt. Derm.," 1896, xxiii., 575.

1896.* The former is Director of the Istituto Dermo-Sifilipatico of the University of Pisa; the latter is Assistant in the corresponding institution at Naples, under Professor de Amicis. The communication was the outcome of three years' work on the subject, and embodied the results of a study of 240 cases from the cities of Pisa and Naples and their suburbs. The patients, who were of all ages, and of the most diverse social conditions, presented a great variety of clinical forms of the disease. Their examination of patients showed:—

1. That in the same individual presenting multiple foci of trichophytosis, these foci may exhibit different clinical appearances.

2. That the trichophytic lesion may present itself under different clinical forms in the several members of the same family, even when there is reason to presume that the one has been infected by the other.

3. That the clinical aspect of the trichophytic lesion may change in the different stages of its evolution: a dry trichophytosis of the scalp may change to kerion; a dry trichophytosis of the beard to sycosis.

In trichophytoses of the scalp, as in those of the beard, the macroscopic characters of the affected hairs of the head or other parts are certainly not always the same. Some are clearly provided with a sheath, others entirely destitute of one; some are broken off at the level of the skin, others at about a millimetre or more from the point of emergence from the follicle; some remain straight, others are more or less irregularly bent, etc. None of these characters is a constant accompaniment of any determinate clinical form of trichophytosis. The microscopic examination of the affected hair as regards the whereabouts of the parasite does not always warrant the sharp distinction between an endothrix and an ectothrix fungus. Neither macroscopic nor microscopic examination of the hairs is sufficient, in the majority of cases, to enable one safely to predict the type of

* "Contribuzione allo Studio delle Tricofizie Umane," Giorn. Ital. d. Malatt. Vener. e della Pelle, xxi., 2.

culture which will be obtained from sowing a given hair. The authors, from their cases, obtained in direct sowings of the morbid products on the same nutrient medium cultures differing widely among themselves. They might be grouped under three principal types, which, having regard to the macroscopic characters distinguishing them in the young or adult state of the same culture —*e.g.* in glycerinised agar—might be styled (*a*) tuft-like (*tomentoso*); (*b*) powdery; (*c*) membranous (*cotennoso*). The powdery type might be sub-divided into flat and raised.

Every time that the authors cultivated morbid products belonging to the same individual, or to members of the same family, whatever trichophytic form these might present, they always, with most rare exceptions, obtained the same type of culture.

The three types which preserve sufficiently well their distinctive macroscopic characters as long as the inoculated material is taken from young cultures and under identical experimental conditions, may undergo modifications more or less profound when the inoculations are repeated under conditions different from those indicated, so as to make confusion of one type with another possible. In old cultures, precisely on account of the transformations which they undergo in their macroscopic characters, the same confusion may equally take place.

The study of the organs of reproduction and fructification in the different stages of culture and of successive inoculations (sub-cultures) shows the great difficulty met with when attempts are made to classify trichophytons on that basis.

Inoculations of cultures, to whatever type they may belong, on hairless parts in man (the authors did not think themselves justified in making them on the scalp or on the beard region) always, when the results were positive, yielded superficial (erythemato-squamous or erythemato-vesicular) forms of trichophytosis.

Ducrey and Reale conclude that there is no definite clinical form of trichophytosis corresponding to each type of culture. Pleomorphism in the cultures is the rule, and must not be confused

with contamination or commensalism; the latter, when it does exist, is altogether exceptional. It is undeniable that the trichophyton can have a pyogenic action of variable virulence.

Among all the cases, in spite of the most minute inquiry made for each single case, in only two could it be ascertained with certainty that contagion had taken place from animals (calf to man). Notwithstanding this, the clinical appearance of the lesion was not constantly the same in the several persons affected. The authors saw sycosis in one person, dry trichophytosis of the beard in another, and, finally, a trichophytic ring on the thigh of a child. Among all their patients there was not one who presented the non-trichophytic small-spored form of ringworm (Gruby's disease).

Unna, of Hamburg, said at the London Congress that the plurality of trichophytosis was an established fact. The small-spored ringworm occurs at Hamburg, and he showed cultures of it. He also had samples sent from London, and he showed a culture of microsporon Audouini from Paris. But in these cultures, similar as they were, one might observe differences that were hereditary and permanent. These varieties might explain the slight discrepancies in clinical descriptions. Unna used for culture what he called the "garden method," sowing the microsporon from different sources side by side in the same vessel. This makes the identity of the culture medium certain and comparison more easy. From the mycological point of view he called attention to the trifurcated mycelial bundles which on sections of young cultures are constant in microsporon Audouini of different origins, and render them recognisable.

CHAPTER V.

ETIOLOGY (*concluded*).

The Author's own Observations: Comparison of Results. General Summary.

THE summaries given in the foregoing chapters of the results and conclusions of the investigators who have worked at the subject show clearly that the question of the relation of ringworm to trichophytic and other fungi is still far from being definitively settled. There is, indeed, an absolute agreement among all the workers on two points: (1) That all the various affections and multifarious lesions of the hair and skin connoted by the term "ringworm," are caused by vegetable parasites; (2) that these parasites are of more than one kind. The unicist doctrine is dead, and the plurality of ringworm fungi is no longer a theory, but an established and accepted fact. But on points of detail there is still wide divergence of opinion. Although all investigators admit that there is more than one fungus concerned in the production of ringworm, no one cares to commit himself to a definite statement as to their number, and there is great uncertainty as to their nature, mode of existence, and pathogenic properties. As to classification, all is confusion. In a word, dermatologists are not agreed as to what the trichophyton does, nor even whether it is the trichophyton that does a particular thing. On the other hand, botanists are not agreed what the trichophyton is. It is not to be wondered at that there should be such diversity of opinion, for the subject is in itself one of almost hopeless complexity, and the imperfection of our means of research puts further stones of stumbling in our path.

My own investigations have not been on so extensive a scale as those of some of the distinguished workers to whom I have referred, and I cannot flatter myself that I have been able to

add anything of importance to the facts which they have so laboriously accumulated. In a case of such difficulty, however, every scrap of evidence has its value, and I therefore think it right to give my results, such as they are. They are founded on the examination of hairs from 126 consecutive cases of ringworm met with in private and in hospital practice, and taken just as they came, without any attempt at selection. All the patients were children, and all the hairs examined were taken from the scalp. The method of preparing the specimens was the same in all the cases; and as much depends on this, it will be well to give precise details on the point.

IMPORTANCE OF STAINING.

Before doing so, however, I cannot refrain from expressing surprise that among those who have worked at the mycology of ringworm, so little importance appears to be attached to staining, which has proved so useful in other fields of histological research. It is true that many attempts have been made to stain the ringworm by Gram's and other methods; but the results have generally been unsatisfactory, mainly because, as pointed out by Adamson,* the fungus takes the stain so abundantly that structural details are blurred, and the whole specimen is more or less opaque. Not long ago, however, I described† a method of staining which was free from these defects, and which appeared to me to make it possible to study the morphology of the fungus in a manner at once more easy and more precise than any other.

Briefly the details of this method are as follows:—A suspected hair is first steeped for one or two minutes in a mixture of a 5 per cent. alcoholic solution of violet gentian and anilin water (ten parts of the former to thirty of the latter); next it is dried with blotting-paper, then treated for one or two minutes with pure iodine and iodide of potassium in water; dried again; treated once more with anilin oil and pure iodine; then cleared with anilin oil, washed in xylol, and mounted in Canada balsam. I am

* *Brit. Journ Derm.*, July and Aug., 1895. † *Practitioner*, August, 1895, p. 135.

glad to know that this method of staining has won the approval of such good judges as Dr. Allan Jamieson, Dr. Unna,* and Dr. Norman Walker,† and I am confident that if it is tried it will find equal favour in the eyes of other workers. As further experience has led to certain modifications of the method just described, I give the details of the procedure which has been adopted in the preparation of the specimens from which the photographs reproduced in this work have been made. Whatever may be thought of my interpretation of, and deductions from, them, I think it will be admitted that as triumphs of technique they bear comparison with anything of the kind that has been brought under the notice of the profession. I feel all the more free to say this, because the chief credit for them belongs to my laboratory assistant, Mr. Colhoun, to whose manipulative skill so competent an expert as Dr. Patrick Manson has borne witness; and to Mr. Andrew Pringle, whom I may call the Raphael of micro-photography.

METHOD OF PREPARATION.

The following is the method adopted in the preparation of the specimens exhibited:—The hair was first washed in ether for some seconds in order to get rid of the superfluous fatty material. It was then placed, for staining purposes, in a solution of gentian violet (5 per cent. in 70 per cent. of alcohol). The small-spored fungus stains very quickly, not more than five minutes, as a rule, being required. The large-spored parasite takes much longer to stain; it must be left for about an hour in the solution, which should, moreover, be heated over a spirit lamp for five minutes or so; in this way the alcohol is driven off, the keratin is dissolved, and the fungus in the interior of the hair is deeply stained. The parasitic elements can be stained red by treating them in exactly the same way, but substituting a 5 per cent. solution of fuchsin in water, with a little alcohol or a 2 per cent. solution of carbol-fuchsin. The red is better than the violet stain for photographic purposes.

* *Monatshefte f. prakt. Derm.*, March 15, 1897.

† *Scottish Medical and Surgical Journal*, September, 1897.

When the hair is taken out of the staining solution, it should be steeped in iodine in order to fix the stain; next it is decolorised by being placed in anilin oil, or a mixture of two to four drops of nitric acid in anilin for ten to fifteen minutes; then it is placed in pure anilin and kept in it for some seconds; next it is washed in xylol, and, lastly, mounted in xylol balsam. It will be observed that the liquor potassæ has no place in this method. I find that potash destroys the mycelium and swells the spores, and hence the use of this agent produces effects that are not merely unsatisfactory, but positively misleading.*

RESULTS.

By the method here described, I have satisfied myself that Sabouraud's doctrine is unsound in some points, and not proven in others. It is naturally with the greatest diffidence that I differ from so painstaking and acute an investigator. He has, however, it seems to me, been a little carried away by the enthusiasm of the pioneer, and the systematising genius which belongs to his nationality has further led him to parcel out the territory he has discovered into trim *parterres*, in which the luxuriance of Nature refuses to be confined. In order not to weary the reader with points of minute controversy, I will here give a summary of my own observations without claiming originality for any of them, but merely presenting them as the results of my own work, whether they confirm or contradict that of others.

* Norman Walker (*loc. cit.*), who has tried every published method, and many ideas of his own, finds that none approach the method described in the text. He thinks, however, that the following modification simplifies it:—

"The hair and scales are put on a slide and a drop of anilin gentian violet or alum gentian violet 1-5 in 100 added. Here it must remain at least five minutes. It is then treated with Gram's solution for three minutes or longer, and then dried with blotting-paper. Then a drop of anilin oil with enough iodine in it to make a dark sherry colour is added, and after a little washing to and fro, it is examined under a low power. In most cases this is enough; but if the specimen is to be preserved, it must be washed in pure anilin, and then in xylol before mounting."

GEOGRAPHICAL DISTRIBUTION.

Of the 126 cases which supplied the material for my preparations, in no fewer than 116 the small-spored fungus was found; in the remainder the parasite was of the large-spored variety. This gives a proportion of 92 per cent. of small-spored ringworm, a result which closely agrees with Fox and Blaxall's estimate of 80 to 90 per cent. Adamson's proportion is still higher. In London hospital practice he found the microsporon in 173 out of 178 cases of ringworm. Allan Jamieson, from his experience in Edinburgh, states the proportion as about 90 per cent. These figures are much higher than those of Sabouraud, who finds that the small-spored fungus is accountable for from 60 to 65 per cent. of all cases of ringworm met with in France. The fungus is not, however, met with in all parts of France, for Dubreuilh and Frèche failed to find it in Bordeaux. Mibelli, though admitting from an inspection of Sabouraud's preparations that the small-spored fungus is a distinct variety, has never met with it among the numerous cases of ringworm that have come before him in Italy.* Nor had Ducrey of Pisa or Reale of Naples ever seen it in Italy. Fergnani of Barcelona has met with it in Spain; he does not state how frequently. The parasite would also appear to be rare in Germany. Krösing states that ringworm of the scalp is very seldom met with in Breslau; Unna says it occurs in Hamburg, though, apparently, it is by no means common there. Possibly the greater prevalence of the small-spored fungus in Great Britain may explain the fact as to which British dermatologists are agreed, that ringworm is more refractory to treatment in their country than it appears to be in some other countries. It is notorious that methods of treatment which are recommended as effectual by some foreign specialists of great authority prove of little use in England. My own statistics, and those of the other British

* Mibelli has recently reported (*Riforma Medica*, Nov. 18, 1897) a case in which the parasite appeared to him to have the characters of microsporon Audouini. Bodin, however, who examined the preparations, pronounced it to be a microsporon from the dog which he had described.

workers referred to, may be held to show that the large-spored fungus is relatively uncommon in England; perhaps, however, its apparent rarity is to be explained by the fact that the affection which it produces is easily overlooked.

There is a similar diversity in the geographical distribution of the trichophyton. Sabouraud suggests that each species has a sphere of influence peculiar to itself, and in his latest utterance he admits that any study of trichophytons gives results that are absolutely valid only for the particular country in which it is made. Hence workers in a given country are not warranted in rejecting the results of workers in other countries merely because they do not agree with their own. This is a most useful warning, and it is only fair to state that Sabouraud has himself acted upon it; for in the records of his latest researches he is careful to limit his statements to France, or even to Paris.

As to the prevalence of the ringworm fungi in America and other parts of the world, no definite statement has, as far as I know, been published. It would be particularly interesting to have some trustworthy information of the kind about India, whence ringworm was, in the early part of the century, believed to have been imported into Britain.

I now proceed to give a summary of the results of my own investigations.

THE SMALL-SPORED PARASITE.

The special characteristic of the small-spored parasite is the absence of any particular arrangement of the spores (Figs. 1, 2, and 3); they are dotted about irregularly, sometimes in swarms (Fig. 1), sometimes in small numbers (Fig. 4); everywhere, however, the individual elements are separate from one another, without visible bond of union. Interwoven with them is a felting of mycelium, irregularly pointed, curved, and branching (Figs. 2, 3, and 4). The fungus lies around the hair, forming the greyish sheath described by Sabouraud. It eats away the hair, fraying the edges (Fig. 5), working its way into the interior of the shaft

(Figs. 6 and 7), and growing downwards towards the root. After a time the hair breaks some way from the follicular orifice; the parasitic sheath becomes disintegrated, forming a patch of ash-coloured scales on the epidermis. Adamson and Colcott Fox hold that the epidermis is attacked before the hair; but my experience is in accord with that of Sabouraud on this point.

THE LARGE-SPORED PARASITE.

The distinctive features of the large-spored fungus, apart from its greater size, are that it attacks the root first and grows upwards, and that the spores are arranged in regular chains (Figs. 17 and 18), intermingled with short, regularly-jointed mycelium. The hairs are broken off short, and there is no visible sheath; the spores lie around the hair, sometimes outside (Fig. 17), sometimes inside (Fig. 20), sometimes both inside and outside (Fig. 19). Figs. 19 and 20 represent sections of the same hair at different levels, and show that the fungus may at one part be altogether outside the hair, and at another inside as well. This corresponds with Bodin's description of the "endo-ectothrix" parasite; but the case was one of tinea tonsurans of the scalp in a child, and there was no reason, as far as I am aware, for considering it to have been derived from the horse, though of course, the possibility of such an origin cannot be absolutely excluded. I confess, however, that I do not look upon the situation of the parasite as having any special diagnostic significance, and Sabouraud's division of the large-spored fungus into two great classes—"endothrix" and "ectothrix"—appears to me to be based on a mere accident of position, possibly dependent on the degree of invasion.

THE SIZE OF THE SPORES.

As regards the size of the spores, it is noteworthy that the difference between the so-called "small" and "large" varieties is not in reality very great. This is evident from careful measurements which Dr. Galloway has been kind enough to make of the parasitic elements in my preparations. He reports that in a

specimen labelled "Small" the mean of ten measurements of detached spores was 3·6 micro-millimetres, the extremes being 2 to 4 μ. The transverse diameter of the mycelium was very variable, ranging between 2·5 and 4·5 micro-millimetres, giving an average of about 4 μ. In a specimen labelled "Large" the mean of ten measurements of detached spores was 4·8 micro-millimetres (from 3 to 6 μ). The diameter of the mycelium was about 5 micro-millimetres, but varied from 3 to 6 μ. In a specimen labelled "Kerion" the mean of ten measurements of detached spores was 3·5 micro-millimetres (2 to 4 μ). In a specimen of "culture" of the small-spored fungus the detached spores were very variable, measuring from 2 to 4 micro-millimetres in diameter. The mycelium was also variable, ranging from 2·5 to 4 micro-millimetres. In a specimen of a culture of a large-spored parasite, the spores varied from about 3·5 to 6 micro-millimetres; the mycelium from 2·5 to 4 micro-millimetres. It seems fair to conclude, therefore, that the differentiating feature between the two varieties is not so much the size of the spores as their arrangement and their mode of growth on the hair. This point has been noted by Sabouraud himself.*

CULTURES.

I have made cultures of both varieties (small-spored and large-spored) of fungus, using Sabouraud's medium, agar maltose. The diseased hair is planted in this medium. For a time there is no apparent difference in the cultures of the two fungi. Both grow slowly. On examining a culture of the large-spored parasite about three weeks after the implantation of the hair, a small reddish-brown central knob is seen; outside this is a fawn-coloured area, which is in turn surrounded by a system of concentric rings, yellowish-green in colour; spreading out from the centre, through these circles, but on a somewhat deeper plane, are closely-set rays which extend beyond the circumference, forming a white fringe. Sub-cultures grow more quickly than the cultures; the

* Op. cit., p. 74.

central point in them is larger and more irregular, and has a wider clear area around it; then there is a deep red ring, and outside that again a fringe of rays; the whole surface is covered with white particles as if powdered with iced sugar.

In the cultures of the small-spored fungus, the central point at first is not so much raised as in those of the large-spored, but it is whiter. About the fourteenth day it looks like a tiny scale lying on the surface of the medium. This is surrounded by a narrow whitish zone, and round this again there is an irregular outer circle of rays. In about two months the central spot is larger and whiter; it is surrounded by a system of concentric rings, marking successive tides of growth, as it were, as in the section of a tree; outside these there is a well-marked white circle, which appears slightly raised; around this circle is a halo of rays. The cultures of the small-spored fungus become white much more quickly than those of the large-spored, and the white rays at the growing edge are finer. Figs. 8 and 9 show the microscopic appearances of the culture of a small-spored fungus from the scalp after eight days' growth. In the former the section, which has been made near the margin, shows scattered spores and mycelium threads, a few of which are curved and twisted in somewhat remarkable fashion. Figs. 11 and 12 represent cultures from a hair taken from a case of kerion; it shows fine branching mycelium growing from the root of the hair. Figs. 21 and 22 represent cultures of the large-spored fungus obtained from the hair of the scalp after eight days' growth; the former shows the mycelium growing from the root of the hair. Fig. 22 is a section from the edge of a similar culture.

On the whole, the differences between the cultures of the two varieties are not great. The principal is the colour. The predominating tone in the small-spored is white, which, together with the powdery surface, gives it a snowy appearance. In the large-spored culture it is reddish-brown. The cultures could always be distinguished from each other without difficulty by the naked eye, owing to the difference in colour. Each of the two classes

presented exactly the same appearance in all the specimens examined, whether they came from the same case or not. Nor was I able to detect any difference between the individuals of the large-spored group. Community of contagion may safely be excluded. It would appear, therefore, that Sabouraud's statement that hardly any two cases of trichophytic ringworm present the same species of trichophyton is, to say the least, too absolute.

It is possible that there may be an "unlimited" number of species of trichophyton, but I have as yet seen nothing, either in the laboratory or in the consulting room, to lead me to believe that every case of trichophytic or, as I prefer to call it, "large-spored" ringworm, has a special parasite of its own.

THE FUNGI IN RELATION TO CLINICAL FACTS.

The conclusion at which I have arrived, as the result of my own observations and researches, is that there are but two varieties of ringworm parasite which concern the clinician. These present sufficient differences in their microscopic appearances, in their mode of growth, and in their pathological effects, to entitle them to recognition as distinct in breed. Whether they belong to different botanical families is a question of little interest to us as clinicians. We may well be satisfied with knowing that the ringworms with which we have to deal are *mycoses*. Whether in a given case the fungus is or is not a trichophyton is a question of altogether secondary importance to us, which I, for one, am content to leave the botanists to settle. In connection with this matter, I may quote the opinion of Waelsch,* who points out that the form of growth of fungi and their biological state are very unstable, and depend on the most diverse conditions. If, on the one hand, they may preserve to the most remote generations the characters acquired in their saprophytic state, on the other, they have the power of adapting themselves to new soils, and they react very markedly to trifling modifications of the nutrient medium. This seems to me to make the exact

* Verhandlung d. Deut. Derm. Gesell., 1894.

classification of the fungi found on the skin and its appendages practically an impossible task.

I may here state my conviction that many forms of tinea tonsurans which were formerly believed to be caused by a trichophyton are really varieties of favus. I am glad to find that this conclusion—at which I had arrived by microscopic as well as by clinical observation, is independently confirmed by Bodin, and more recently by Sabouraud. I entirely agree that the boundary line between the favus fungus and the trichophyton is difficult to draw. At any rate, the line of demarcation hitherto supposed to exist between these parasites can no longer be regarded as a "scientific frontier."

What dermatologists are chiefly concerned with is not so much the family tree of the parasites as their effect on the human integument and its appendages. A classification of ringworm parasites according to the degree of facility with which they can be dealt with therapeutically would, doubtless, be grossly unscientific, but, after all, to us it is the most practical. From this point of view, there is a very sharp distinction between the small-spored and the large-spored fungi, the former being incomparably more refractory to treatment than the latter. In Great Britain at least it is the most common in cases of ringworm of the scalp, and it is, unquestionably, the most contagious. Sabouraud's teaching, that the small-spored fungus is confined to the scalp, is, I venture to think, erroneous. Fig. 13 represents a scraping from a patch of tinea circinata in a child affected with ringworm of the scalp; it distinctly shows the small-spored fungus. I may here recall the fact that Bodin has found a small-spored parasite in all respects corresponding to the microsporon Audouini, in lesions of ringworm nature, on the skin as well as on the scalp.

M. Sabouraud insists that although cultures of the large-spored fungus from different cases always present marked differences, the fungus from the same case is always the same—in other words, he holds that there is no mixing of breeds. I have, however,

recently had a case of ringworm of the head and neck in a child, in which the fungus on the scalp showed all the characteristics of the small-spored, and that on the neck all those of the large-spored, variety.

I may also state that in every case of kerion which I have examined, I have found a fungus similar to the small-spored parasite (Figs. 10, 11, and 12). This is in absolute contradiction to the teaching of Sabouraud, who says that kerion and all other suppurative lesions are caused by a special large-spored trichophyton derived from the horse. In this observation I am happy to find myself in agreement with Adamson and Colcott Fox.

As to tinea circinata and ringworm of the beard, my own investigations throw no light on the subject, as all my material was derived from the scalps of children. My clinical experience, however, makes it difficult for me to believe that in all cases of sycosis the parasite has been derived even indirectly from the horse.

On the whole, therefore, although the relation of ringworm to the trichophyton is, as a question of mycology, still far from a complete and satisfactory solution, as a question of practical medicine it may be regarded as settled in its essential point. We have learned to distinguish the rebellious from the more tractable forms of the disease in a way at once easy and certain. This in itself is a great progress, and this progress we owe above all to the genius—and to that infinite capacity for taking trouble which has been held to be the greater part of genius—of M. Sabouraud.

GENERAL SUMMARY.

In concluding this review of the recent researches on the nature of the parasites which cause ringworm, it may be useful here to sum up what is known as to the etiology of the affection in a series of propositions:—

1. The cause of ringworm is a vegetable fungus.
2. This fungus is not, as was till lately believed, the same in all cases.

3. There are at least two, probably three, possibly more, distinct species of fungi which produce the disease in different cases.

4. One of these is a small-spored fungus—microsporon Audouini—which attacks chiefly the scalp, and almost exclusively in children. The spores are arranged in the fashion of a mosaic around the outside of the hair, its interior being occupied by mycelia.

5. Another is a large-spored fungus which attacks the body (tinea circinata), the beard region (sycosis), the nails (onychomycosis), and, occasionally, the scalp. This class is subdivided by Colcott Fox, whose classification is mainly founded on that of Sabouraud, into: (*a*) a fungus which is entirely in chain formation and branches dichotomously, and which, in its fully developed form, is situated entirely inside the hair (endothrix); and (*b*) one like the former arranged in chain formation and branching dichotomously, but also forming mosaic groups outside the hair (ectothrix). "The term ectothrix is not meant to signify that the fungus is exclusively outside the hair, but to contrast the arrangement with endothrix." The endothrix fungus is said sometimes to attack the scalp, and a large proportion of cases of tinea circinata are attributed to it. The ectothrix fungus also attacks the body, and is said to account for all ringworms of the beard and nails; it frequently produces suppurative lesions (kerion, perifolliculitis, etc.).

6. The botanical character of the ringworm fungi is uncertain. Sabouraud classes the large-spored fungus, to which alone he allows the name of trichophyton, among the sporotricha, a species of the genus Mucedo; the microsporon Audouini is as yet "unattached." Colcott Fox believes that the microspores and trichophytes all belong to the same family.

7. The origin of the fungi is also uncertain. Sabouraud thinks it probable that the trichophytes, or some of them, may exist independently as saprophytes, and this suggests the possibility of direct contagion from mouldy vegetable substances. "Ectothrix is believed to be exclusively of animal origin" (Fox) — more particularly the horse and the cat. Some trichophytes also infest birds. The small-spored fungus is likewise believed to be occasionally derived from the horse, cat, or dog.

8. Ringworm is transmitted by direct contagion from one human being to another, or from an animal to a human being; possibly, sometimes, by inoculation with a vegetable mould in its natural or saprophytic state. It is also transmitted by indirect contagion, by infected brushes, caps, etc.

9. Age is an important etiological factor in the case of scalp ringworm produced by the small-spored fungus, the affection being almost peculiar to childhood. There seems to be no limit of age in the case of body ringworm.

10. Both sexes are about equally liable to the disease.

CHAPTER VI.

PATHOLOGY.

Conditions and Mode of Growth of Fungus—Its Action on the Hair and Skin—Its Effects.

We have yet little precise knowledge of the conditions favouring or retarding the growth of the ringworm fungi on animal tissues. They can grow only when in contact with air, and they require an adequate supply of nitrogen for their nutrition. Their growth is favoured by moisture. Experimental inoculation is, as most investigators have found, by no means easy; and there are individuals who appear to be insusceptible of infection even on close and prolonged contact. Sabouraud observed in the case of a child who though he had slept for weeks with a brother suffering from ringworm had not contracted the disease, that the sweat was strongly acid. This led him to try in experimental inoculations the effect of making the sweat alkaline by means of large doses of bicarbonate of soda; the result showed clearly that an alkaline condition of the sweat largely increased the proportion of successful inoculations. Nevertheless, a trichophyte of exceptional vitality can grow on an acid medium, and in any case the fungus has a marked power of adapting itself to varying conditions of the soil in which it is planted. It is found that inoculations can be effected more easily by means of hair or scales than by cultures, an experimental fact which is in harmony with the clinical observations that the virulence of the parasite becomes exalted by transmission through a number of human hosts. Sabouraud says that in an epidemic of trichophytic ringworm the cases, which at first are few, in a short time increase by geometrical progression. The quality of the hair also seems to have some influence. Leslie Roberts who, as already stated, holds that the criterion of a trichophyte is the degree of its capacity to

digest horny tissue, has found that more pigmented hairs resist digestion longer than less pigmented ones—a fact which furnishes experimental confirmation of an observation made by me several years ago as to the greater liability of fair-haired children to attack by ringworm, and as to the greater obstinacy of the disease in such patients.

As regards the action of the fungus, it may be said in general terms that it is limited to the cuticle, the epidermis and its appendages, the hair and the nails, and, occasionally, the epithelium of the mucous membrane. The action on the tissues on which it takes root is mechanical and irritative. By the development of the fungus and the growth of its various elements among the epidermic structures, the epidermic cells are thrust apart, and the superficial layers are detached from the underlying strata, and disintegrated, the *débris* supplying material for the nutrition of the parasite, which, in its development, gradually eats away the hair. The irritant action excites hyperæmia of the superficial integument, often with exudation in the form of vesicle formation or scaling. In addition to this immediate reaction, the results of secondary inoculation with pus cocci and other organisms are frequently observed at a later stage, in the form of pustules, small abscesses, and more or less diffuse suppurative processes. However severe and extensive the local phenomena may be, there is never any sign of constitutional infection. Passing to a more particular mode of action of the parasite, it is difficult at present to arrive at a satisfactory conclusion. The subject in itself is complex, and it is made still more confusing by the lack of literary perspective in the writings of most of those who have dealt with it. In reporting their researches they have laid such stress on minutiæ—which, however interesting from a mycological point of view, are neither pathologically nor clinically of much importance—that the larger issues involved are obscured; one cannot see the forest for the trees. Moreover, much of the work itself is admirable more as an example of infinite patience

in the study of the infinitely little, than for its practical fruitfulness.

My object in this chapter is to place before my readers in broad outline the present state of opinion as to the pathology of ringworm. Those who wish to pursue the subject in its minuter ramifications should consult the writings of the workers to whom I have referred in the foregoing pages, and particularly those of Sabouraud, which should be read in conjunction with the elucidative and occasionally corrective commentary supplied by Colcott Fox and Blaxall.

As regards the relation of the fungus to the lesion which it produces, Sabouraud states that the trichophyton is present in the circinate lesion to which it gives rise only in two cryptogamic forms—viz. (*a*) mycelial filament; (*b*) mycelial spore (endospore). On the epidermis it also exists in the two forms above mentioned. The mycelial filaments, whether sporulated or not, always divide dichotomously. Inside the hair the trichophyte is present only in the form of mycelial spore. When the fungus occupies the follicle around the hair, the filaments along the hair usually consist of mycelial spores. The outer filaments connected with the follicular epidermis present themselves sometimes in the sporulated, sometimes in the mycelial form. On the nail the trichophyte consists of deformed mycelial elements.

In the case of the microsporon Audouini the following arrangement is seen on microscopic examination: (1) In the interior of the hair there is a thick filamentous mycelium, irregular in direction, and with septa at long intervals; (2) from this mycelium there come off at an angle of 20° to 30° branches, which in their turn ramify indefinitely into fibrils of extreme tenuity; (3) the terminal mycelial filaments pierce the cuticle and creep along the surface; (4) on these terminal fibrils the spores of the parasitic sheath are fixed one by one on the same side of the fibril.

As regards the manner in which the fungus attacks the host, Sabouraud indicates a difference of behaviour on the part of the

large-spored and the small-spored parasite respectively, which he considers to be one of the points of distinction between them: the former first attacking the root end and growing upwards, and sometimes projecting beyond the broken end of the hair; the latter fastening on the hair near the mouth of the follicle, and creeping downwards towards the root. The military strictness of discipline in the mode of attack thus attributed to these parasites by Sabouraud is an instance of the love of neatness of division characteristic of the French mind, but, unfortunately, not always exemplified in the methods of Nature. It is not surprising, therefore, to find that Fox and Blaxall "cannot subscribe to this sharp distinction." "After a careful study of the early stages of infection," say these observers, "we affirm that there is no rule to be laid down as to the exact spot where the fungus first attacks the hair. It is always in the follicular portion, and often towards the root end, but sometimes in one place, sometimes in another, and on occasion in several."

Whatever may be the exact manner of attack, the result is that the hair is destroyed. Roughly speaking, the small-spored fungus erodes the shaft from the outside, so that it breaks a little way beyond the level of its implantation in the skin; while the large-spored parasite works, as a rule, from within outwards, and destroys the deeper portion of the hair, so that it breaks sharp at the mouth of the follicle.

Sabouraud states that in small-spore ringworm the scalp is implicated secondarily to the hair, whereas in the large-spore affection the epidermis is attacked, though in a slight and fleeting manner, before the hair. On the latter point there is practical agreement among investigators, but on the former Fox and Blaxall differ from Sabouraud. They say that if the skin of a ringworm patch of the scalp be examined in the early spreading stages a quantity of mycelial felt-work is always present, even before the hairs are appreciably affected, and this tinea circinata character disappears *pari passu* with infection of the hairs.

As regards the action of the fungus on the skin, there is

nothing of a special character in the hyperæmia and inflammatory disturbances which it excites. Sabouraud states that certain trichophytes of animal origin (cat, horse) are in their own nature pyogenic, some of them producing pustules, others deep folliculitis and kerion. In this general statement he has the support of Ducrey and Reale, Rosenbach and other observers. But the small-spored fungus may also produce kerion, as is shown by Figs. 10, 11, and 12, which represent the results of microscopic examination and staining of cases of kerion. Further, as has already been said, I have found a small-spored fungus in many cases of kerion that I have examined.

Rosenbach, as already stated (see p. 30), differs from nearly all workers in holding that the action of trichophytic fungi is not limited to the epidermis or even to the skin, but may be extended to the subcutaneous structures, causing deep suppurative processes.

Campana of Rome and Pellizzari* reported cases in which the trichophyton extended into and germinated in the skin. The former observer has also recorded† a remarkable case in which the trichophyton caused the formation in the skin of a mass resembling a tumour. The patient was a woman, the subject of slight chronic parenchymatous nephritis, who had a papulo-squamous eruption disseminated over the whole body. The nails of both feet were diseased, and there was (the exact situation is not stated, but presumably it was in one of the feet) a swelling ovoid in shape and as large as a hen's egg, and of greater consistence than the skin. Examination of the hair of the scalp gave negative results. In the scales from the eruption trichophytic mycelia and conidia were found. Examination of the nails and of the derma revealed the presence of the same trichophyton diffused in the epidermis, with scattered conidia and mycelium in varying degrees of development. In the tumour also mycelial and conidial forms were found—the former being much thicker, pigmented,

* *Riforma Medica*, Feb. 20 and 21, 1896.

† *Ibid.*

and granular; the latter also granular, but scattered. Often the mycelia ended in a large spore, or in a claviform swelling sending out lateral buds. The tumour was composed in great part of a dense fibrous connective tissue in a state of commencing necrobiosis. Here and there were seen vessels, much narrowed, and with walls greatly thickened by periphlebitis and endophlebitis. No parasitic elements were seen in the adventitia. It is evident that in this case the trichophytic affection dated from very many years back, in view of the great degree of onychogryphosis that existed. The tumour was consecutive on the latter. With material contained in the tumour cultures were made on various media, but, owing to accidental contamination, the results were not conclusive.

From his observations, Campana concludes that parasitic forms are found not only in the epidermis as generally believed, but in the derma. Such forms give rise in the epidermis and its appendages to hyperkeratosis and necrosis, and in the derma to inflammatory infiltrations and to connective tissue neoplasms which cannot be distinguished from fibrous tumours.

I have thought it right to refer to these researches, though I have no personal knowledge of such anomalous forms of trichophytosis. As far as I am aware, this trichophytic tumour remains an unique pathological curiosity.

CHAPTER VII.

CLINICAL VARIETIES OF THE DISEASE. RINGWORM OF THE SCALP.

CLINICALLY, ringworm presents a great diversity of form according to the part which it attacks, and also according to the age, and in a lesser degree, the textural peculiarities of the patient. It has been seen that the manifold differences in the appearance and evolution of the lesions are attributed by Sabouraud to differences in the nature of the parasite which produces them, each distinct form of the affection being caused by a distinct species of fungus. The list of species which he claims to have identified is already long enough to be a burden to the memory of the average man, and, to use his own expression, the number can be added to indefinitely. His persevering ingenuity in the detection of infinitesimal differences cannot be too highly praised; but it recalls what was said of a great statesman in the last century, who, we are told—

> "Still went on refining,
> And thought of convincing—while they thought of dining."

M. Sabouraud goes on refining, but practitioners, whether convinced or not, have to think of treating, and from this point of view there are, as I have already said, only two species—small-spored and large-spored—that need be taken into account. At any rate, the clinician can without much fear of doing injustice to his patients be content with these till the precise relation of particular species of fungus to determinate varieties of ringworm is more accurately defined than it is at present. For practical purposes, this rough classification of the parasites, correlated with a knowledge of the sites which they respectively affect, will be sufficient.

As there are two great classes of fungi, there are two main varieties of localisation, the hair and the hairless skin. Ringworm of the hairy parts is naturally subdivided into ringworm of the scalp, or *tinea tonsurans*, and ringworm of the beard, or *tinea barbæ* or *tinea sycosis*. A rare form of ringworm, *tinea palpebralis*, which attacks the eyebrow, belongs, strictly speaking, to this category, but is generally classed with the following group. Ringworm of the hairless parts comprises ringworm of the body, or *tinea circinata*, ringworm of the nails, or *onychomycosis*, and ringworm of the mucous membrane (mouth, vulva). A special form of body ringworm which attacks the inguinal, perineal, and gluteal regions occurs mostly in tropical climates, and is often called *eczema marginatum*.

It will be convenient to describe each of the clinical varieties of ringworm separately, leaving the subjects of diagnosis, prognosis, and treatment, to be dealt with in a comprehensive manner later.

RINGWORM OF THE SCALP.

Age.—Ringworm of the scalp (*tinea tonsurans*) is a disease almost peculiar to childhood. It is sometimes seen in an adult, but this is quite exceptional. Thin,* Crocker,† and Jamieson ‡ have each met with two cases; Aldersmith,§ in twenty-five years, has seen five cases, in one of which, however, the disease was contracted under the age of sixteen. I have myself seen only six cases in twenty years of dermatological practice. Cases have also been reported by C. Pellizzari and other foreign observers. On the whole, however, all dermatologists will agree with Besnier ‖ that scalp ringworm in the adult is so extremely rare as not to invalidate the law that the disease is essentially

* "Pathology and Treatment of Ringworm," London, 1887, p. 27.

† "Diseases of the Skin," 2nd Ed., London, 1893, p. 812.

‡ "Diseases of the Skin," 4th Ed., Edinburgh and London, 1894, p. 558.

§ "Ringworm and Alopecia Areata," 4th Ed., London, 1897, p. 36.

‖ Besnier and Doyon: French Translation of Kaposi's "Pathology and Treatment of Diseases of the Skin," 2nd Ed., Paris, 1891, t. ii., p. 820.

one of childhood. Liability to attack continues up to puberty, but the great majority of cases occur in children in the second half of the first decade of life. It sometimes occurs in infants. I have seen it in a baby under a week old. Epstein, of Prague, has seen a series of cases in babies from two to three weeks old, and he thinks the affection is not rare at that age; Crocker* has seen it in an infant of nine days, and Toch† has reported a case in one of fourteen days. In such cases, infection must take place very soon after birth, or even during delivery. In the Prague Clinic, however, in which the cases of Epstein and Toch, just referred to, were observed, the source of the infection could not be discovered in any of them; the mother was in every instance free from the disease in any form.

After the age of ten, the liability to ringworm begins to decrease; at fourteen to fifteen the disease is much less obstinate than in younger children; at sixteen or thereabouts, susceptibility virtually ceases.

Sex.—There is practically no difference in the liability of the sexes to scalp ringworm. The slightly greater preponderance of boys shown in most collections of statistics bearing on the point is easily explained by the greater exposure to contagion in schoolboys by interchange of caps, etc.

Incubation.—The incubation period of scalp ringworm has not, as far as I am aware, been accurately determined. It doubtless depends to some extent on the nature of the fungus, and also on the nature of the soil on which the fungus is implanted. As regards the soil, it certainly varies within wide limits in different persons, though the conditions which make one child's head favourable and another's unfavourable to the growth of the parasite are unknown. Aldersmith,‡ who, in his position as medical officer to a large school, has been led to give special attention to this

* Op. cit., p. 812.

† Arch. f. Derm. und Syph., 1895, Bd. xxii., S. 365.

‡ Op. cit., p. 42.

point, says that the usual time is certainly under a fortnight, and this period may, I think, safely be accepted for practical purposes.

Clinical appearances.—Ringworm of the scalp is seldom, if ever, seen in its first beginning. Some localised scurfiness or loss of hair is discovered accidentally, or in consequence of the child scratching at the affected place. The initial lesion is often a small red papule, which develops about the orifice of a hair follicle; sometimes it is nothing more than a minute scaly spot. The papule spreads peripherally, becomes scaly on the surface, and in a short time grows into a patch round or oval in outline, and slightly raised beyond the level of the surrounding skin. Other similar patches are formed in the same way from other centres of infection. The patches vary in size from a "threepenny-bit" to a florin, but they are often as large as a five-shilling piece, and sometimes they are several inches in diameter, equalling in area a clerical tonsure (hence the name *tonsurans*). Generally there are one or two small satellite spots in the neighbourhood of a patch. The patch, as a rule, stands out against the healthy skin more or less sharply by difference of colour as well as by scaliness. The hue varies from a dirty grey or slaty blue to reddish brown; in fair subjects it is generally yellowish. Sometimes there is no contrast of colour between the patch and the unaffected skin. The typical patch of *small-spore ringworm* is round, but it may be oval or irregular in shape, and the running together of neighbouring patches may give rise to areas of thickened desquamating integument with winding contours. The typical patch has a sharply-defined margin, but sometimes around what may be called a central clearance there is an undergrowth of diseased hairs spreading out more and more luxuriantly towards the belt of healthy hair which marks the limit of the disease. The typical patch is often girt about by a narrow zone of erythematous redness; very rarely the edge of the ring is marked out by tiny vesicles, but this must not be looked for

as a characteristic appearance. A typical patch is studded with dry, withered stumps of broken hairs, which stand out on its surface like the stubble on a mown field; it looks as though the hair upon it had been roughly cropped, not shaved. On inspection of the hair stumps, they will be seen to have lost their natural gloss; they are thickened, and have a whitened, frosted appearance, produced by the parasitic sheath (see p. 20) which surrounds them. Each stump sticks out of what may be called a miniature molehill or cone-like elevation thrown up around the hair by the massing of epithelial *débris*, caused by the burrowing of the fungus in the follicle. These tiny projections of the surface produce an appearance like "goose-skin." The individual hairs lose their elasticity, and do not spring back when bent by the finger; and they do not lie in the natural way, but are twisted and crumpled, presenting the appearance of corn-stalks beaten down by wind and rain. In children with fine hair the broken hair is sometimes twisted and matted together with powdery epithelial *débris* mingled with fungus elements. The hairs are also loosened, so that they can be pulled out without pain.

The thickening of the hair is due to infiltration with fungus, which in its growth pushes asunder the epithelial cells of which the shaft is built; the hair is literally stuffed with fungus, and is not only thicker, but darker (Besnier). The whole fabric of the hair crumbles under the invasion of the parasite, and becomes so brittle that it is broken to pieces by the epilating forceps, however gently handled, and is crushed with the greatest ease between the slide and the cover-glass.

Instead of stumps, the surface is sometimes studded with small black points, which plug the mouths of the follicles; these are hairs which have broken off at the level of the skin. The hair, however, soon grows to an extent sufficient to show itself for what it is. Microscopic examination of the hairs, after washing in liquor potassæ, shows the fungus on the outside of the hair (*microsporon Audouini*) in the form of spores, arranged in

the fashion of a mosaic, surrounding the shaft like the bark of a tree; and inside the hair in the form of threads of mycelia, branched, curved, and irregularly jointed. The relations of the fungus to the hair can be best studied in preparations stained according to the method described at p. 39 (see Figs. 1, 2, 3, 4, 7, and 8). When the vegetation of the fungus is luxuriant, the spores are in swarms and the mycelia in thick masses, and the hair can be seen to be split and frayed at the edges (Fig. 5). The small-spored fungus, as stated elsewhere, is accountable for some 90 per cent. of the cases of scalp ringworm met with in London.

The *large-spored fungus* causes a small proportion of the cases, and the affection is much milder than that produced by the microsporon. The stumps of hairs attacked by the large-spore fungus have no white sheath, and commonly break off on a level with the skin. With the microscope the spores are seen to be arranged in chains, and the mycelium is short and regularly jointed (Fig. 17).

As already said, as the fungus grows the hair breaks, and infected fragments are carried to other parts, there to set up secondary foci of disease.

Atypical forms.—No form of ringworm of the scalp can be considered really typical; the affection presents an infinite variety of clinical appearances. I have described the form which is, on the whole, most common; but the practitioner must be prepared to meet with it mingled with other forms in almost every degree of variation.

It will be sufficient for practical purposes to sketch out the principal departures from the form which has been taken as a type. The essential feature—what logicians call the *note*—of the ringworm lesion is the broken hair. There may be no discoloration; there may even be no scaliness; there may be no distinct patch. But if the parasite is still preying on its host, the tell-tale stump is always somewhere on the scalp, and can be found by persevering search. There is

often, for a time, merely a thinning of the hair in one or more places, hairs of a natural length being mixed in considerable number with the stumps. Generally, however, the fungus sooner or later lays hold of these resisting hairs, and the classical stubbly patch is the result.

Disseminated ringworm.—Ringworm may exist in localised foci, scattered over almost the whole of the scalp. To this form of the disease Aldersmith, who first described it, has given the name of "disseminated ringworm." To quote his description: "Numerous isolated thickened stumps and groups of stumps, and even 'black dots,' are seen here and there, scattered all over the scalp, with sometimes long, lustreless hairs, which easily break off." There are no distinct patches, or only one or two small ones, to be seen; these may, however, have existed in an earlier stage of the disease, for the condition arises in old-standing cases. The skin is generally of healthy appearance.

Tinea decalvans.—This is an anomalous form of ringworm, in which the hair falls out in places, leaving a smooth, bald spot of greater or less extent. The shedding of the hair may occur in a spot to all appearance previously unaffected, but more frequently it takes place in an ordinary patch of ringworm. Generally other patches then become bald in like fashion, and the appearance is similar to that of alopecia areata. Crocker, indeed, holds that the common form of alopecia areata and "bald ringworm" (as the condition under consideration is called by Liveing) are synonymous terms.

Complications.—Besnier says that the sole essential changes caused by the ringworm fungus are a little swelling and erythema at the outset; with, it may be, some slight lesions produced by scratching. This condition is quickly followed by scaling and desquamation. Inflammatory phenomena, whether vesicular, eczematoid, or impetiginous, are all in the nature of accidental complications. Furthermore, they are rare except in very young subjects, in

whom a very slight irritation is sufficient to set up catarrhal inflammation. The eminent French dermatologist says that in the great majority of cases in which he has seen such complications they were caused by over-active treatment. That the abuse of irritant applications aggravates the disease in many cases by giving rise to diffuse suppuration, whereby the coccus infection is spread over the whole scalp, is the common experience; but it is certain that inflammatory complications of considerable severity may occur quite independently of treatment. Sabouraud and some other recent investigators hold that certain trichophytes (large-spored fungi) belonging to the so-called "ectothrix" group are pyogenic in their own right. These fungi are believed by them to be exclusively of animal origin, and their distinctive clinical character is their tendency to produce inflammatory and suppurative lesions, such as impetigo and kerion. The action of a fungus of this kind would account for those rare cases mentioned by Thin,* in which the entrance of the parasite into a follicle leads forthwith to the formation of a minute pustule around the root of the hair, which is thrown off with the pus; in this way the process tends to spontaneous cure.

As regards kerion, I can only repeat what I have already said, that in several cases which I have examined I have found a fungus in all respects similar to the small-spored parasite (see Figs. 10, 11, and 12).

There can, however, be little doubt that in most cases the development of pustules or of diffuse inflammatory processes is the result of secondary infection by pus cocci. Invasion by these organisms is facilitated by the unhealthy condition of the epidermis, due to the disintegrating action of the fungus; by lesions produced by scratching; and by the lowered vitality of tissue and actual excoriation often caused by the injudicious use of irritants. A suppurative focus once formed, infection is distributed far and wide by the fingers, or in other ways.

* Op. cit., p. 33.

The most common complication is impetigo, characterised by the appearance here and there on the scalp of isolated pustules. As the pustule dries up a scab forms, on removing which a red, oozing, uneven surface is exposed. If the impetiginous process is not speedily stopped, it is apt to spread over the scalp. Sometimes raised inflammatory patches, having the appearance of boils, which after a time are covered with scabs, are seen scattered about the scalp.

Kerion.—The most severe complication of ringworm is *kerion*. In this the inflammation is more intense, and extends more deeply than in the impetiginous and spreading pustular conditions. The skin is raised into a dome-like surface, which may be of considerable extent; the surface is angry-looking, smooth and moist, and is thickly dotted with small holes, from some of which there projects a loose stump of hair, while others are filled with a plug of muco-purulent matter, and others, again, are empty and gaping. The holes are dilated follicles, and when a large proportion of them are plugged in the manner just described, the appearance is very like that of a carbuncle. The swelling is tender and feels boggy, but does not give a distinct sense of fluctuation. Incision gives issue to little or no pus. The suppurative process is, in fact, localised in the follicles, at the bottom of each of which there is a little abscess. The pus loosens the hairs, and they are finally thrown off, the way being thus opened for the escape of a thick, viscid pus. Sloughing never occurs, but in rare cases a subcutaneous abscess may form. After the swelling disappears the site of it remains for some time red and bare, and it may be long before a new growth of hair takes place. In some rare cases the necrosis is so intense as to destroy the roots of the hairs, and thus cause permanent baldness over the affected area.

Kerion is seldom seen in adults. A special texture of skin appears to be needed for its development at any age, for cases are sometimes met with in which the use of the strongest irritants fails to induce it.

Relations with other forms of ringworm.—When the scalp is the seat of small-spored ringworm, secondary lesions in the form of spots or small rings are sometimes seen on neighbouring parts, such as the face and neck. Fig. 13 shows the small-spored fungus found in a scraping from a patch of tinea circinata in a child affected with ringworm of the scalp. This fungus, however, according to Fox, "makes but a small contribution to the cases of tinea circinata."*

The so-called "endothrix" fungus, which the same observer believes to be the agent responsible for many of the old chronic ringworms with one or two stumps disseminated about the head, is said to be frequently associated with well-marked tinea circinata, which is largely due to that parasite. The "ectothrix" fungus, which Sabouraud considers responsible for the production of kerion and other inflammatory and suppurative complications, also occasionally attacks the body at the same time as the scalp.

That fungi of different species (small-spored and large-spored) may coexist on the same patient is proved by a case of my own to which reference has already been made (see p. 47).

Symptoms.—The objective phenomena have already been described. The only subjective symptom in uncomplicated ringworm of the scalp is itching, and even this is often absent. Even in strumous and ill-nourished children the affection causes no appreciable disturbance of the general health.

Course and termination.—The course of the affection is sometimes very rapid, almost the whole of the scalp being invaded in a week or two; this is particularly the case in very young children. The degree of rapidity with which the fungus grows doubtless depends partly on the intensity of its virulence (which, as already said, may be greatly increased by passing through a number of hosts), partly on the nature of the soil

* *Brit. Med. Journ.*, Oct. 2, 1897, p. 816.

in which it strikes root. This varies not only in different children, but probably, also, in different parts of the same scalp. Dark hair is a less easy prey to the fungus than fair hair, and coarse hair resists more than fine hair. A patch of considerable size often takes several weeks, it may be months, to form. They may remain circumscribed, or may go on extending for several years. By continued spreading and confluence of patches, the whole scalp may in time be laid waste, its surface being covered by a thick layer of dry epidermic scales. On long-standing patches there may be seen at the same time thickened stumps and soft, downy, new hair, at first in small amount, but increasing as growth proceeds till a fresh crop of hair has taken the place of that blighted by the ringworm. However long the disease may last, it usually ends in cure—at puberty if not before. I have, however, seen few cases in which the disease had lasted from childhood to beyond the age of twenty-five. Besnier states that permanent baldness never results except in cases in which "the untimely application of irritants such as croton oil has caused irreparable mischief." Small, bare spots are, however, sometimes left owing to destruction of hair roots by kerion, and it may be added that bald spots are sometimes left in cases in which there has been neither artificial irritation nor suppuration.

It may be mentioned here that kerion naturally tends to the cure of ringworm, the diseased hairs being cast off and the multiplication of the pus cocci having the effect of choking the growth of the fungus. In an ordinary case when the fungus has worked its way to the bottom of the follicle there is little or no further reaction, and a dry, scurfy condition of the affected surface results. The disease then enters on an excessively tedious phase. In consequence of the thickening around the neck of the follicle, which is the result of the inflammatory process set up by the irritation of the parasite, or by excessive treatment, the sac is converted into what may be called a bottle with a narrow neck; thus the fungus is imprisoned in the follicle and remedial agents are

prevented from gaining access thereto. Disseminated ringworm, in which isolated stumps are scattered about among the healthy hairs without distinct patches, are usually very obstinate—perhaps mainly because they are easily overlooked and so escape treatment. Such a case may continue for a very long time to be an unsuspected source of contagion. I have known a boy in a school to be the source of infection to other boys for several terms without suspicion attaching to him in consequence of the very limited extent of the disease.

As regards the severity of the disease apart from the nature of the soil, age greatly mitigates the effects of invasion by the parasite. Ringworm of the scalp in a child of fourteen is, other things being equal, usually much milder than in a child of ten. Lastly, the nature of the fungus itself influences the severity of the disease, the small-spored being, as a rule, more obstinate than the large-spored; it must not be forgotten, however, that cause has been shown by Sabouraud why the large-spored fungus should in certain circumstances be considered capable of producing a type of disease marked by its tendency to troublesome complications. The constitutional state of the patient appears to have no influence in determining the measure of severity of the attack; some of the most persistent cases that have come under my notice have been in perfectly healthy children.

Immunity.—Does one attack of ringworm of the scalp protect against further attack by the fungus? This is a question not altogether easy to answer. As a matter of fact, children do often enough have what appear to be second attacks of ringworm, but such cases are probably for the most part instances of relapse rather than recurrence. It is plain, however, that the new hair which grows on a patch where the fungus is still vegetating must in some way be unsuitable for its development. Aldersmith, who says that he has known a new crop of hair to be attacked owing to reinfection from some distant uncured spot, admits that such an

occurrence is very rare.* It has recently been suggested by Gottstein† that in some of the exanthemata subsequent immunity is really due to the hardening of the skin which follows the rash preventing cutaneous infection. He illustrates this notion by reference to the fact of workers in vanilla who, after having had the "eczema" peculiar to their occupation, are no longer liable to that affection. It is conceivable that a similar "hardening" of the skin following one attack of ringworm might prevent the fungus from taking root in it again.

Some children appear not to be liable to the disease at all, as notwithstanding the fullest possible exposure, they do not contract it. The hair of these children is probably in some way impervious to the parasite, like that of the adult. The immunity of the latter has been ascribed by Thin to the firmer texture of the root sheath, and the comparative want of moisture between the inner root sheath and the hair.

Social aspects of the disease.—Although ringworm of the scalp causes no pain, and no disorder of the health, and in most cases has no permanent ill effect even on the hair, the disease is one of considerable importance to the community as well as to the individual. It entails exclusion from school and, to a great extent, banishment from society. This is a serious matter not only for the child but for his parents. The introduction of ringworm into a school is a misfortune which, in the case of a private school, may mean ruin to its proprietor. It cannot be too clearly and emphatically stated that cleanliness, however scrupulous, is no safeguard; it has indeed been conjectured that dirt is a protection.‡ Children of every social grade are equally liable to ringworm; if less is seen of it among the well-to-do than among the poor, it is because the former are less ignorant and take greater care of their offspring.

Ringworm is more prevalent in England, and particularly in

* Op. cit., p. 42.

† Berlin. klin. Wochenschrift, September, 1897.

‡ Aldersmith, op. cit., p. 44.

London, than elsewhere; but it is common in France and in Italy; it appears to be comparatively rare in Germany and Austria. Jamieson suggests that the proclivity to ringworm may to some extent be a matter of race, and Liveing thinks climate may be a factor, humidity of the atmosphere favouring its development. Although Besnier scoffs at this notion, it is clear from what is already known of the life-history of the fungi concerned in the production of the disease, that climatic influences may account for the great differences in their geographical distribution which have been noted (see p. 41).

CHAPTER VIII.

CLINICAL VARIETIES OF THE DISEASE (*Concluded*).

Ringworm of the Skin and Mucous Membrane.

SKIN.

RINGWORM may attack any part of the integument besides the scalp. It may affect the skin of the trunk, the limbs, the neck, and the face, and, in rare cases, the mucous membrane of the mouth and vulva. In all these situations the disease is the result of irritation, caused by the growth of a fungus, though the parasite does not in all cases belong to the same species. The clinical appearances also vary according to the varying conditions of anatomical texture, moisture, and warmth of the particular locality in which the fungus develops. Ringworm of the skin may therefore be roughly divided into two kinds—one which affects parts usually exposed, and one which affects parts usually covered. The former group comprises the manifestations connoted by the term "tinea circinata," the seats of election of the disease being the hands, forearms, neck, and face; the latter those still generally, though wrongly, designated by the name of "eczema marginatum," the territory of the affection including the inguinal and perineal, and also the axillary, regions. On one part of the exposed skin—the sides of the face and the skin where the beard grows—the character of the lesions is so different from those seen in other localities that ringworm of that region may be looked upon as an affection clinically distinct from other forms of the disease; it will therefore, for the sake of convenience, be dealt with separately.

Ringworm of the nails has also special features which prevent its being included under the head of tinea circinata; but it is not of sufficient importance to justify its being placed apart.

In the present chapter the other forms of what may be called, in broad distinction from the scalp affection, "body ringworm" will be considered in the following order:—

1. Tinea circinata.
2. Ringworm of the nails.
3. Ringworm of the palms and soles.
4. Eczema marginatum.
5. Tinea of mucous membrane.

TINEA CIRCINATA.

Age.—Tinea circinata may occur at any age. Children are, however, more liable to be attacked than adults, and among the latter "tender juvenals" are decidedly more susceptible than "tough seniors." The affection is rare after middle age.

Sex.—Both sexes appear to be equally liable to the disease.

Incubation.—The incubation period is uncertain, but does not, as a rule, exceed a week. With the object of determining this point, I made some experiments many years ago.* These showed that a crop of itching papules might form on the third day after scraping had been placed on the skin. By the sixth day these coalesced to form a well-marked erythematous patch of ringworm. The results of some experimental inoculations have also been reported by Edward Wigglesworth.†

A gentleman inoculated his arm with hairs and scales from the head of a child suffering from ringworm on December 18th 1873; on January 25th there was a ring of tinea circinata as large as a silver "half-dime" (rather smaller than a threepenny-piece). Another gentleman inoculated the flexor surface of his left arm (on October 5th, 1877) with scales from a case of ringworm of the scalp and body. By October 16th a patch one centimetre in diameter had developed.

* Journ. Roy. Microscop. Soc., Series 2, vol. iii., p. 329.

† Arch. of Dermatology, 1878 (quoted by Thin).

The incubation period doubtless varies according to the thickness of the epidermis and other conditions of the soil.

Clinical appearances.—The fungus, when it has effected a lodgment on the skin, tends to grow on the surface in a centrifugal direction, the mycelial threads extending between the layers of the epidermis. The irritation caused by the growth of the parasite is greatest at the beginning of its attack. The tissues quickly get accustomed to its presence, and signs of active resentment, so to speak—such as erythema and the formation of papules, vesicles, and crusts—speedily subside.

The first visible lesion is a small spot slightly raised above the level of the surface. This spot, which is at first red, soon becomes scaly, while at the same time it enlarges in circumference. The redness fades away at the centre, and in this way a circle is formed, which for a time continues to expand, like the fairy rings of the mushroom, without broadening of the edge. When the ring has reached its full development it encloses an area from half an inch to several inches in diameter. After remaining stationary for a time, it gradually dies away. A typical ring of tinea circinata is generally more or less scaly in the centre, with a narrow, raised, scaly border, which is always crowned with papules thickly set together, and often with vesicles. According to Thin, "there is always an attempt at the formation of vesicles"; but their size and number vary according to the intensity of the inflammation. Occasionally the border is pustular, and in that case there is more or less subsequent crusting.

There may be only one ring in a given case, but usually there are several, which develop simultaneously from independent centres of infection, or secondarily from auto-inoculation. The rings are scattered about without any definite arrangement. Neighbouring rings often intersect each other's orbit, with the result that the points where they come in contact disappear, and figures of festooned or irregularly rounded outline are formed.

The situations chiefly affected by tinea circinata are the hands and forearms, the face and the neck. These parts, being exposed,

are particularly liable to infection by fungus derived from the head of the patient, from the head or body of any other person suffering from ringworm, or from animals (horse, cat, dog, rabbit, birds) affected with the disease.

Atypical forms.—Very often the lesion appears not in the form of a ring but of a patch—that is to say, it has begun, as described, in a red spot, which has spread peripherally, but involution has not taken place in the centre. The patch is slightly raised, reddish in colour, and covered with branny scales; it is generally circular, sometimes of no regular shape. The border is always well defined, and, like that of the typical rings, is papular; sometimes it is crested with vesicles, occasionally with pustules. The surface of the patch is sometimes crusted. If there happen to be no characteristic rings, these patches may be difficult to identify as the lesion of tinea circinata; but although there are often rings without patches, there are seldom patches without rings. The most common situation in which a single patch of the kind described is seen is on the back of the hand.

A rarer atypical form is an arrangement of one ring within another. There may be three or more such concentric rings.

Among the atypical forms of tinea circinata may be placed the secondary lesions not infrequently seen on the face, shoulder, chest, and other parts adjoining the head, when that is the seat of ringworm. Sometimes they are seen in the exposed parts of children living in the intimacy of family life with the patient. The lesions take the form of rings or segments of circles, sometimes of circular furfuraceous patches, or red scaly spots. They develop from a point of auto-inoculation and go through the phases already described. They are often excoriated by scratching. This is the form of body ringworm described by Besnier under the name "*trichophytie accessoire des teigneux.*"

Relations with other Forms of Ringworm.—This question has already been discussed in dealing with ringworm of the scalp (see p. 66). The lesions which are sometimes produced on the face and neck of children suffering from that disease have just

been described. A patch of tinea circinata may develop on the back of the hand as the result of rubbing the chin when that part is the seat of tinea sycosis.

Complications.—The lesions may, as the result of scratching, be infected with pus cocci and other pyogenic organisms. Occasionally some of the neighbouring lymphatic glands may be slightly enlarged.

Symptoms.—Tingling and itching is the only subjective symptom caused by tinea circinata. These sensations are most pronounced in the early stage of the development of the lesions.

Course and Termination.—The affection always tends naturally to recovery. The fungus after a time ceases to grow for want of nourishment.

The disease if untreated may last for some weeks or even months, its greater or longer duration depending on the virulence of the fungus, as well as on the fitness of the soil for its growth.

Immunity.—There is probably no real immunity in regard to tinea circinata, but a hard dry skin is an effective if not an absolute protection against it.

RINGWORM OF THE NAILS.

The nails are sometimes attacked by the ringworm fungus. The parasite which chooses these structures for its point of attack is mostly of the large-spored species and belongs to the "ectothrix" variety. The finger nails are the most common situation, but those of the toes are sometimes attacked. The affection may or may not co-exist with ringworm in other regions of the body. As an independent condition it is perhaps most frequently developed in nurses who have charge of children suffering from ringworm. The fungus works its way into the substance of the nail, setting up inflammation of the matrix. The nail becomes thickened, dull, uneven, and brittle. Exfoliation occurs, and under the free border a mass of disintegrated nail structure is seen. In this the fungus will be found.

There is nothing characteristic in the changes produced in the

nail by the ringworm parasite, and without the microscope it would be impossible to distinguish the effects of that fungus from those of favus or psoriasis.

In view of the large amount of scratching caused by ringworm of the scalp and body, which is so common, there must, in persons not addicted to the use of the nail brush, be a constant lodgment of parasites under the nails. It is somewhat remarkable, therefore, that ringworm of the nails should be so rare as it is. Besnier thinks that a pre-existing pathological condition, such as eczema, psoriasis, or traumatism, is required for infection to take place.

RINGWORM OF THE PALMS AND SOLES.

A peculiar form of ringworm sometimes attacks the hands and feet, the palms and soles being the parts especially liable to invasion. The affection first shows itself in the form of vesicles, which enlarge so as to give rise to blisters. These break, leaving a bare pink surface, which soon becomes dry and scaly and continues to spread at the edge, which is formed by a collarette of thickened epidermis. The appearance of the lesion is accompanied by considerable itching, and this usually persists at the raised edges. The affection is of indefinite duration; Moukhtar,* of Constantinople, who first called attention to the form, mentions cases which had lasted six years. The fungus is found in the fluid of the vesicles and in the epidermic scales.

ECZEMA MARGINATUM.

This affection, which would more appropriately be termed "tinea marginata," is altogether distinct in its nature from eczema; it is a form of ringworm differing in its clinical appearances and mode of evolution from tinea circinata, but caused by a parasite of like kind. The most marked point of difference is its localisation. Tinea marginata affects parts of the skin that are usually covered—particularly regions in which the epidermis is soft and moist and in which a considerable degree of warmth is maintained

* Ann. de Derm. et de Syph., vol. iii., 1892.

by the close apposition of surfaces, as the groin, perineum, inner parts of thighs, axillæ, and under the breasts in stout women. The lesions begin like those of tinea circinata, but the rings spread more rapidly and run more freely into each other, producing a more broken contour and covering a larger area. The centre is often fawn-coloured, and usually moist, but sometimes scaly. The most distinctive feature of these lesions is the border, which rises abruptly from the healthy skin, and is broader than that of tinea circinata; hence the designation "marginata." The borders are scaly and mostly rough with papules. One or more rings may form around the original one, traces of which may continue to be visible within the enclosure. The whole process is more actively inflammatory than in other forms of ringworm; it often assumes an eczematoid character, free exudation taking place, with subsequent abundant scaling and crustation. So marked indeed is this tendency, that Jamieson describes the affection as "a compound of eczema and tinea tonsurans"; and goes on to say: "Either this condition has developed out of a pre-existing eczema intertrigo, or an eczema becomes superadded."

In its typical form, tinea marginata starts from the groin or the outer surface of the scrotum, and the corresponding surface of the thigh, and may spread backwards over the gluteal region between the nates up to the sacrum, or upwards in front over the belly, or downwards along the inner side of the thighs.

The affection is not altogether rare in Great Britain; but it is much more common in tropical climates (India, Burma, China), where also it is far more severe than in Europe. It always gives rise to much itching and discomfort, and sometimes to severe pain. It has no natural tendency to cure, and is very refractory to treatment. It often lasts for years.

Tinea marginata is often met with in the axilla. It is remarkable that the fungus, however luxuriantly it grows, never attacks the hair of the pubic or axillary regions. The fungus is said to be of the "ectothrix" (large-spored) variety. In the early stages of the disease the mycelium is very abundant, but it is not easy

to discover. Thin says that tinea marginata is never endemic in a family or school, and is practically not contagious.

TINEA OF MUCOUS MEMBRANE.

The mucous membrane of the vulva may be attacked secondarily in cases of tinea marginata; in this case the itching is often very distressing, and the parts may become acutely inflamed and excoriated, and afterwards thickened by scratching.

The mucous membrane of the mouth is occasionally affected by extension of tinea circinata situated on the face; cases of this nature have been reported by Robinson and Cutter.* A case of primary ringworm of the mucous membrane of the mouth has been reported by A. Giletti;† as this case is, as far as I am aware, unique, I give it here in detail.

The patient was a man aged twenty-four, of robust health and dark complexion. The mucous membranes were normal and red, except that of the mouth, in which the following changes were observed:—

1. Over the whole mucous membrane of the free border of the lower lip there was an eruption, with dry continuous scales, dirty yellow in colour, terminating towards the angles of the mouth in groups of punctiform elevations like heads of pins, distinct from each other and whitish in colour. The scales could be detached easily enough and exposed the underlying mucous membrane, covered with a thin whitish epithelial layer, dry and adherent and riddled with numerous tiny holes, through which could be seen normal mucous membrane.

2. The mucous membrane of the floor of the mouth and the gums was the seat of a special whitish eruption, constituted in part by elevations of various dimensions—some punctiform, others miliary, isolated, and scattered in varying abundance among filiform raised lines, interwoven in divers manners and spreading over the

* Dermatological Society of New York, 1893.

† Tricofitiasi primitiva della mucosa boccale. Torino, v., 1895. Analysed by G. Ciarrocchi, Archivio Italiano di Otologia, July 10, 1896.

whole surface of the mucous membrane. These elevations were not soft to the touch, and on scratching were so resistant that the detachment of the diseased epithelium from the underlying tissue gave rise to slight bleeding. There was no trace of eruption on the mucous membrane of the internal surface of either lip, except towards the angle of the mouth. The corresponding mucous membrane of the gums on their inner and outer surfaces was normal and red. The whitish eruption extended internally over the mucous membrane of both angles of the jaw, over the sides of the soft palate on to the hard palate.

3. The mucous membrane of the hard palate over almost the whole of its extent was covered by a network of whitish threads. The mucous membrane of the pillars of the fauces, the tonsils, the tongue, the pharynx, and the nose was normal. There was no sensation of pain or itching, and no disorder of taste. Microscopic examination of scales from the lip and of epithelium from the floor of the mouth and the palate, gave the following results: —(1) In the scales from the lips there was an abundance of spores of hyphomycetes, arranged in chains of three or four together in some polygonal cells, and in others arranged in numerous masses; the spores were less numerous in the deeper cells; on separating one cell from another, there could be seen cylindrical uniform mycelia, with dissepiments at varying distances, some of their bifurcations bearing refractory spores. (2) In the epithelium there were seen spores of hyphomycetes in smaller number, with shorter mycelia fragmented between cell and cell.

Giletti discusses in great detail the differential diagnosis of the affection which he describes, and those more or less resembling it, such as buccal leukoplakia, mucous syphilides, mercurial stomatitis, and thrush, concluding, from the clinical as well as the microscopical appearances, that it was a case of primary ringworm of the mucous membrane of the mouth. Giletti appears to me to have proved that the affection was of parasitic origin, but whether the parasite was one of the fungi concerned in the production of ringworm may, perhaps, be open to doubt.

CHAPTER IX.

RINGWORM OF THE BEARD.

Ringworm of the beard (*tinea sycosis*) is not uncommon in England. It is propagated by contagion, the immediate source of which is generally the barber's shop. The medium of infection is probably the brush. It may also be conveyed by direct contact with a human being or with an animal on whose integument the fungus has become implanted.

Age and sex.—Ringworm of the beard, in the strict sense, affects only adult men. It occurs most frequently in early manhood, and is rare after middle age. The chin and side of the face may, however, be the seat of tinea circinata at any age and in either sex.

Incubation.—The incubation period is from three to ten days.

Forms of the disease.—Before we proceed to consider the clinical appearances of ringworm of the beard in detail, a general indication of the various forms in which it may be met with will help to make the subject clearer.

As a preliminary, it will be well to eliminate a spurious form of the affection in which the epidermis alone is attacked, the hair being untouched. This condition is not ringworm of the beard in the true sense, but ringworm of the skin of the beard region. In like manner the eyebrows are sometimes the seat of ringworm, but the disease does not attack the hairs of the part. In both instances the affection is ordinary tinea circinata developed, by an accident of localisation, in a part of the skin that happens to be hairy. True ringworm of the beard occurs, broadly speaking, in three well-marked types—(1) a dry form in which the hair itself is exclusively or chiefly affected; and inflammatory forms involving both skin and hair, divisible broadly according to the intensity and extent of the process into (2) superficial; and (3) deep.

These forms used to be regarded as varying degrees of the same process, but Sabouraud* has brought forward evidence which tends to show that they are caused by parasites of different species. This indefatigable worker has also studied the affection from the clinical point of view with great care and with the unequalled abundance of opportunity offered by the St. Louis Hospital. The following description is mainly founded upon his observations and researches.

The dry form is characterised by slight desquamation, together with a "goose-skin" appearance of the affected surface, produced by a heaping up of epidermic *débris* at the orifice of each follicle into a little cone. From the top of each cone there projects the stump of hair which is usually thickened and discoloured, being greyish in its aërial, and chalky white in its dermic, portion. The stump breaks off close to the root on attempted epilation. The diseased hairs are scattered about in little patches, or singly, among the healthy hairs. If the disease involves the epidermis, some fragmentary traces of rings, like those of tinea circinata, scaly, greasy, and slightly raised, are discoverable. There is no sign of inflammatory reaction throughout. Some itching is usually complained of. The affection is very slow in its course.

On microscopic examination it is seen that the parasite occupies not only the hair, but its follicular sheath. The former is completely infiltrated with large spores arranged in linear series, while in the sheath the slender mycelial filaments weave a network around the hair in which it is curtained, "as in a cage."

The superficial inflammatory form of ringworm of the beard is characterised by small, scattered patches of epidermic exfoliation, which look as though they had been produced by the application of a blister, or by a slight burn. The surface of the patch is moistened with a slight serous exudation, condensed here and there into a yellow bead, which can be seen clinging about the lower part of a hair. In a few isolated spots tiny follicular abscesses may form. There is scarcely any appreciable

* Les Trichophyties Humaines, Paris, 1894, p. 184 et seq.

thickening of the skin; after a time induration can be felt at several points below the skin, especially on the chin, where they give the sensation of small hard foreign bodies. Abscesses sometimes, though rarely, develop at these points as the result of microbic infection, but they generally undergo resolution. The diseased hairs, which are generally pretty numerous, are scattered about; they are thickened and greyish, and break on being pulled out. On microscopic examination, the hair is seen to be surrounded near its root by a parasitic sheath, composed of abundant mycelial bundles and large spores. This form of ringworm of the beard is, according to Sabouraud, not seldom accompanied by circinate lesions on the skin; or some one in the patient's immediate environment may be found to be the subject of tinea circinata. In such cases the rings are large—as much as four or five inches in diameter—and their border presents an appearance similar to that of the patches of exfoliation described above.

The third type of ringworm of the beard is characterised by a more marked degree of inflammation. It corresponds to the condition known as kerion, which occurs as a complication of ringworm of the scalp (see p. 65). To this form of ringworm of the beard the name of "Sycosis" should, in the opinion of Besnier and Sabouraud, be restricted. Its characteristic feature is the formation of patches of suppurative folliculitis, in which the purulent collections are agminated, sometimes in masses of considerable size. Sabouraud says that this form of ringworm of the beard is, in his experience, of more frequent occurrence than either of the others, amounting to more than fifty per cent. of all the cases.

As seen in Great Britain, the most common form of ringworm of the beard, in my own experience, is one corresponding in its main features to the superficial inflammatory type described by Sabouraud. The initial lesion is a red, scaly spot, which quickly enlarges and forms rings or patches, in the same way as in tinea circinata. Pustules develop around the hairs in these rings and patches, and thus each pustule has a hair growing out of it. The

hairs are often withered-looking, and can be pulled out without causing pain. By confluence of lesions a considerable area may be affected. The kerion-like form of the affection is rare. In this form the inflammatory process is more severe, and spreads rapidly. The follicular abscesses may be so large, and so close together, as to look like a mass of boils. There is brawny infiltration of the skin of the chin and sides of the face, the surface of which is red and glistening, thrown up here and there into irregular lumps, hard to the feel in the mass, but with soft points here and there, and is thickly studded with hair-pierced pustules, and with holes from which a yellowish viscid fluid exudes, and which mark the orifice of follicles from which hairs have fallen out. Often, however, the hair is loosened, but as a rule it is not otherwise damaged except in long-standing cases. At other parts, isolated pustules may be seen. The lumpy masses are sometimes covered with crusts, removal of which exposes a fig-like surface. The suppurative process may, however, be sufficiently severe to destroy the follicles, leaving permanent scars on which no hair can grow.

Kaposi refers to very severe forms of the disorder characterised by diffuse infiltration of the skin, suppurating ecchymoses, subcutaneous hæmorrhages, and confluent abscesses. After the opening, the skin presents the aspect of a strainer or a honeycomb. He states that in some cases he has witnessed the development of nodular tumours, with smooth or papillomatous surfaces, "analogous to carcinoma."

According to Besnier, sycosis—by which term he designates the kerion-like process in ringworm of the beard—is very rare as a primary condition. He says, that in the very numerous cases of that affection which he has observed in the course of many years, he has never met with one in which the disease was of the kerion type from the first. The condition, in his experience, was always developed at a more or less advanced stage of ringworm, and the supervention of the complication has always appeared to be related to the use of irritants, or to neglect.

The only subjective *symptom* in the milder forms of the disease

is itching, but in the kerion-like conditions there is generally considerable heat, tension, and tenderness, sometimes with throbbing pain.

The disease may be associated with ringworm in other situations. Auto-inoculation of the back of the hand not infrequently results from rubbing a diseased chin with it; infection has been known to be conveyed from the perineal region, which was the seat of tinea marginata (Crocker).

The fungus which causes ringworm of the beard is large-spored, and is said by Sabouraud to be a trichophyton of the "ectothrix" kind. This fungus he believes to be exclusively of animal origin, and as already said, he considers that he has identified three species, which he holds severally accountable for the three types of the disease which he describes, the dry form being caused by a parasite from birds, and the other two by parasites derived from horses. In regard to this theory as to the source of the fungi, I have only to say that it appears to me to be not proven. Exhaustive as were Sabouraud's microscopical and cultural researches, the clinical material on which he bases the view above referred to is decidedly scanty. I may add that my own clinical experience makes it difficult for me to believe that in every case of ringworm of the beard the parasite has been derived even indirectly from animals.

CHAPTER X.

DIAGNOSIS AND PROGNOSIS.

THE clinical appearances of ringworm of the scalp or body are so distinctive that a diagnosis can generally be made offhand in the earlier stages of the disease. Difficulty now and then arises later when, as sometimes happens, the lesions caused by the fungus are disfigured and, it may be, hidden by others of different aspect, which are the result of scratching, inoculation of pus cocci, or irritant applications. At a still more advanced period in cases of scalp ringworm the pathological record is obscured and almost lost in a waste of scaliness extending all over the head, and showing at first sight no trace of any characteristic feature. Again, in cases of disseminated ringworm, it is by no means easy to decide whether the disease has been completely rooted out or still lurks among the seemingly healthy hair, making the child a source of infection all the more dangerous that it is very likely to be overlooked. The consequences of errors in the diagnosis of ringworm are so serious to all concerned that it is worth while to consider in some detail the points that should guide us to a right conclusion in this matter. It will be convenient for this purpose to take the several forms of ringworm separately.

RINGWORM OF THE SCALP.

Diagnosis.—A typical case of ringworm of the scalp presents characters so obvious and so distinctive that the experienced British matron of the lower social strata recognises it at a glance. The round, scurfy patch, bristling with twisted, thick, lustreless stumps of broken hairs, forms a picture which, once seen, can hardly be mistaken for anything else. In cases as to the nature of which there is any reasonable doubt, the problem may generally be

simplified by the elimination of those in which the patient is over the ringworm age, or in which the *note* of the disease—the characteristic stump of blighted hair—is not discoverable. "No broken hair, no ringworm," is an axiom of diagnosis. But before it can be positively declared that there is no broken hair, rigorous search for it must have been made. The practitioner cannot be too careful in his examination, for there may be but one or two broken hairs, and in a thick head of hair it may be almost as difficult to find as the proverbial needle in a bottle of hay. The examination should be conducted in a good light, with the help of a lens, and it should be not only minute but methodical, for it is essential that no part of the scalp should escape scrutiny. In boys the surface can be explored by passing the hand slowly through the hair "against the fur"; in girls it is necessary to part the hair with both hands, making, as it were, a series of furrows through the thickness of it, and proceeding thus systematically till every part of the scalp has been laid bare. The process is tedious and troublesome, but it is neither honest nor politic to scamp it. In cases in which there is reason to suspect that ringworm is present in what may be called a latent form, it may be well to advise that the hair be kept short until repeated examinations have satisfied the practitioner that no trace of the disease exists.

As already said, the only cases in which a difficulty is likely to arise in the diagnosis of ringworm of the scalp are (1) those in which the disease is present in the so-called "disseminate" form; (2) those in which the lesions produced by the fungus are to a considerable degree masked by complications of one kind or another; and (3) those in which the characteristic features of ringworm have come to be almost obliterated by long action of the various processes set up by the fungus itself and by the microbic auxiliaries which often assist its ravages.

(1) In disseminate ringworm presumptive evidence of the strongest kind is furnished by the broken hair, and conclusive proof by the microscope, which shows the fungus preying on the hair.

For this purpose the suspected hair should be freed from any extraneous material that may be sticking to it by soaking for half an hour or so in liquor potassæ (B.P. 7–10 per cent.). Or the following method, recommended by Jamieson,* may be employed:—

"Several of the suspicious hairs are placed on a slide with a few drops of liquor potassæ. The slide is next warmed over the flame of a spirit-lamp for twenty seconds, and the hairs are at once thereafter transferred to a watch-glass containing distilled water. From this they are conveyed to a fresh slide on which a drop of glycerine has been placed, and a cover-glass laid on. This renders the parasites plainly conspicuous, and the specimen can be preserved indefinitely for reference or comparison. If epidermic scales are to be examined, these are in like manner placed in liq. potassæ, and the slide is heated. The liq. potassæ is then drawn off by means of a slip of blotting-paper, and distilled water dropped on and again removed several times. Thus the scales are washed free from the alkali, and, like the hairs, can be mounted and examined in glycerine."

On examining it with the microscope the hair will be seen to be bent like a green stick, while its free end is frayed. With a power of from two to three hundred diameters spores and mycelium can be seen lying around and within the hair, according to the species of the fungus. The details of the arrangement of the fungous elements will be seen more distinctly if the method of staining described at p. 39 be used. The fungus, as already said, is, in the great majority of cases of ringworm of the scalp, of the small-spored kind (Figs. 1, 2, 3, and 4), but occasionally it is large-spored (Figs. 17 and 18). For a description of the microscopic appearances of these parasites the reader is referred to p. 42 *et seq.*

(2) When as the result of scratching, the application of irritants, or secondary infection by micro-organisms, a condition resembling eczema or impetigo has been set up, there may be great difficulty in recognising the true nature of the disease. Inquiry into the

* Op. cit., p. 555.

mode of evolution of the lesions will, however, guide the practitioner to a correct interpretation of the phenomena. In eczema there is, or has been, "weeping," a symptom altogether foreign to ringworm; moreover, the patches of eczema are irregular in shape, and have not the sharply defined border of the ringworm patch; further, itching is much more marked in eczema than in ringworm. Lastly, but by no means least, the characteristic stumps are conspicuous by their absence in eczema.

In the same way an impetigo, in which no broken hairs project from the tops of the pustules, may safely be assumed to have no connection with ringworm. Lesions caused by pediculi will be traced to their true cause by the presence of the insects or their nits. Pustular pediculosis may further, according to Fox, be distinguished from "ectothrix" ringworm of the scalp by the fact of its spreading out excentrically, rounded parent and satellite areas being produced.

(3) In very chronic cases, in which the whole or greater part of the scalp is dry and scaly, it is not always easy to say whether the condition is the result of ringworm or of old-standing seborrhœa eczema, or psoriasis. Here, again, the absence of the characteristic stubble enables the practitioner to exclude the three last-named conditions. There are other points which serve to differentiate them from ringworm. Thus in seborrhœa capitis the scaliness is not in patches, as it is in ringworm, but in one large crusty sheet, which occasionally forms a kind of cone on the head. Again, though there may be loss of hair in seborrhœa, this gives rise not to stubble but to thinning.

In the dry, as in the more recent stages of eczema, the patches are not circumscribed.

As for psoriasis, it is seldom confined to the scalp; but even when it is, the scaliness is generally far greater than it is in ringworm, and the scales are of a peculiar silvery whiteness, and not infrequently the scales are so dense as to form "cakes." In psoriasis, too, falling out of the hair is exceptional, and no stumps are visible.

In some cases of inveterate ringworm, in which the whole scalp is covered with dry scales, it may be difficult to find the characteristic stumps in the mass of heaped-up epithelial refuse. With perseverance, however, they may be discovered. A condition of scaliness resembling dry eczema sometimes follows the cure of an obstinate ringworm, and it is important to know positively whether the disease has completely ceased and determined. In such cases the chloroform test, which we owe to Sir Dyce Duckworth,* may be useful. The following is the method:—

When a hair from a case of tinea tonsurans of the head in a child is placed on a glass slide, and a few drops of chloroform are added so as to float it, on the evaporation of the chloroform the hair, if still containing spores, or if its fibrous structure has broken up by the action of the parasite, becomes a chalky white. A hair from a case of dry chronic eczema, or one affected with favus, presents, when similarly treated, no such appearance. When the hair is fair the white appearance is less distinct than when dark or reddish.

Alopecia areata is sharply distinguished from ordinary ringworm of the scalp by the billiard-ball smoothness of the bare patches, within the area of which there are no stumps and no scales. The short hairs occasionally found at the edge of a spreading patch of alopecia areata are not twisted and bent, and are shaped like a note of exclamation (!), so that they are not likely to be mistaken for the broken hair of ringworm. "Bald ringworm" (tinea decalvans), however, can be distinguished from alopecia areata only by the fact of its having begun in scaly patches and by the presence of the fungus in some broken hairs at the edge of the patch. Sometimes the affections are practically indistinguishable. Some authors, as already said, regard the common form of alopecia areata and tinea decalvans as synonymous terms.

From *impetigo contagiosa* pustular ringworm is differentiated by the fact that the pustules in the latter each surround a hair.

* St. Bartholomew's Hospital Reports, 1873. See also Behrend, Trans. Internat. Med. Congress, 1884.

Prognosis.—Ringworm of the scalp, if left to itself, may last for years; but as a general law, to which there are but few exceptions, the disease wears itself out as adult life is reached.

By proper treatment the disease can generally be cured within a reasonable period, but the practitioner will do well in a given case not to commit himself to any definite limit of time. In cases of no extraordinary severity, the treatment may have to be continued from three to six months; in chronic cases for a year or so, and in exceptionally obstinate cases for a much longer period. The small-spored fungus which causes about 90 per cent. of the cases of ringworm met with in London is far more difficult to deal with than the large-spored parasite, a circumstance which accounts for the failure in England of methods found successful elsewhere.

In tinea decalvans spontaneous cure often takes place within a few weeks; it is in cases of this form that the marvellous cures wrongly credited to quack remedies occur.

As to the consequences of the disease, in the majority of cases there are none whatever. The hair grows as abundantly as before, except when the inflammation has been severe enough to destroy the hair follicles, when a few bald spots will be left.

TINEA CIRCINATA.

Diagnosis.—The lesions of body ringworm are so characteristic that they at once suggest the nature of the disease; this, however, can be certainly established only by microscopical examination. Occasionally psoriasis in process of involution, when there are only a few wavy lines of erythematous redness left, may look like broken rings of tinea circinata. The symmetrical distribution of the lesions, and the fact that the knees and elbows are, or have been, affected, are points that should lead to the identification of psoriasis. Jamieson describes a recurrent syphilide, sometimes seen on the face in the tertiary stage, which he thinks might suggest tinea circinata; in such a case the presence of marks of syphilis elsewhere, the amenability of the condition to the treatment appropriate to that

disease, and the absence of the fungus, will show the nature of the eruption.

From seborrhœic eczema tinea circinata is differentiated by its sharply-defined border and more complete ring, and, of course, by the presence of the fungus; from favus by the absence of the characteristic yellow cup-shaped crusts and the microscopic difference of the parasites; and from tinea versicolor by the absence of the peculiar brown uniform discoloration with branny scaliness and the asymmetry of its distribution.

From herpes circinatus, particularly as seen on the back of the hand, tinea circinata is generally said to be distinguishable by the fact that it does not affect both sides. Besnier, however, insists that real herpes circinatus (which he says has nothing to do with erythema multiforme) is neither bilateral nor symmetrical; the point of distinction is that tinea circinata, even when most profusely vesicular, as it generally is on the forearm and the hand, is not accompanied by the hyperæsthesia characteristic of herpes circinatus. Moreover, it does not cause enlargement of glands, and is very tolerant of irritants.

The discovery of the ringworm fungus will, of course, establish the diagnosis of tinea circinata in doubtful cases, but this is much more difficult than in the case of ringworm of the scalp. The parasite should be looked for not only at the seat of the lesion, but among the epidermic scales immediately around the patch. It is important that the fungus should be looked for among the dry elements. In such cases the advantages of the method of staining described at p. 39 are particularly marked.

Prognosis.—Tinea circinata tends naturally to self-extinction. The life-history of a particular lesion does not usually extend beyond a few weeks, and the affection, as a whole, lasts only a month or two. By proper treatment it can be very speedily cured.

RINGWORM OF THE BEARD.

Diagnosis.—Ringworm of the beard has first of all to be distinguished from sycosis proper (folliculitis due to microbic infection),

the differentiating points being that it begins in a circinate, scaly patch, the pustules are conical, and stand out on an inflamed and markedly uneven surface, and broken hairs may usually be found on careful examination. Tinea barbæ may be a more acute affection than sycosis; it spreads more rapidly, and gives rise to the formation of characteristic lumps more quickly than in the non-trichophytic disease. The essential difference between the two, however, is the presence of a fungus in ringworm of the beard which is not found in sycosis.

Eczematous folliculitis, which in some subjects resembles ringworm of the beard, is differentiated from it mainly by the fact that it extends beyond the limits of the beard region, and that a serous discharge is an unfailing feature in some stage of the process.

The broken hairs are sometimes shorter than those seen in ringworm of the scalp, and can usually be extracted without breaking. The tissues about the broken hair should be scraped, and the material thus obtained examined microscopically.

Prognosis.—Ringworm of the beard can always be cured by suitable treatment, but it may take some time thoroughly to eradicate the disease.

RINGWORM OF THE NAILS.

Diagnosis.—The diagnosis of this condition can be made only by microscopic examination. A presumption of the parasitic nature of the disease may be established by the existence of ringworm lesions elsewhere. The fungus may be found in the disintegrated material under the nail, and sometimes on the hairs of the dorsum of the phalanx.

For an account of an elaborate microscopical and cultural investigation of nail ringworm the reader is referred to a paper by MM. Box and Galavielle, of Montpellier, presented to the Congress of Nancy.*

* *Indépendance Médicale*, Sept. 2, 1896.

Prognosis.—The condition can always be cured by appropriate treatment.

TINEA MARGINATA.

The diagnosis of tinea marginata can be made positively only with the help of the microscope, though the circinate outline and bluff, bold margin of the lesions are suggestive.

The disease shows less tendency than tinea circinata to spontaneous extinction, and is somewhat refractory to treatment.

CHAPTER XI.

TREATMENT.

RINGWORM varies very greatly in its amenability to treatment, a patch even on the scalp being sometimes cured almost at a stroke by the application of iodine, while in another case the fungus may defy the most scientifically directed and persevering therapeutic attacks. The difference is due to several causes, the chief being the nature of the parasite which is the root of the evil. Of the two great varieties of fungi — small-spored and large-spored — which concern the clinician, the former is easy to recognise, but usually difficult to get rid of, while the latter is difficult to find, but when found can generally be rooted out with comparatively little trouble. But there are certain circumstances which in both cases may materially increase the difficulty of effecting a cure. The quality of the hair and skin is in certain cases in some way specially adapted to the growth of the fungus, which accordingly flourishes there with extraordinary luxuriance; this is particularly observed in children with fine fair hair and delicate skin. Neglect may enable the fungus to strike deeper root than it otherwise might have done, and may further lead to troublesome complications. Lastly, the tissues may by injudicious treatment be, as it were, goaded into a state of active rebellion, which has to be subdued before the ringworm can be cured, and which when subdued may leave behind it chronic thickening and other conditions, which protect the fungus against the action of therapeutic agents.

Ringworm, being purely a local disease, can be cured only by local remedies.

It will be convenient to discuss the treatment of the principal

forms of ringworm in the order of their clinical importance. Ringworm of the scalp will accordingly be dealt with first; next ringworm of the beard; and lastly, ringworm of the body (including the perineum and axilla, the nails, and the mucous membranes).

RINGWORM OF THE SCALP.

It may appear to be superfluous to begin by advocating careful treatment of this affection, in however mild a form it may occur. Yet the average parent is a little prone to make light of it; hence it is too often neglected, and an infection which might easily have been stamped out in the beginning, runs riot over the head. Even medical practitioners are sometimes inclined to apply the *laissez faire* principle to the treatment of ringworm, which they profess to regard as simply a happy hunting-ground for dermatologists. This opinion is by no means confined to the rank and file; it has found expression in high places. One of these utterances is so characteristic that I cannot refrain from quoting it. Addressing a provincial medical society a year or two ago, Dr. Goodhart, speaking of certain diseases which he considered to be overtreated, delivered himself as follows:—

"With some trepidation, too, I am inclined to say that a very different disease is made more of than its importance deserves, and that is ringworm. I never now attempt to treat it, I send it on to the dermatologist. I cannot cure it, and very often he cannot. And sooner or later it is taken out of his hands, and either left alone, or treated with ink or Condy's fluid by the herbalist, who then, having made to himself friends of the mammon of unrighteousness as far as he deems judicious, calls it cured, and thenceforth the child is let loose again upon society. I often wonder when I hear of a child with ringworm of a year's, or perhaps two years' standing, and, of course, kept out of school and away from his companions all that time, what would have happened to his associates, equivalent to the harm that has accrued to the child and his attendants from the treatment that he has undergone. Honestly, I should very much like to see the parable

of the tares and the wheat applied to this disease under scientific observation. To start with, no doubt the sheep and the goats—I mean myself and the dermatologist; no, I beg pardon, the dermatologist and I—should differ as to the prospects of the harvest, I not expecting in the end to have much of the tares to deal with, *he* not much of a field of wheat. Anyhow, I am quite sure of this, that we should hear much less about ringworm—whether for the good or evil of the community I will not attempt to decide—if mothers had not got it into their heads, quite erroneously, that it is a dirty disease. Not long ago I was seeing a baby that had scurvy rickets, and the father was bemoaning the hardness of his luck, that, whereas he had always considered his family as a particularly clean one, one child had recently had ringworm, and now another had got scurvy."*

Dr. Goodhart adds: "This is a very fair confession for me as a physician." As the particular "limitation of medicine" to which he refers is clearly intended to be placed to the discredit of the dermatologist rather than the physician, it may be hinted that it is easy to confess the faults of other people. But has not the harmless necessary dermatologist some reason to complain of the light and airy fashion in which the subject is dealt with by the distinguished physician whose words have been quoted? It is implied that the dermatologist generally fails to cure ringworm, and that his patients therefore, sooner or later, drift into the hands of the herbalist. It is unhappily true that dermatologists—like physicians—are sometimes unsuccessful in curing their patients, but I venture to say that it is not true that they often fail to cure ringworm — if they are given a fair chance of dealing effectively with it. This, for one reason or another, they too often do not get, and the indifferentism as regards ringworm, which Dr. Goodhart appears to preach, will, within the sphere of influence of his teaching, tend to make the practice of "letting

* An Address on "Some of the Limitations of Medicine," delivered at the opening meeting of the Session of the Medico-Chirurgical Society of Exeter, on Friday, October 18, 1895. (Reprinted from the *Lancet*, Nov. 2, 1895.)

loose upon society" boys affected with it even more prevalent than it is now. I hold that every case of ringworm *can* be cured, and that every case *ought* to be cured. The task is often a tedious, and not seldom a thankless, one; but the victory will surely be won at last by General Grant's plan of "pegging away."

The duration of ringworm must, except in the few cases in which it is checked at the very outset, necessarily be long, whatever be the treatment employed, because it is difficult to extirpate all the diseased hairs owing to their extreme fragility, and still more difficult to destroy the fungus without destroying the papilla, and thus making the growth of a new hair impossible.

GENERAL PRINCIPLES.

Treatment of ringworm of the scalp consists in the destruction of the fungus and the removal of the diseased hairs. These objects are effected by (1) mechanical measures directed to the removal of the epithelial *débris* and hair stumps, containing spores and mycelia, and of the superficial parts of the epidermis, so that access may as far as possible be gained to the deep-growing portion of the fungus; (2) by the application of parasiticide agents, which may act directly on the fungus; (3) by the production of some chemical or other change in the soil rendering it unsuitable for the growth of the fungus, with the view of getting rid of the fungus by causing the exfoliation of the layers of the epidermis in which it has taken root.

EPILATION.

In ringworm of the scalp the great difficulty of treatment is to reach the fungus. The first thing to be done is to get a clear field of action. The hair, over as large an area as may be necessary, must be cut short and kept so. If the fungus has actually quartered itself in its host—that is to say, if the disease is not quite recent, strictly confined to one or two small spots, and very superficial—epilation will be required. As many of the diseased hairs as possible should be picked out individually with forceps.

Not only should all the hair that is visibly diseased be removed, but a ring of sound hair around the seat of disease, so as to isolate the affected area from the surrounding parts. It has been argued* that this plan helps to spread the infection by opening the mouths of the follicles to invasion by the fungus; but there is little danger of such an occurrence if the skin is kept strictly antiseptic. If done little by little and with due care to pull out each hair in the direction in which it grows epilation causes but little pain. But epilation, however carefully it is done, does not by any means always suffice for the removal of all the diseased hairs. Many of them break under the lightest touch of the forceps, and it is hopeless to attempt to extract the roots, even when the hair has been loosened by the application of salicylic acid dissolved in ether. In very young children epilation is not, as a rule, advisable.

CLEANSING OF AFFECTED SURFACE.

The next step should be to open up a free way into the interior of the follicles by clearing away obstructing fat and epithelial *débris* from their orifices. For this purpose the parts should be washed with spirit and ether lotion, which will dissolve fatty substances and dehydrate the tissues. It may here be pointed out that, as water is one of the substances required by the fungus for its nutrition, parts that are the seat of ringworm should never be washed with that fluid; the disease, in my opinion, is always spread by this process. The application of antiseptic washes is, however, permissible. A good lotion for the purpose is salicylic acid dissolved in chloroform or ether (grs. v, ad ℥j); it dissolves the fat, dehydrates, loosens the hairs, and directly attacks the fungus. By the use of salicylic acid in this form, if applied sufficiently early, before the fungus has had time to reach the deeper part of the follicle, a rapid cure may be effected. It is an essential condition of success, however, that no fatty substances should be used.

* H. A. Pulsford, *Journ. of Amer. Med. Assoc.*, Jan. 9, 1897.

ATTACK ON FUNGUS.

In a recent case the application of iodine, pure carbolic acid, or blistering fluid, may be the means of removing a large amount of fungus which is brought away in the detached epidermis. Where, however, the fungus has struck deeper root, it requires to be more vigorously dealt with by the use of remedies which kill it, or, at least, prevent its growth. In theory this is simple enough, but in practice it is quite another matter. In the laboratory the development of the ringworm fungus can be prevented with the greatest ease by means of iodine, acetic acid, carbolic acid, nitrate of silver, sulphate of copper, corrosive sublimate, chloroform, essence of turpentine, and other substances; but even the most powerful of these agents, used in any doses short of such as will destroy the living tissues of the scalp, often fails to exterminate the parasite in the hair follicle. One reason of this is that when the orifice of the follicle is blocked with epithelial *débris*, and when the hair itself is further protected by a dense outer sheath of scales and fungus elements, the parasiticide agent does not reach the stronghold of the enemy. This explanation is, however, inadequate. I showed some years ago that, even when the skin of a dog was rubbed with coloured mercurial ointment for weeks at a time at one spot, no staining took place at the bottom of the follicle. From this it is clear that the fungus can continue to grow in the lower part of the follicle whatever agent may be applied on the surface. Not infrequently the difficulties due to causes proper to the disease are increased by the effects of previous treatment. Thus, by the too long continued use of certain irritants, the superficial layers of the epidermis may become transformed into a thin pellicle, which acts as a protective varnish; or they may become thickened as the result of prolonged inflammation.

OPENING THE WAY.

Various methods of facilitating the access of parasiticide agents to the fungus have been proposed in addition to epilation and cleansing the surface in the manner already described.

Quinquaud* scrapes the patches with a special curette, and in this way thoroughly clears away scales, broken hairs, and fungus elements lying in the upper layers of the epidermis. Particular care is required in carrying out this procedure not to allow any of the material removed to fall on other parts of the head. The local sensibility may, if necessary, be deadened by previous spraying with chloride of methyl; immediately after the patches have been scraped, the following lotion is applied over the whole head, particularly over the patches:—

℞ Biniodide of mercury, grs. iij.
Bichloride of mercury, grs. xv.
Triturate in a mortar and dissolve by adding
Alcohol (90°), ʒi.
Distilled water, ʒviij.

Next he places over the patches round pieces of plaster, medicated as follows:—

℞ Biniodide of mercury, grs. iij.
Bichloride of mercury, grs. xv.
Simple plaster, ʒviij.

By means of these plasters the infection is prevented from spreading and the remedy is kept in contact with the fungus. The child's head is covered with a linen cap, the whole dressing being kept on for forty-eight hours; then the plaster is removed, the head is thoroughly soaked, and the mercurial lotion above referred to rubbed in over the whole scalp. Plasters are then applied as before, and the whole procedure is repeated every two days till a cure has been effected.

If the affection proves obstinate, epilation may be practised a second time, and the patches may once more be curetted.

Quinquaud says that this method properly carried out does not usually cause irritation; there is sometimes a little redness, which, however, quickly disappears. If in rare cases small

* International Congress of Dermatology, Paris, 1889.

pustules develop, this complication can be prevented by lessening the strength of the lotion and medicated plaster. Quinquaud states that in the first year that this treatment was used methodically in the school for children affected with ringworm connected with the Hôpital Saint-Louis the number of cases cured was 120, the average in preceding years having been ten. The duration of treatment ranged from three to five months. Quinquaud attaches the greatest importance to the regularity with which the treatment is carried out; and I may be permitted to express the opinion that it is to this that the success of the treatment is mainly due. A large proportion of the disappointments and failures which occur in the experience of every one who has to deal with ringworm is due to interruptions, almost inevitable when the disease has to be treated under the ordinary conditions of out-patient hospital or private practice.

A curette for scraping ringworm patches has also been devised by P. Colombini,* of Rome. He states that the use of his instrument gives rise to so little pain that even young children bear it well. Where a local anæsthetic appears to be indicated he applies chloride of methyl, cocaine, or guaiacol before the operation. The scraping should not be limited to the patch, but the epidermic layers around the visible lesions, to the extent of about half an inch, should also be removed, so as to isolate the focus of disease. Colombini joins his testimony to that of Quinquaud, to the effect that the only sign of irritation set up by the scraping is a trifling local redness. The curette should be disinfected after use, the epithelial *débris* being carefully removed from the teeth of the instrument. After scraping, the parts are washed with an abundance of some antiseptic soap, *e.g.* salicylic acid; they are next painted freely with the following:—

℞ Pure carbolic acid, grs. xxx.
Powdered camphor, ʒi.
Ethereal tincture of iodine, ʒi.

* "Nuovo Raspatore per la Cura delle Tricofizie." Estratto dal *Supplemento al Policlinico*, Anno 1896.

Afterwards the following is applied:—

℞ Pure carbolic acid, ʒi.
Pure iodine, ʒi.
Flexile collodion, ʒiss.

For this latter application may be substituted traumaticin, to which have been added 5 grammes of pure iodine; or the following:—

℞ White gelatine, ʒiss.
Glycerine, ʒijss.
Water, ʒvi.
Heat in a bain-marie, and shake up with
Pure carbolic acid, grs. xv.

These applications form an antiseptic coating, which, in addition to its parasiticide action, excludes the air and thus prevents the growth of the fungus.

The washing with hot water and soap and the application of the lotion and of the varnish should be repeated every morning; the scraping should be done at first once, or at most twice, a week, and afterwards at longer intervals.

Ambrosi* suggested the use of the galvanic current as a means of increasing the penetrative power of parasiticide agents; and electrolysis has been employed for the same purpose by Cantrell.† Pulsford‡ has used the current in connection with an aqueous solution of the bichloride. A sheet of lint saturated in a 1 to 1,500 solution was placed upon the scalp and pressed in contact with the diseased area by the positive pole of the battery. The other pole was placed upon an indifferent spot, and the current (the strength of which is not stated), allowed to flow for fifteen or twenty minutes twice daily. This treatment was tried in three cases, but with no greater improvement than would have resulted had the same solution been thoroughly rubbed into the scalp.

* *Raccoglitore Medico*, 1888.
† *Philadelphia Polyclinic*, 1888.
‡ *Journ. Amer. Med. Assoc.*, Jan. 9, 1897.

PARASITICIDE AGENTS.

Of the substances that have been used with the object of destroying the ringworm fungus the name is legion—a fact which of itself testifies to the obstinacy of the resistance of the parasite. It is only those who have had little experience in dealing with the disease that are likely to pin their faith on any particular remedy. For myself I can only say that I have seen the rise and fall of so many infallible methods of treating ringworm that I have become rather sceptical in the matter. The fact is that a remedy which acts like a charm in one case will fail utterly in another, often for no apparent reason. But the practitioner must not despair because some tried and hitherto trusty weapon proves in a particular instance a *telum imbelle sine ictu;* he must try another or use the first in a different way. In the treatment of ringworm it may truly be said that patience—and patience alone—hath a perfect virtue. But it is necessary that this remedy be applied by the child's parents as well as by the practitioner.

The list of agents possessing, or supposed to possess, parasiticide properties that are used in the treatment of ringworm of the scalp includes the following substances:—Acetic acid, boric acid, carbolic acid, chrysarobin, copper, formic aldehyde, fuchsin, hydronaphthol, ichthyol, iodine, mercury, naphthalin, pyrogallic acid, salicylic acid, sodium chloride, sodium hyposulphite, sulphur, tar, thymol, turpentine, and veratria. They are applied in various forms after careful cleansing of the affected surface, and epilation, and perhaps scraping. The last-mentioned procedure is, in my experience, very seldom necessary. The mode of use, indications, advantages and disadvantages of these remedies will be considered *seriatim.*

Acetic acid.—This is an old remedy. In a work published in the early part of the century, J. Berres speaks of pyroligneous acid as often having a very remarkable effect in ringworm.* In quite recent cases the disease may sometimes be stamped out by painting

* Ueber die Holzsaüre und ihren Werth zum Gebrauche für Aerzte, etc. Wien, 1823 (quoted by Besnier).

on a mixture of one part of glacial to two parts of acetic acid daily for a very few days. It may be combined with other agents, *e.g.* perchloride of mercury (grs. iij—iv. in ʒi). Acetic acid cannot be used for any length of time, as it is a strong irritant. Aldersmith* finds it useful at times mixed with water as a preliminary to the application of other parasiticides.

A method of using this agent, which was proposed some years ago by Cramoisy, of Paris, deserves mention as an example of *what should not be done* in treating ringworm. The entire scalp of the unfortunate little sufferer was to be vigorously rubbed for some minutes with a rough brush of boar's bristles, saturated with a liquid composed of pyroligneous acid 1,000, red oxide of mercury 1, salicylic acid 2. This was to be done three days in succession. Besnier was induced to try this method, but quickly gave it up on "the ground of humanity," and also because it was utterly useless.

Boric acid.—Boric acid has been used by Cavafy in the form of a lotion, composed as follows:—

℞ Boric acid, ʒiv. (or a sufficiency).
Sulphuric ether, ℥v.
Rectified spirit, ʒxx.

This is applied and kept in close contact with the parts after cleansing for ten minutes or more several times a day.

Aldersmith finds boric acid lotion very useful in extensive forms of the disease. The following is the formula:—

℞ Acidi borici, ʒi. (vel q. s.)
Ætheris methylati, ℥x.
Ol. rosmarini, ℥ij.
Sp. methyl. ad., ℥xl.
M. Ft. sol. saturata limpida.

A little salol (commencing with grs. iii. in ʒi) is sometimes added.

Carbolic acid.—In recent cases the growth of the fungus may be effectually checked by a few applications of pure carbolic acid in the liquid form. In old-standing cases the glycerinum acidi

* Op. cit., p. 165.

carbolici (B.P.) well rubbed in is sometimes useful, or the following formula may be effective :—

℞ Acid. carbol.,
Bals. Peruv., āā 10.
Petrol.,
Glycerin., āā 100.

M. Sig. for external use. To be painted daily, or every two or three days, over the affected part after washing with liquid soap, and shaving.

The acid may also be employed in a vehicle of lanolin (ʒi—ʒij in ʒi), or with iodine and other substances, in the form of varnish (see p. 102). But this agent, if applied in a strength sufficient to be effective, is too destructive to the tissues for continuous use ; it is, however, a valuable adjuvant to other parasiticides.

Chrysarobin. — This agent has in my hands proved more generally useful than any other. On the whole, I have come to regard it as the most effective weapon for the particular purpose that we at present have at our disposal. It may be applied in the form of an ointment, containing from ten grains to two drachms of chrysarobin to the ounce, the strength best adapted for ordinary use being twenty grains to the ounce. I generally begin with a strength of ten grains to the ounce. It can also be used in plaster mulls. It may advantageously be combined with salicylic acid and other agents. A small amount of the ointment is well rubbed in with a bit of cloth or a mop. My favourable estimate of the value of chrysarobin in the treatment of ringworm is borne out by that of other dermatologists. Duhring speaks very highly of the remedy.* Hutchinson also places reliance on chrysarobin, which he uses as follows :—

℞ Chrysarobini, ʒi.
Hydrarg. ammoniat., grs. xx.
Liq. carbonis deterg., ♏x.
Lanolini, ʒi.
Adipis recentis, ʒvi.

M.

* *Amer. Journ. Med. Sci.*, Feb., 1893.

Unna, after preliminary clearing of the surface, uses the following ointment, which is rubbed in with considerable vigour twice a day for several weeks:—

℞ Chrysarobin, 5 parts.
Salicylic acid, 2 parts.
Ichthyol, 5 parts.
Vaseline, 88 parts.

On the other hand, Crocker,* whilst acknowledging its powerful parasiticide properties, holds that it is not more rapidly efficacious than many less unpleasant remedies, and thinks its drawbacks outweigh its advantages, an opinion which he shares with Thin.† Aldersmith uses chrysarobin "only for small and comparatively recent cases."‡

Chrysarobin undoubtedly has certain disadvantages. It produces a peculiar erythema with congestion of the skin, causing swelling of the eyelids and the face, which, though alarming to those about the child, passes quickly away. It also dyes the hair yellow, and indelibly stains linen and clothing. But, after all, I consider that the inconveniences attending the use of chrysarobin are slight in themselves and of no account in comparison with its good effects (*vide infra*, p. 117); moreover, with a little care they can mostly be prevented.

Copper.—Copper, applied by the primitive method of rubbing the affected parts with a penny which has been allowed to soak for some time in vinegar, is an old popular remedy for ringworm. In the more scientific forms of the oleate and sulphate the agent is sometimes effective. It may be used in ointments, according to the following formulæ:—

℞ Cupri oleatis, grs. xxv—l.
Lanolini, ℥i.

or

℞ Cupri oleatis, ℥i—℥iij.
Olei amygdalæ, ℥ij—℥ijss.
Lanolini ad ℥i.

* Op. cit., p. 825. † Op. cit., p. 66. ‡ Op. cit., p. 168.

I do not use copper much myself, but Crocker states that "in a large number of cases a thorough and satisfactory cure may be effected by its persevering employment." He finds that a drachm of the pure oleate to one ounce in the form of an ointment is most generally useful; but where the application is well borne, the strength may be gradually increased up to ʒiv to the ounce, and occasionally to equal parts. The addition of 20 per cent. oleate of mercury in equal parts is sometimes useful.

Formic aldehyde.—Formic aldehyde, or "formalin," was tried by Pottevin* in a series of cases with some success, not sufficient, however, to entitle the substance to be regarded as in any way superior to many older remedies. More recently the same remedy has been used by Alfred Salter,† who was much more impressed by its efficiency. He treated forty cases of ringworm of the scalp from the out-patient department at Guy's Hospital. The preparation most used was Schering's "formalin" in full 40 per cent. strength, though in the later cases formaldehyde of English manufacture was employed. The fluid was vigorously rubbed in with a largish brush or mop for ten minutes, the hair having been shaved round the margin of the patches. The application was repeated every other day on four occasions, and then entirely discontinued. In some patients the head was painted every day for four successive days. Of the forty cases only five required re-painting, owing to non-eradication of the disease, and in these the fault lay not with the remedy, but in the fact that, owing to the struggles of the child, no proper application could be made. The ages of the children treated ranged from four to twelve, and the extent of the disease varied from a small, strictly localised patch to areas practically extending over the whole scalp. Microscopical examination was always made before commencing the treatment, and the actual presence of the trichophyton verified, whilst before pronouncing any case cured microscopical examination was again made. In thirty-eight of the cases the fungus presented the

* *Ann. de Derm. et de Syph.*, 1884, p. 808.

† *Brit. Med. Journ.*, Oct. 17, 1896.

characters of trichophyton microsporon (*sic*). Formalin thus applied, according to Salter, induces discomfort and irritation of very brief duration rather than actual pain, and does not vesicate the scalp as it does the skin elsewhere. Only three cases showed any suppuration after its use, and in these the process was slight, and did not destroy any of the follicles. It produces, however, a thick crust, just as weaker solutions cause desquamation upon the skin of the arm, and the subsequent application of some emollient is advisable to accelerate the removal of this exudation. Growth of healthy hair commences immediately, and in three or four weeks the denuded patch is covered with hairs $\frac{1}{6}$ inch long. Salter calls attention to an occasional complication of the treatment. In six cases œdema of the face was noted some hours after the painting. In one boy this was so extensive as completely to prevent vision from swelling of the eyelids, and the forehead pitted $\frac{1}{2}$ inch on pressure. The skin, however, was neither hot nor red. The condition is probably analogous to that produced by a nettle sting on a large scale. Salter points out that the active toxic agent in the nettle is formic acid, and it is thus closely related to the substance now under discussion. The occurrence of this œdema renders it advisable either to deal with limited areas at a time, or to warn the parents of the possible result if the whole scalp is to be attempted at once.

Vidal Solares* has treated twenty-five cases of tinea tonsurans in children by means of local application of formic aldehyde. He first shaves the patches in the scalp, and rubs them daily, or every two days, with a 40 per cent. solution of formaldehyde. This manipulation is carried out with the aid of a brush for ten minutes, and finally he sprays the affected parts. After five applications he allows the patient to rest for five days. This mode of treatment is usually well tolerated, although some patients complain of a sense of heat.

I have myself employed formalin in several cases of ringworm, but the results have been in no way superior to those obtained

* Arch. de Gine. Obste., y Pediatria, No. 10, 1897.

by many other methods. In the cases in which I have used the treatment it has caused very severe pain. Aldersmith, who has also tried it, reports very much in the same sense, adding that the formalin treatment is intensely painful.

Fuchsin.—Fuchsin, from its powerful staining properties, has been thought likely to penetrate sufficiently to destroy the fungus In some cases in which it was tried, in the New York Skin and Cancer Hospital, it was judged to be useless, as there was absolutely no staining either of spore or mycelium, however vigorous and protracted the treatment with the agent was.*

Hydronaphthol. — Hydronaphthol has been used in ointment and in plaster, but the results have not been very encouraging.

Ichthyol.—This agent is not of much use by itself. I think it probable that its chief utility lies in the prevention or mitigation of the inflammatory reaction that would otherwise be set up by other agents. A mixture of equal parts of ichthyol, oil of cade, and cotton-seed oil, or crude petroleum has given good results in the hands of some American physicians.

Iodine.—As already said, the application of iodine in the form either of the tincture or the liniment (B.P.) will not infrequently, in recent cases where the infection is quite superficial, eradicate the disease. The action of the remedy is mechanical, the iodine blistering the affected surface and the fungus coming away with the detached epidermis; it has also a parasiticide action.

"Coster's paste," which is often an effective remedy, contains iodine. It is composed as follows:—

℞ Iodine, ʒij.
Light oil of wood tar ad ʒi.

The application causes the formation of a scab; when this separates, the remedy can be applied again if necessary. The drawback of this treatment is the interruption caused by the long time the scab takes to come away.

Butte† has in some severe cases used the protochloride of

* Pulsford, loc. cit.

† Congrès Internat. de Derm. et de Syph. tenu à Paris en 1889, Paris, 1890, p. 193.

iodine, a substance which, in addition to being a powerful parasiticide, is so slightly toxic that it can be used externally with considerable freedom. He uses it in the form of a pommade, composed as follows:—

℞ Protochloride of iodine, ʒijss.
Lanolin, ʒiv.

The protochloride is poured slowly on the lanolin and carefully triturated. The pommade is at first bright yellow, but in the course of a few days becomes blackish, probably in consequence of the decomposition of the chloride of iodine and the action of the iodine thus set free upon the lanolin. The pommade should therefore be used when freshly made, or, at least, within two days of making. The following is the mode of use:—Every two days the whole scalp (which should be shaved) is thoroughly sprayed with hot water. When the integument has thus been somewhat softened, the head is dried, and the patches of disease and adjoining parts are rubbed for a considerable time with the pommade. The head is then covered, and the treatment carried out again, at intervals of two days, as long as may be necessary. An interruption of a fortnight, or even a week, entails the loss of whatever benefit may have been gained by the previous applications. By this method Butte claims that a cure is effected in three to five months *without epilation*. Perhaps the results would be still better if epilation were combined with the use of the protochloride of iodine. In a small proportion of the cases treated in the manner that has been described, slight inflammatory reaction followed the use of the pommade, but it was found that this could be avoided by reducing the strength of the pommade from 1 in 10 to 1 in 20.

Mercury.—This agent has been used in the form of the perchloride, the biniodide, the oleate, the nitrate, the red oxide, and the red iodide. It is used in lotions, ointments, or plasters; but in whatever form it is applied, the strength of the preparation must be adapted to the tolerance of the patient, and its effect

must be carefully watched. In very young children, or in those with delicate skin, it should not be used at all.

The perchloride of mercury may be applied in alcoholic or ethereal solution in strengths varying from ½ to 2 per cent.: or with weak acetic acid, according to the following formula:—

℞ Hyd. perchlor., grs. vi.
Glycerine, ʒiss.
Acid. acetic. dil. ʒijss

In order to make the agent penetrate more deeply by a preliminary softening of the integument, Harrison* suggested that, before the perchloride is applied, the parts to be treated should be soaked with a solution of iodide of potassium in liquor potassæ; in this way, it is stated, the perchloride becomes converted into the biniodide within the follicle. Equal parts of the liquor potassæ and spirits of wine are first mixed together, and iodide of potassium is next added in the proportion of half a drachm to the ounce of the solution, which is called "No. 1." This is applied with a pledget of lint for three or four minutes at a time, at intervals of two or three days, when the part is ready for the mercurial solution, which is prepared by dissolving four grains of mercuric chloride in equal parts of spirits of wine and water, sufficient being used to make up one ounce. This, which is called "No. 2" solution, is first applied ten minutes after a preliminary application of No. 1. Nothing else is done for a few days, beyond applying cacao butter to loosen any scabs that may have formed. The treatment is then repeated at intervals of a few days, the potash and the mercurial solutions being, however, generally used at one sitting, with an interval of ten minutes between the two applications. The treatment is, doubtless, effective, but it is severe, and, as a rule, cannot be continued for the length of time needed for the complete destruction of the fungus. In some reported cases, it has been persevered with for about five months without success.

Great penetrative power is attributed by C. R. Kerley† to an

* *Brit. Med. Journal*, Dec. 5, 1885.

† *New York Med. Journ.*, Oct. 10, 1897.

emulsion made by adding a saturated alcoholic solution of the perchloride of mercury to kerosene oil, which, owing to its capillarity, is supposed to penetrate deeply into the follicle. The strength of the emulsion as generally used varies from 5 to 4 per cent. Kerley states that by the use of this emulsion he cured a series of cases in an average period of six and a half weeks, but, as is usually the case, the results of the treatment have not been so brilliant in the hands of others. Thus Pulsford* reports that he treated several patients with the emulsion for a period varying from six to ten weeks without effecting a cure in a single instance. Aldersmith† refers to a case in which death was believed to be due to the application to the scalp of a strong solution of the perchloride in spirit.

The biniodide of mercury may be used in combination with the bichloride in the manner already described (p. 100).

A mixture of equal parts of mercurial ointment and iodine ointment has been used with success in some cases and without advantage in others.

Nitrate of mercury ointment (*unguentum citrinum*) has sometimes been favourably reported on; but though it may be tried with advantage in exceptional cases, it is far too irritating for ordinary use.

The oleate of mercury is an effective remedy in certain cases, but, on the whole, is not superior to other mercurial preparations. It may be applied diluted in oil, in ether, or in an ointment base, such as lanolin, in a strength of 2·5 to 20 per cent. Crocker finds the oleate useful in all stages in a strength of 5 to 20 per cent. Aldersmith, who first drew attention to the use of this preparation in the treatment of ringworm, has sometimes seen the oleate "cure the most inveterate and most extensive cases of ringworm, which had existed for years and on which all sorts of other remedies had been tried in vain."‡ He uses it in a strength of 25 per cent. in the case of children over ten whom he can watch, and for patches of moderate size he often employs 33 per cent. He says the

* Loc. cit. † Op. cit., p. 182. ‡ Op. cit., p. 195.

oleate of mercury, as a rule, does no appreciable harm, but he admits that he has seen a few children who have appeared to decline in general health while under the treatment. From this it may, I think, fairly be inferred that in the hands of less experienced practitioners the treatment with the oleate of mercury might be highly dangerous.

Red iodide of mercury is recommended by Aldersmith for small places. He gives the following formula:—

℞ Hydrargyri iodidi rubri, grs. iv ad vij.
Sodii iodidi, ʒss.
Spiritûs chloroformi, ʒij ad ʒiv.
Aquam ad ℥i.
Misce. Fiat lotio.

The red oxide may also be useful, especially in preventing the spread of the disease by auto-inoculation:—

℞ Unguenti hydrargyri oxidi rubri, ʒiij
Unguenti sulphuris, ʒv.
Unguenti zinci oxidi, ℥i.
Misce et fiat ung. Sig. Apply once or twice daily.

Ammoniated mercury combined with sulphur was a favourite remedy of Sir William Jenner's. Jamieson recommends that it should be employed with lanolin, as follows:—

℞ Sulphuris præcip., ʒi.
Hydrarg. ammoniat., ℥ss.
Lanolini, ℥i.

The same writer speaks of the following prescription, slightly modified from one often used by the late Mr. Startin, as "most useful" and as seldom occasioning any undue irritation:—

℞ Sulphuris præcip., ʒss.
Hydrarg. ammoniat.,
Hydrarg. sulphuret. nigri., āā grs. x.
M. et adde
Olei sesami, ʒii.
Creosoti, ♏iv.
M. Lanolini, ʒvi.

Naphthalin.—Naphthalin in a 20 per cent. ointment has, in some cases, effected a rapid cure.

Pyrogallic acid.—This substance has been used by Quinquaud as an application under an impermeable dressing with satisfactory results. This remedy must be used with great caution on account of its poisonous properties.

Salicylic acid.—This agent, as already said (p. 98), used dissolved in chloroform or ether (grs. v—xx in ʒi) as a lotion will often effect a cure in the early stage of the disease. It may also be used in an ointment (ʒi—ij in ʒi), or in a plaster. Crocker finds the following method of application more useful than any other:—"The head is shaved, not clipped, over the affected region, and for at least three-quarters of an inch beyond the patch. Then salicylic collodion (consisting of salicylic acid, grs. x, collodion, ʒi) is painted daily for a week on and beyond the patch. At the end of a week the thick skin formed by the collodion is lifted off by insinuating one blade of the epilation forceps under the skin, and gradually lifting up a portion. This is repeated in various directions until the skin is cleared off, and then the scalp is again shaved, and the salicylic collodion re-applied for another week. The advantages are, that with this artificial skin on the patient is no longer a source of infection, the air is excluded, and as the fungus is aërobic, its development is hindered. The salicylic acid loosens the epidermis, and also the hairs, so that when the collodion is lifted off enormous numbers of stumps can be seen adhering to the under surface, and the diseased area is eventually cleared of them. The disadvantage is that the removal of the collodion is somewhat painful, so that it is inapplicable to very young children; but there are few over seven years of age for whom it cannot be used. If the skin is very adherent at the end of a week, a day or two longer may be given; if any excoriation is accidentally produced, boric ointment should be applied until the skin is sound before renewing the collodion."

Sodium chloride.—Common salt has lately been recommended

as an effective remedy. F. J. Reilly* was led to use it by observing the damaging effect that the urine of dogs, which, of course, contains chloride of sodium, has on laurels and other plants, and the way in which weeds can be destroyed by salt. In cases of ringworm he applies a solution of common table salt to the scalp five nights consecutively, washing it off the following morning with 10 per cent. boric acid soap. By this treatment, he says a speedy cure is effected. Other practitioners have tried the method with success.† But though salt may cure a few cases in which the disease is of a type that would readily yield to almost any treatment, it is of no use in obstinate forms, and where there is any inflammation in the scalp its application would be very painful.

Sodium hyposulphite.—This agent was strongly recommended by Sir William Jenner. It may be applied as a lotion (℥ij in ℥i of water) on lint and covered with oiled silk. In ringworm of the head, it is chiefly useful in young children. I have several times seen excellent results from its use.

Sulphur.—Sulphur may with advantage be used in combination with mercury, carbolic acid, salicylic acid, etc., in an ointment with a lanolin base. Examples of prescriptions have been given at p. 113. The following are some other formulæ:—

℞ Sublimed sulphur, grs. iij.
Acid. carbol., ♏xx.
Lanolini,
Ol. olivæ, āā ℥ii.

or

℞ Sulphuris præcipitati, ℥iss.
Hydrargyri ammoniati, ℥ss.
Acidi salicylici, grs. xv.
Lanolini, ad ℥iij.
Misce. Fiat unguentum.

* *Brit. Med. Journal*, Nov. 23, 1895.

† G. S. Perkins, *Brit. Med. Journal*, Dec. 7, 1895; C. E. Murphy, ibid., Sept. 25, 1897.

Sulphur is particularly useful in the case of young children; it may be applied in the following form:—

℞ Sulphur, ʒi.
Acidi carbol., ʒss.
Lanolini c. oleo., ℥i.

Tar.—Tar is credited by Thin with a special power of penetrating hair follicles and exciting inflammation in them. It is certainly a useful agent, but it is by no means a specific. It may be used, combined with iodine, in the form of Coster's paste (see p. 109). This application causes the formation of a black crust, after the removal of which the part is well washed and the paste re-applied. Crocker attaches great importance to *tearing off* the crust, as this brings away more fungus and diseased hairs than if it is allowed to separate spontaneously. Tar may also be used in the form of oil of cade or creasote. Neither of these substances, however, can be relied upon to effect a cure; the most they do is to hold the disease in check.

Thymol.—Thymol may be used in an ointment (℥iij—v in ℥i). Dissolved in turpentine (ʒss—i in ℥i), it is sometimes an effective application. I sometimes use thymol or menthol (ʒss) with chloroform (ʒij) and olive oil (ʒvi) in very recent cases, after the scalp has been cleared of diseased hairs.

Turpentine.—This agent may sometimes do good by exciting inflammation. Its chief utility in ringworm, however, is as a stimulant to the scalp after the removal of diseased stumps. Turpentine may also be used as a solvent for thymol, as above stated.

Veratria has been used in ointments containing from eight to thirty grains to the ounce with some success. I do not think, however, it is safe to use such a powerful alkaloidal poison as this in the treatment of this disease.

THE CHOICE OF AN AGENT.

Of the indications which should guide the practitioner in the choice of an agent there is little definite to be said. As may

be gathered from the multitude of remedies enumerated above, there is none that is infallible and none that is of universal application.

The remedies have, for the sake of convenience, been grouped under the general head of "Parasiticides," but it is necessary to point out that in the case of a considerable number of them the therapeutic effect in ringworm is due less to their parasiticidal properties than to a special action which they exert on the tissues in which the fungus is implanted. As a result of this the soil is modified so as to become unsuitable for the growth of the parasite. The change is not due merely to inflammation such as can be caused by the application of irritants. By the use of various drugs simple dermatitis, or artificial eczema, or pustular eruptions can be produced, but such processes have of themselves no special tendency to arrest the growth of the ringworm fungus. Indeed, as has been pointed out, they may be the means of assisting the spread of the disease. The exact nature of the change in the soil brought about by certain agents is not clearly understood. It may be a chemical change in the tissues; or a toxin may be generated which destroys the fungus; or, again, a change may be produced in the horny layer which renders it more resistant to the action of the parasite, or incapable of supplying the nutritive material required for the growth of the fungus. Whatever the change is, it is something more than the result of a simple inflammatory process. The power of producing this change is peculiar to certain agents, and it is in virtue of their possessing this special property, not of their being irritants or parasiticides, that they cure ringworm. Among such agents the first place must be accorded to chrysarobin (see p. 105). Next to that, though *longo intervallo*, comes sulphur (see p. 115). Then there is mercury in one or other of its pharmaceutical forms (see p. 110). These are the only remedies that can be credited with any approach to specific curative action in regard to ringworm.

As an exemplification of my own method of treating ringworm, I may here describe the plan which I ordinarily adopt in dealing

with chronic ringworm of the scalp. The hair on the patch and for one inch all round it is first cut short. Then all the diseased hairs that can be seized are picked out with broad-pointed forceps. No water or soap should be used in washing the scalp. In order to remove from the skin the dried scales and sebaceous matter accumulated upon it, the parts should be washed, *once only*, with soft soap and spirits of wine, or with spiritus vini rect. and carbolic acid or hydrarg. perchlor. When the surface has become dry chrysarobin is rubbed in for ten minutes; the excess must be wiped up, and care taken that no particle of the ointment gets into the eye. The ointment should be applied on subsequent days till the part becomes tender or till a red halo is visible. The use of the chrysarobin should then be stopped and an ointment either of boric acid, or oleate of zinc or oleate of copper applied. As soon as the tenderness of the skin has disappeared, the chrysarobin should again be used. This time inflammatory reaction is longer in showing itself than on the first occasion. It is essential, however, to produce what I call the "chrysarobin crisis" in order to obtain a rapid cure. If after three such "crises" a very marked improvement—shown by a notably diminished number of diseased hairs —has not been effected, sulphur should be tried instead of chrysarobin; if this does not answer recourse should be had to mercury and that failing, to iodine.

But it must once more be repeated that each case must be dealt with in accordance with its peculiar features; and the practitioner must, in treating it, carefully feel his way, not putting his trust in any one remedy, but trying one after another till he finds that which will suit the requirements of the case, and using that only as long as it serves its purpose. It may be said in general terms that the small-spored fungus calls for more drastic measures than the megalosporon, but even in dealing with the most refractory fungus it is useful to remember the famous caution against over-activity in another sphere—"*Surtout, Messieurs, pas trop de zèle!*"

SOME SPECIAL METHODS OF TREATMENT.

Vapours.—The action of vapours, particularly acid vapours, such as acetic acid, etc., was tried by Lailler in the Saint-Louis Hospital at the suggestion of M. Duclaux. The results of the experiments were not sufficiently encouraging to induce Lailler to persevere with the treatment.

Unna's method.—Unna, as already said, finds chrysarobin almost a specific in ringworm. I give the description of his method in his own words*:—

"First of all, the whole scalp must be cropped short (not shaved), even though only a few bald spots be present; for, as it soon becomes apparent under the treatment, there are always more hairs attacked than we may at first sight imagine. The same plan must, of course, be adopted if there be no bald spots, but only scattered stumps. The whole forehead of the child, the temples, the ears, and naked parts, are then covered with strips of zinc gelatine; and after this has been done, the scalp within the zinc gelatine margin is carefully painted over with strong chrysarobin ointment—*e.g.* my ung. chrysarobin co. (Chrysarobin 5, ac. salicyl. 2, ichthyol 5, and ung. simpl. 100)—or any other ointment containing from 5 to 10 per cent. of chrysarobin. The hairy part of the head is then covered with some waterproof material (waxed linen, gutta-percha tissue, etc.), the edge lapping over the marginal strips and gummed down with zinc gelatine, then bound with an adhesive mull binder, and, lastly, a well-fitting flannel or wax-cloth cap is tightly fixed over everything with strings.

"Once in twenty-four hours the cap is removed, the waterproof material cut along on one side and reflected, and the head washed, dried, and covered again with fresh ointment. The slit in the material is then closed with fresh mull strips, and the cap replaced. If this proceeding can be really carefully carried out, on

* "On the Treatment of Trichophyton Capitis"; Selected Monographs on Dermatology, New Sydenham Society, London, 1893, p. 103 *et seq.*

the fourth day—when the first chrysarobin cycle is terminated—only the upper edge of the zinc gelatine strips should be stained yellow from chrysarobin. Every spot of the latter is at once to be seen on the white ground of the border strips, so that an unobserved contact with the eye is impossible. Should there be any discoloration of the lower part of the marginal strips, or of the neighbourhood near the eyes, it should be washed off and smeared over again with zinc gelatine.

"With this bandage we can allow children to play about quite harmlessly; they may sleep on it, and even go to school, being not contagious nor dangerous either to themselves or others.

"On the fourth day, when the cap is removed, the chrysarobin ointment is washed off, and replaced by a 5 per cent. ichthyol ointment, which is to be used for the remaining three days of the week, in order to allay the irritation produced by the chrysarobin, to make the horny layer fall off quickly, and to bring the skin back to its original colour. This application may be replaced by a 5 per cent. ichthyol solution, or, not so well, by a 5 per cent. sulphur ointment, also to be applied every day for three days.

"Now, only at the end of the first week can we wash off without danger the zinc gelatine strips at the back, and cleanse the whole head properly with oil and soap. The diseased parts are now very apparent from their white colour contrasting with the healthy scalp around, and they frequently astonish us from their unexpected number. From all these places some stumps (about twenty altogether) are epilated, in order accurately to observe the condition of the fungus.

"After this the second cycle is commenced, and this lasts also for a week, and runs the same course as the first. At its termination again twenty stumps are drawn out to confirm the improvement.

"A third and a fourth cycle, following, generally conclude the treatment. I have not found it necessary to follow on with a fifth. The total length of time required for my treatment amounts, therefore, to four weeks. Possibly the very old and

severe cases of the London hospitals would need a five- or, at most, a six-weeks' course. This result, at any rate, is immeasurably different from that obtained by the best London dermatologists, who are accustomed to estimate the treatment of medium cases always by months, and who can even speak of cases under treatment for years."

Vidal's method.—Vidal* has based a method of treatment on the fact that the fungus is aërobic. The principle of the method is to kill the fungus by depriving it of the air necessary for its life. Experiments made by him, in conjunction with Marfan, showed that if a layer of sterilised vaseline were poured over a pure culture of trichophyton in a test tube, the growth of the fungus was prevented. The following are the details of the treatment:—After cutting the hair as short as possible, the whole scalp is rubbed with essence of turpentine, and the affected spots are painted with tincture of iodine. A coating of vaseline is then spread over the scalp, which is covered with an india-rubber cap, or, if economy be an object, with gutta-percha tissue, kept hermetically applied by means of a cap with strings. The dressing is renewed morning and evening, the head being washed in the morning and carefully dried, and the gutta-percha tissue likewise in the evening, when a fresh layer of vaseline is put on. Iodated vaseline (1 gramme per 100) may with advantage be substituted for simple vaseline. If the applications of tincture of iodine to the patches are well borne, they are repeated every day; if they give rise to irritation, every two or three days, or at longer intervals. After a few months the application of pieces of Vigo's plaster,† *cum mercurio*, is substituted for the iodine paintings. This plaster, in addition to its parasiticide effects, acts, according to Vidal, by excluding the air. The plaster is applied every morning, after which the scalp is covered with iodated vaseline, and the head then covered with gutta-percha.

* Congrès Intern. de Derm., Paris, 1889.

† Vigo's plaster is composed of lead plaster, yellow wax, resin, olibanum, ammoniac, bdellium, myrrh, saffron, mercury, turpentine, liquid borax, and oil of lavender.

Quinquaud sometimes combines this sealing-up treatment with the application to the patches of parasiticides, such as perchloride or biniodide of mercury, pyrogallic acid, chrysarobin, protochloride of iodine (1 in 20); the dressing is left on several weeks. The results are said to be good.

Hallopeau's method.—Hallopeau's method somewhat resembles that of Vidal. The hair having been cut close, the scalp is washed every morning with soft potash soap; this is followed by friction with a stimulating lotion, composed as follows:—

℞ Camphorated alcohol, 125 parts.
Essence of turpentine, 25 parts.
Liquid ammonia, 5 parts.

Half an hour afterwards iodine, 1 per cent. in vaseline, is applied; this latter application is repeated at the end of the day. A gutta-percha cap is worn all day.

Besnier's method.—Besnier's method of treating ringworm* is as follows:—

1. The hair must be cut quite close with scissors, not shaved, the latter procedure involving the risk of auto-inoculation by means of the razor. The hair must be kept close cut during the whole time of treatment and as long as the patient is kept under observation subsequently.

2. On the scalp the healthy surfaces must be kept separated from the diseased patches by a zone of epilation, which must be kept up until the diseased place is cured. Besnier states emphatically that when this measure is rigorously carried out, it is altogether exceptional either for the patches to spread or for new ones to form. It has, furthermore, the advantage that the diseased surface is exposed in its whole extent, and thus, whatever remedies are used, can be applied methodically and effectually.

3. With the curette, or a disarticulated blade of an ordinary dressing scissors, all the stumps on the patch and all the *débris* of

* French Translation of Kaposi's "Pathology and Treatment of Diseases of the Skin," Paris, 1891, t. ii., p. 832 *et seq.*

whatever kind accumulated there are scraped away; this procedure is greatly facilitated by the previous inunction of the patch with vaseline, which will also prevent any scattering of the *débris* on healthy parts. The first scraping, or, as Besnier calls it, "*rugination*," should be done rather gently, so as not to cause bleeding; but a second scraping is necessary thoroughly to clear the affected surface. This should be done after the patch has been washed with a pledget of sterilised cotton soaked in the following liquid:—

℞ Alcohol 90°, 100 grammes.
Boric acid, 1 gramme.
Chloroform, 5 grammes.

This second "rugination" is rather painful and causes some bleeding; but if thoroughly carried out its action is decisive. After this second scraping, if the surface operated upon is examined with the lens (bleeding having first been stopped by compression for a few minutes with sterilised cotton), it can be seen that the mouths of the follicles, which were before stuffed with fungus, are clear and wide open, so that any local remedy which may be thought suitable can be applied effectually. The procedure should be supplemented by the removal, with the curette or other suitable instrument, of all the satellite diseased hairs which can be discovered, on close inspection with the lens, in the zone of epilation.

4. When the fungus has in this way been got rid of as completely as possible, the patch and its "zone of safety" are a second time washed with the lotion above mentioned, and afterwards dabbed with a pledget of sterilised cotton soaked with the following solution:—

℞ Van Swieten's solution,* 100 grammes.
Crystallising acetic acid, 1 gramme.

Lastly, it is accurately covered with the following:—

℞ Vigo's ointment, 100 grammes.
Acetic acid, 1 gramme.

* Van Swieten's solution has the following composition:—Corrosive chloride of mercury, 2 grains; alcohol, 3 drachms; distilled water to 4 ounces. One teaspoonful contains $\frac{1}{16}$ of a grain of corrosive sublimate.

The procedure, so far, may be summed up as follows:—

(*a*) The patch has been isolated from the healthy parts;

(*b*) Has been cleansed antiseptically;

(*c*) Mechanically cleared of all accessible fungus;

(*d*) A second time, cleansed antiseptically; then,

(*e*) Impregnated with a mercurial acetic solution 1 in 1,000;

Lastly (*f*), Dressed with an aceto-mercurial plaster, which acts also by occlusion.

Besnier points out that, with the exception of the epilation and the scraping, every detail of the treatment just described can be carried out by those about the child, so that he need be brought to the doctor only once a week. With the head cleansed in the manner that has been described, and the diseased parts covered with an occlusive dressing, the child ceases to be dangerous to others. The cleanliness of the head is maintained with the greatest ease, if the hair be kept close cut over the whole scalp, by daily washing with hot water and a medicated soap of some kind (boric acid, sulphur, tar, etc.). Besnier states that although the method described would appear to be likely to cause great irritation, inflammatory and pustular complications more rarely follow it than they do gentler methods, provided the hands of the dresser and the instruments used, as well as the patient's head, are kept scrupulously aseptic.

5. The appearance of diseased hairs on the surface of the patch is an indication for the repetition of the epilation and scraping; the necessity for such repetition will be less in proportion to the thoroughness with which the treatment was carried out in the first instance. Progress towards cure is shown by the growth of hair not infiltrated with, although sometimes containing, the fungus —a point that is easily settled by microscopic examination or culture. The new hair must be pulled out until it is absolutely free from any trace of fungus.

If this treatment be accurately and thoroughly carried out Besnier says that a period of not more than two to three months is required to effect a cure.

Sabouraud's method.—Writing of the method introduced by Sabouraud, Brocq * says that in *trichophytosis* of animal origin it is frequently necessary to begin with soothing treatment, on account of the inflammatory symptoms which are often present. For this purpose dressings of boric gauze may be used. After the inflammation is subdued, vaseline containing iodine in increasing strengths from 1 up to 20 per cent. is applied. Still more may be accomplished by painting the diseased areas, which have been washed and surrounded with a zone from which the hair has been epilated, with tincture of iodine, and then applying over this a layer of Vigo's plaster. These applications may be made every day or every second day, according to the amount of reaction caused.

In the form of the disease depending upon the presence of the *microsporon Audouini,* Sabouraud thinks the following method the best: Each night the diseased area is entirely covered with a cotton tampon soaked in the following solution:—

℞ Calcium chloride, ʒiijss.
Water, ℥x.
M.

Cover with a piece of rubber tissue. The next morning wash with soap and cover with diachylon plaster. Twice a week apply tincture of iodine to all the diseased spots.

The croton oil treatment.—In some cases a more destructive inflammation, producing a condition resembling kerion, is required, the object being to excite an acute inflammatory process and perhaps local necrosis, whereby the fungus as well as the affected tissues shall be involved in the destruction.

For the production of artificial kerion to this end Aldersmith † uses croton oil. The following is a description of the method, almost in his own words:—

Before commencing the treatment every place should be accurately marked out, and the hair also cut for an eighth of an

* *Jour. Cutan. and Genito-Urin. Dis.*, Oct., 1894.
† Op. cit., p. 228 *et seq.*

inch round the patches. It is advisable for the first few days to treat only one place, and to begin with a small patch.

The croton oil should be well rubbed into the place with a very small camel's-hair brush; but only a drop is required, as no excess must be left to spread to the surrounding skin or to run down. If great care be not taken and any excess be used the pustulation will extend much farther than is required. Carbolic lanolin (℥iss in ℥i of *anhydrous* lanolin) can then be painted round the place. This prevents the disease from spreading, and also the croton oil from extending beyond the place. A little piece of tissue-paper can be put over the place, sticking to the lanolin, and the oil left to soak in, if a cap has to be worn at once; or the oil may be left exposed to the air for a time. After three or four hours a linseed-meal poultice about half an inch thick should be placed directly on the patch, covering it and extending for about half an inch around it. The poultice should be covered with a piece of oil silk, the whole being kept in position by a handkerchief tied round the chin, and at night by an ordinary white night-cap securely fastened. Carbolic glycerine 1 in 8, or oleate of mercury in almond oil 15 per cent., should be applied to the rest of the scalp once a day.

The next morning the poultice must be removed, and the place well bathed with warm water, when a number of small, yellow blisters will be seen. These may be pricked and any matter let out, and the place well bathed before it is again painted with croton oil. The pustulation may have spread beyond the place, but the oil must only be applied to the original patch, the position and size of which should be carefully noted. Carbolic glycerine or lanolin should always be smeared round the places to prevent the croton oil from extending, and after the oil has soaked in for an hour or two a poultice should be applied as before.

Constant poulticing should be continued day and night, the place or places being bathed each time the poultice is changed and any matter removed. On the second morning after bathing

off any yellow exudation, if there is no appearance of superficial sloughing of the skin, the oil can again be applied.

If kerion is not set up this bathing, poulticing, and daily application of a drop of oil after the drop of pustular exudation is removed may be continued from one to three weeks, according to the effect produced. If kerion be set up the hairs and stumps are loosened, and either come away with the discharge or can easily be pulled out.

When kerion comes on the croton oil must at once be discontinued and soothing remedies applied, such as simple bathing with warm boric acid lotion and constant poulticing, with some borogly ceride on the poultice, till all the stumps are loosened. When this happens, the sooner they are all extracted the better. This does not cause any pain, as the hairs are simply lying loose in the follicles.

When all the hairs have been removed the swelling soon goes down under the above treatment, and if any stumps remain they can be extracted from time to time. When the stumps have all been removed and the inflammation has subsided, and the skin has returned to its normal condition, Aldersmith paints it every day with tincture of iodine till the new hair grows, or applies the following lotion :—

℞ Tincturæ cantharidis, ℥ij.
Acidi acetici, ℥i.
Glycerini, ʒss.
Spiritûs rosmarini, ℥i.
Aquam rosæ ad ℥viij.
Misce. Fiat lotio.

The following are the cases which, in Aldersmith's opinion, are suitable for the croton oil treatment: (1) Chronic small patches which have resisted treatment for some time; (2) any moderate-sized place where a cure is necessary as quickly as possible; (3) old cases of disseminated ringworm, especially of the "black-dot" form, when the individual stumps should be needled with croton oil. The method should never be used in cases in which the disease is spreading.

I have described Dr. Aldersmith's treatment in detail, as it has proved so successful in his hands. I do not, however, employ it myself on account of the extreme difficulty of controlling the inflammation and the consequent risk of spreading the disease. I have seen this untoward result in several cases.

WHEN CAN RINGWORM OF THE SCALP BE SAID TO BE CURED?

For the sake of his own credit as well as for the interest of the patient and that of those with whom he comes in contact, the practitioner must not be too hasty in pronouncing a case of ringworm of the scalp to be cured. A case can be said to be cured only when the most minute inspection reveals no broken or diseased hair, and when the absence of any trace of the fungus is confirmed by microscopic examination, which may for greater safety be supplemented by culture experiments. To make assurance doubly sure, the examinations and cultural tests should be repeated in two or three months, and if there be the slightest shade of doubt, more than once. Besnier lays great stress on the fact that what appears clinically to be a cure, though often sufficient as far as the individual is concerned, by no means offers an adequate guarantee that he is incapable of conveying infection to others; as long as he has on his head a single diseased hair he can transmit the disease. Besnier states emphatically that it is the confusion between what he calls clinical cure and histological cure, which is the fundamental cause of the perennial prevalence of endemic ringworm in towns, and as long as this point is not attended to in practice the suppression of the disease can never be achieved.

Wickham * advises that no case be reported cured until the following method has failed to reveal the parasite:—The hair having been cut short and the scalp thoroughly washed, the head is left absolutely undisturbed for a week; then the scalp is carefully examined for evidences of disease. If none are found the hair is cut again, the scalp washed, and the head left undisturbed

* *Annales de Dermatologie*, 1894.

for another week, when the second examination is made. If that also proves negative, the head, after hair cutting and washing, is left untouched for two weeks, at the end of which period a final examination should be made.

My own rule is, after a careful examination, to leave the case untreated for a month; and if no short hairs can be found, if the part is free from scaliness, and the new hair sufficiently grown to cover the patch, I pronounce the case cured.

RINGWORM OF THE BEARD.

The treatment should be conducted on the same general principles as that of ringworm of the scalp. In the early stage, when the only visible lesions are erythematous rings, shaving should be forbidden, but the hairs should be cut close with fine scissors. The affected parts are then to be rubbed vigorously with tincture of iodine, the friction being repeated till thorough desquamation has taken place. If the disease is more advanced epilation must be carried out piecemeal. This will give exit to the pus; neither incision nor scarification is ever required. Parasiticides must then be applied, their nature and strength being carefully adapted to the condition of the affected parts and the susceptibility of the patient's skin. Chrysarobin in the form of an ointment (grs. x to ʒss of the drug to ʒi of lanolin or lard) is the most efficient application. Corrosive sublimate in an ointment (1 in 100) is also an effective application. Resinol ointment is sometimes effective, and does not cause irritation. Naphthol may be used according to the following formula:—

℞ Naphthol, ʒi.
Saponis viridis
Cretæ præp.
Sulphuris
Lanolini
āā ʒvi.
M. Sig. Apply locally at bed time.

Besnier insists that each separate focus of the disease, "should they consist of single hairs," should be isolated by a zone of epilation,

and then dealt with in the same manner as ringworm of the scalp by scraping, followed by the application of mercurial or other parasiticides. Kerion-like conditions he treats with repeated sprays of carbolised water (1 to 5 in 100), followed by washing with an alcoholic solution of boric acid or salol. If the irritation is very great, he wraps the affected parts in compresses of lint soaked in boric acid solution, and seals them up with an impermeable dressing.

Boisseau de Rocher* has used electrolysis with success. Needles of pure silver were thrust into the affected tissues, and these were connected with the positive pole of a galvanic battery, while a moist electrode connected with the negative pole was placed on a neighbouring part of the body. In the passage of the current through the silver the liquids of the body are decomposed, sodium chloride being produced, which with the silver forms the oxy-chloride. A strong current is not necessary, one of from 3 to 4 milliampères being sufficient. In one case, ten or twelve needles were implanted at once, and the current passed for ten minutes, the sittings being given twice a week. In all, twenty-five sittings were necessary to effect a cure.

RINGWORM OF THE BODY.

Ringworm of the body is easily and rapidly cured, as the parts are always accessible, and the fungus does not penetrate beyond the superficial layers of the epidermis. The most effectual mode of treatment is the mechanical removal of the superficial layers of the epidermis by the application of iodine, liquor epispasticus, or other blistering fluid. Besnier says that even when the affected surface is in an irritable condition, it should be rubbed roughly (*rudement*) with a pledget of short-cut and tightly-packed charpie (a charpie besom, he calls it), or with a piece of wood covered with linen, till the part has been stained a dark chestnut colour, deeper than that of the surrounding skin, which should also be rubbed with the iodine. He often even slightly scrapes the border of the patch with the wooden handle of the charpie besom. This vigorous

* *Journ. des Mal. Cut. et Syph.*, April, 1889.

friction, he says, is not followed by any great reaction, and generally suffices to cure the disease, as shown by the immediate arrest of the centrifugal extension of the process, and in a few days when the exfoliation caused by the iodine is complete, by microscopic examination.

If some fungus be left in the deeper layers of the rete, below the limit of the action of the blister the application of a parasiticide remedy will speedily destroy it. The most effective agent for the purpose is chrysarobin, which may be applied as an ointment composed of xx grs. of the drug to ʒi of lanolin, or in the form of Unna's ung. chrysarobin. co., which consists of 5 parts of chrysarobin, 2 parts of salicylic acid, 5 parts of ichthyol, and 100 parts of unguentum simplex. Other useful applications are ointments composed of oleate of copper or oleate of mercury, 3 grs.; lanolin cum oleo, ʒi; or sublimated sulphur, 3 grs.; carbol ♏xx; lanolin, ʒij; ol. oliv., ʒij; either of these should be rubbed in thrice daily. For young children a milder application, such as hydr. ammon., 3 grs. lanolin or lard, ʒi, is advisable.

In cases in which large areas are affected, or in which the disease is acute, Besnier recommends the use of pommades of beta-naphthol, pyrogallic acid, or chrysophanic acid.

Allan Jamieson finds that body ringworm, as a rule, yields within ten days to washing with superfatted potash soap twice a day, followed by the application of white precipitate and sulphur ointment.

TINEA MARGINATA.

This condition is much more difficult to deal with than simple tinea circinata. Thin* recommends washing with soft soap twice daily and rubbing in the following ointment:—

℞ Sulphuris sublimati,
Olei cadini, āā ʒiv.
Saponis viridis,
Adipis, āā ʒi.
Cretæ præparatæ, ʒijss.
M. Ft. ungt.

* Op. cit., p. 81.

F. Roux,* after wetting the affected parts with water, sprinkles them with Goa powder, which is left on all night. A method of using Goa powder dissolved in acetic acid or vinegar is common in India. Chrysarobin may be used as an ointment (ʒss of the drug to ʒi of lanolin); this is, on the whole, the best treatment. Kaposi advises the application of a 1 per cent. solution of naphthol in alcohol and a 5 per cent. naphthol ointment. R. W. Taylor recommends the following, to be painted on daily:—

℞ Hydrarg. perchlor., grs. ij.
Tr. benzoin co., ʒi.

Another mode of treatment, which is said by Jamieson to be the most efficacious of all, is to apply a freshly-prepared solution of sulphurous acid freely to the parts several times a day. A suspensory bandage should be worn and the surfaces should be kept apart by means of Unna's bags filled with salicylic talc dusting powder.

RINGWORM OF THE NAILS.

A "radical and immediate treatment" of this condition is, as Besnier says, evulsion of the nail. If this be objected to, it will generally be found sufficient to scrape the nail thin, and then to soften it with potash soap and apply chrysarobin or some other parasiticide. If need be, a local anæsthetic may first be applied. The treatment used by Harrison, of Bristol, for ringworm of the scalp is particularly useful for the disease as it affects the nails. He uses two solutions—No. 1 composed of liquor potassæ and distilled water āāʒss, and iodide of potassium, ʒss; and No. 2 consisting of hydr. perchlor., gr. 4, spir. vini. rect. and distilled water, āāʒss. The nail having been scraped, No. 1 is applied on lint under oiled silk for fifteen minutes; then No. 2 is immediately applied in the same way, and kept on for twenty-four hours. The nail is then again scraped, and the applications are repeated as often as may be necessary. H. Fournier† recom-

* Traité Pratique des Maladies des Pays Chauds, t. iii., 1888, p. 231 (quoted by Besnier).

† *Journ. des Mal. Cut. et Syph.*, April, 1889.

mends the removal of the whole of the affected parts by scraping, scratching, or evulsion, and by the action of various local remedies, such as creosote, acetic acid, benzine, corrosive sublimate (2 per cent. in alcohol or chloroform), mercurial plaster, resorcin, or tincture of iodine. The two last named, combined with previous maceration of the nail by means of india-rubber coverings, are those which Fournier has found most successful.

Sabouraud* presented to the Soc. Française de Derm. et de Syph., on January 2, 1896, a patient with large spore ringworm of all the nails of the right hand, proved by microscopic examination. He had been for four months under treatment by a permanent moist iodised dressing; each finger was dressed with a piece of absorbent wool steeped in the following liquid:—

℞ Metallic iodine, 1 gramme.
Iodide of potassium, 2 grammes.
Distilled water, 1 litre.

The dressing was kept in place by a finger-stall; the patient's fingers were thus fairly free, and he had not to give up his work for a single day. When shown, after four months of this treatment, the nails were seen to be divided accurately into two by a transverse line separating the old (diseased) nail from the recent healthy parts. The same condition was visible in all the nails, showing that the growth of the fungus had stopped since the application was begun. Sabouraud thinks this treatment, though slow, superior to any rapid method, whether it be evulsion, which often misses its object, or the production of an artificial whitlow, which may easily go beyond it.

* Ann. de Derm. et de Syph., t. vii., No. 1.

CHAPTER XII.

PROPHYLAXIS.

THE continued prevalence of ringworm is a standing reproach to the medical profession, and in a lesser degree to the authorities of schools. The disease could in no very long time be stamped out if every case that occurs were properly isolated, and if doctors were more careful in giving certificates of cure. It is the cases in which the marks of the presence of the fungus are few and far between, and in which, therefore, a minute examination is required to discover them, that are the sources—often unsuspected by teachers or parents—of infection. Therefore no certificate of cure should be given until the complete and permanent disappearance of the fungus has been proved in the manner described in the preceding chapter (see p. 128). All children should be strictly examined by a competent practitioner before admission to schools, public or private, and this inspection should be repeated each time the school reassembles after a period of closure extending over several weeks. This precaution is particularly necessary in the case of Board Schools, which often are, and always are in danger of becoming, nurseries of ringworm. Teachers should be instructed in what may be called the "snap-shot" diagnosis of the affection, and should be vigilant in looking for it. Any suspicious case should forthwith be referred to a doctor for examination. Any child in whom the disease is actually discovered should at once be removed from the school; doubtful cases should be quarantined till such time as, after due examination, a clean bill of health can be given. In the child's home isolation of the patient in the ordinary sense would, in the vast majority of cases, be impossible, if it were desirable; but all that is needful can be accomplished by *isolation of his scalp*. This can be effected as part of the

treatment by making him wear a close-fitting cap over carefully-applied parasiticide dressings, as already described (see pp. 100, 119, 121).

But, as has been said, ringworm often resists treatment for months, sometimes for years. Are the unfortunate children suffering from the disease to be kept apart from their fellows like lepers, and is their education to be interrupted all that time? Many persons, medical as well as lay, will be disposed to wonder with Dr. Goodhart, what would have happened to the child's associates "equivalent to the harm that has accrued to the child and his attendants from the treatment he has undergone." I admit that the rigorous methods above suggested are, at first sight, somewhat akin to those of the bear in the fable, who (with the best intentions) smashed the man's head with a huge stone in order to crush a fly on his face. On the other hand, ringworm being so easily preventible, it appears to me to be worth while to make a united and systematic effort to prevent it. The children's education need not be interrupted. At the Seventh International Congress of Hygiene and Demography, held in London in 1891, I read a paper on "Ringworm in Elementary Schools,"* in which I suggested the establishment of special schools in which children suffering from the disease could be educated while under medical inspection and treatment. The following passage may appropriately find a place here:—

On the one hand the schoolmaster, who is watchful and zealous as to the physical well-being of the children under his charge, refuses to admit a child with ringworm to his school; whereas, on the other hand, he who is lax is apt to overlook or minimise the importance of the disease. In both cases, in my opinion, a grievous injustice is committed, for in the former case a child, presumably in good health, is banished from school and all its advantages, both moral and educational, for a prolonged period, at a time of life when these are essential for its well-being. In

* Transactions of the Seventh International Congress of Hygiene and Demography, London, 1892, vol. iv., p. 27 *et seq.*

the second case, the spread of the disease to other children is inevitable, and the community at large, as well as the individual children, must suffer. Of these alternatives, from a medical point of view, the former is the only logical course, though its effect must of necessity be a marked diminution in the general standard of national education and the reduction of the educational returns. It can hardly, I think, be questioned that it is the duty of the State to remedy this, and I would suggest the following practical recommendations as the only ones which have suggested themselves to my mind as offering any solution of the difficulty. It is clearly necessary, before attempting to cope with the disease, that the exact extent and frequency of its occurrence should be estimated. This can only be carried out by means of *systematic inspection*, in order to accomplish which persons should be trained in each school by skilled medical men to make a weekly examination of every child's head. By this means alone trustworthy statistics would soon be obtained. My second recommendation is directed towards the eradication of the disease without interrupting the educational progress of the child. In the more crowded districts, or wherever feasible, special schools ought to be established, in which both systematic treatment and instruction could be carried out. In less populous districts a single classroom might be isolated with a separate entrance. If such a system could be enforced, the advantages would be that the education returns would at once show a marked improvement, that the children would no longer be deprived of their just privileges of education, and that ringworm would be materially diminished in Great Britain, if not entirely eradicated.

Dr. Colcott Fox, in discussing my paper, recommended the following course:—

(1) That a systematic inspection of the school children should be carried out by a staff of medical men or by specially trained nurses, at the beginning of term and at stated intervals afterwards. (2) That the infected children should be sent to a convenient hospital or dispensary for a course of treatment to be prescribed.

The cure would be much expedited if nurses could assist and supervise those in charge of the treatment. (3) That the children should still attend the schools, but be isolated, as far as possible in the schoolrooms; that they should have their heads properly treated with germicide applications, and be covered with suitable caps to prevent any dissemination of the fungus; and that they should be discharged from school before the other children, to prevent intermingling.

The last of these precautions, which amounts to what I have called isolation of the scalp, would doubtless be efficient in the child's home, but would simply make the little sufferer's life a burden to it in the rough environment of a large school, and would probably also be ineffective as a protection to others.

For some years there has been a ringworm school attached to the great hospital of St. Louis in Paris, where children suffering from the disease are taught and treated till they are cured; and statistics of cure in this school are, in point of rapidity, far better than anything that can be shown in hospital practice in England.

Fig. 1.—Ringworm of scalp: small-spored fungus lying thick around hair; spores scattered irregularly; some few threads of mycelium here and there.

The microphotographs were taken by Mr. Andrew Pringle.

Fig. 2.—Ringworm of scalp: small-spored fungus; portion of affected hair outside follicle; spores surrounding hair; in centre here and the reirregularly-jointed mycelium, branching in parts and curved.

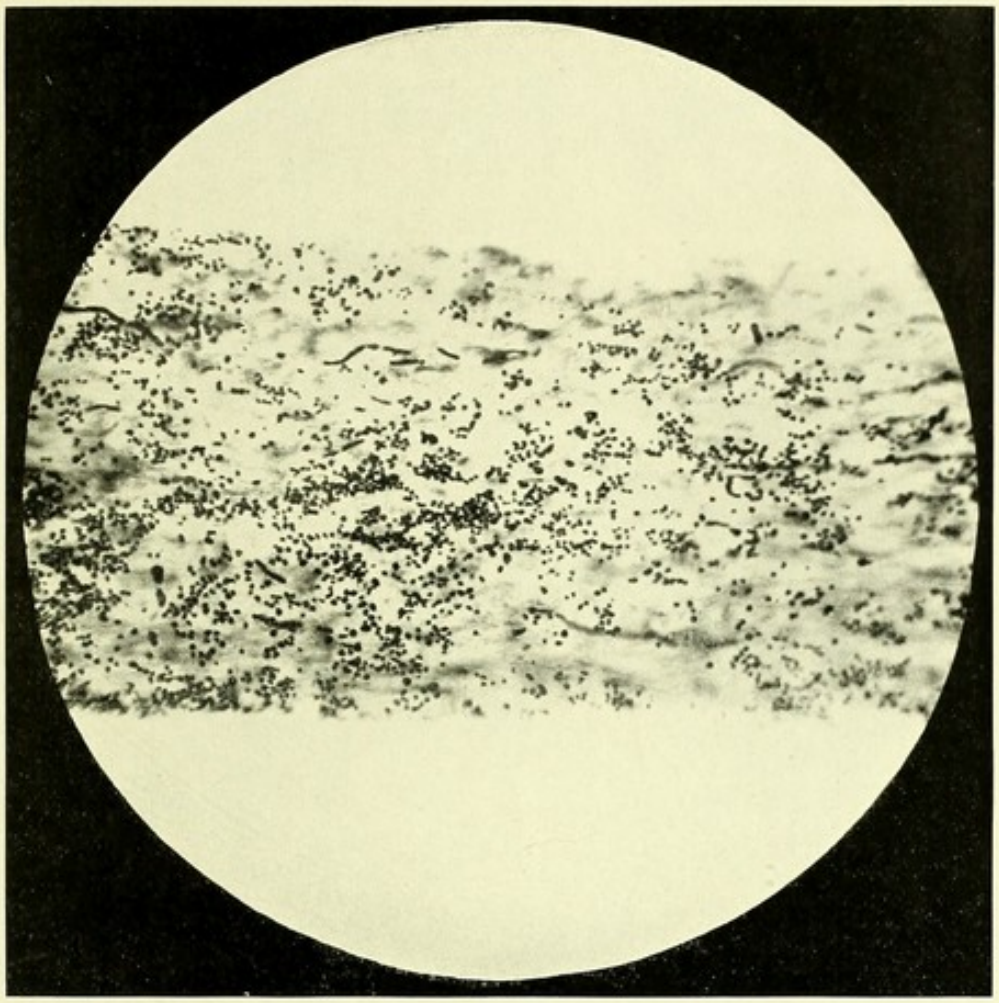

Fig. 1.

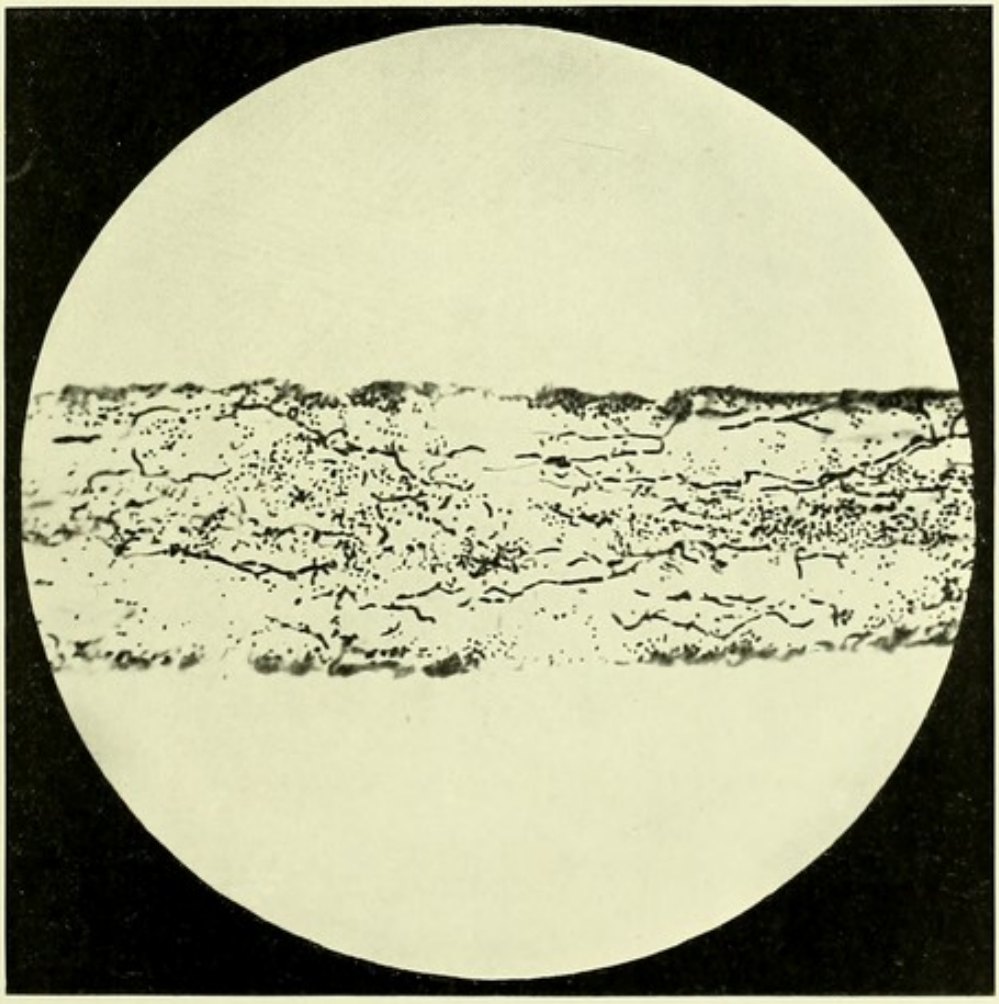

Fig. 2.

Fig. 3.—Same as II. : focussed to show middle of hair; smaller number of spores; a few threads of irregularly-jointed mycelium, branched and curved.

Fig. 4.—Hair from scalp: small-spored fungus; a very few spores, some on surface; thick, irregularly-jointed mycelium.

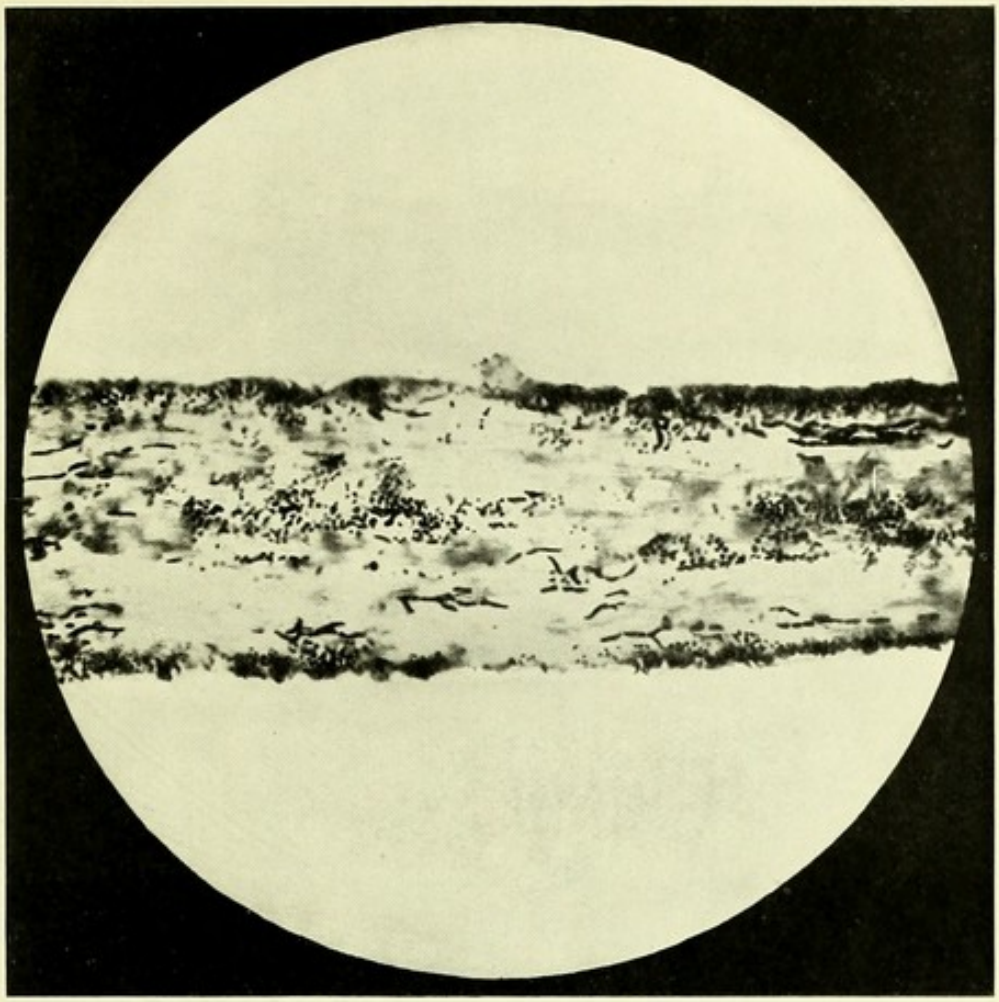

Fig. 3.

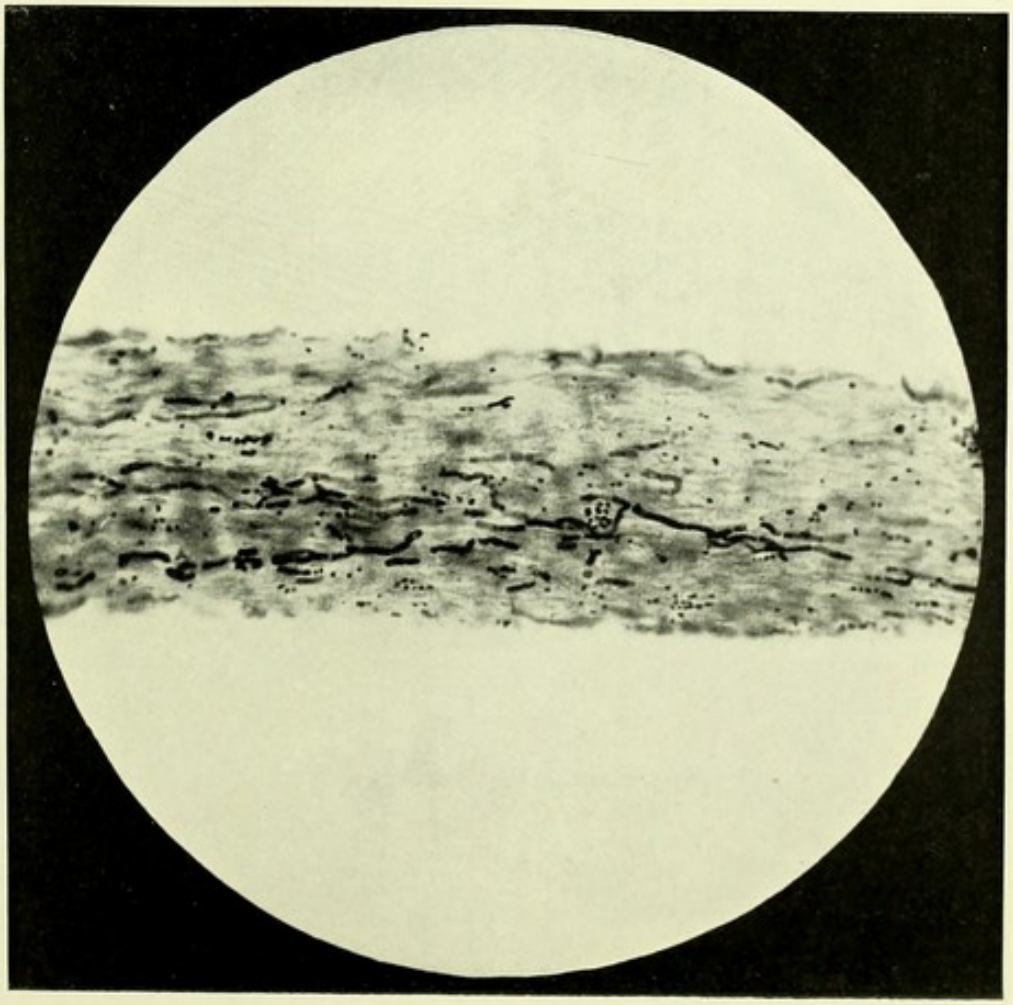

Fig. 4.

Fig. 5.—Hair from scalp: small-spored fungus; thick masses of mycelium and swarms of spores; hair split in centre and frayed at edges.

Fig. 6.—Hair from scalp: tranverse section, showing thick growth of fungus in centre, and spores round shaft.

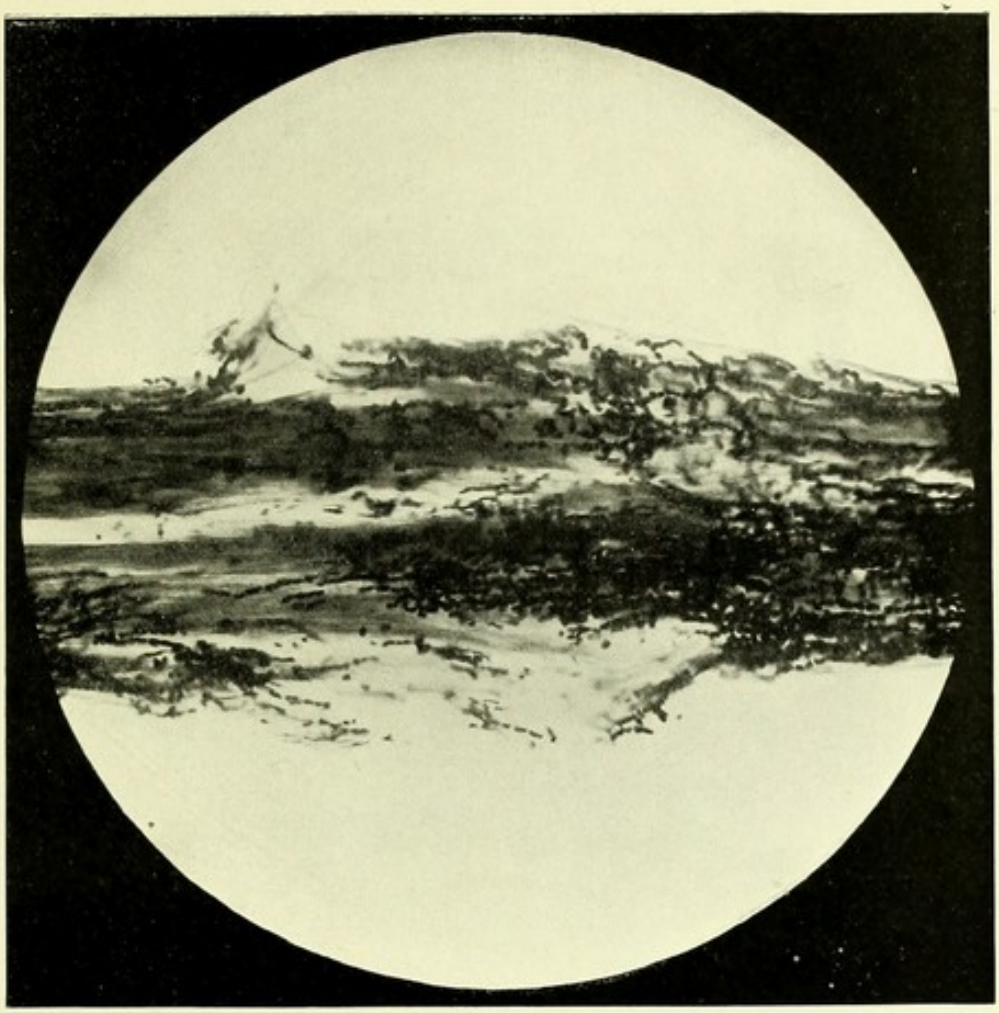

Fig. 5.

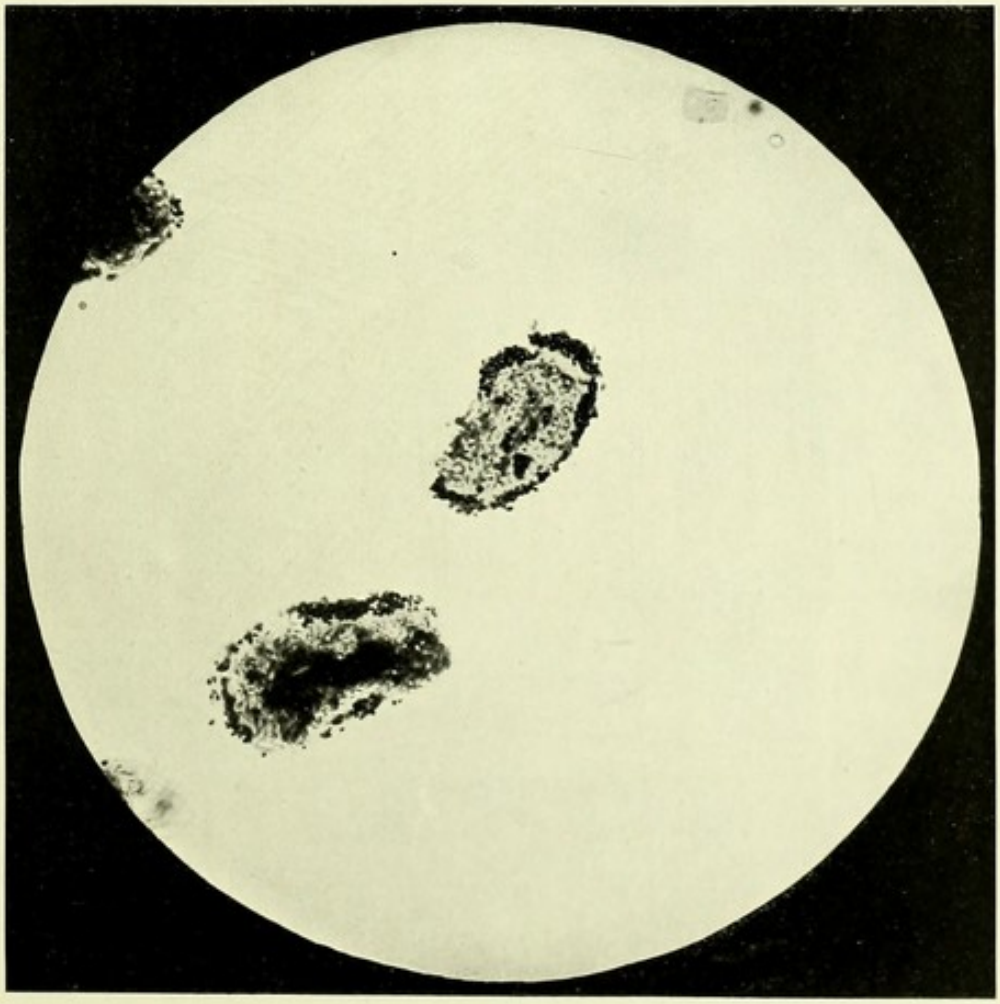

Fig. 6.

Fig. 7.—A second section of the same (higher power).

Fig. 8.—Hair of scalp: culture of fungus after eight days' growth; section near margin, showing scattered spores and mycelium threads, the latter in parts curved and twisted, and presenting certain differences of appearance; on one side the mycelium is large as in Tinea circinata.

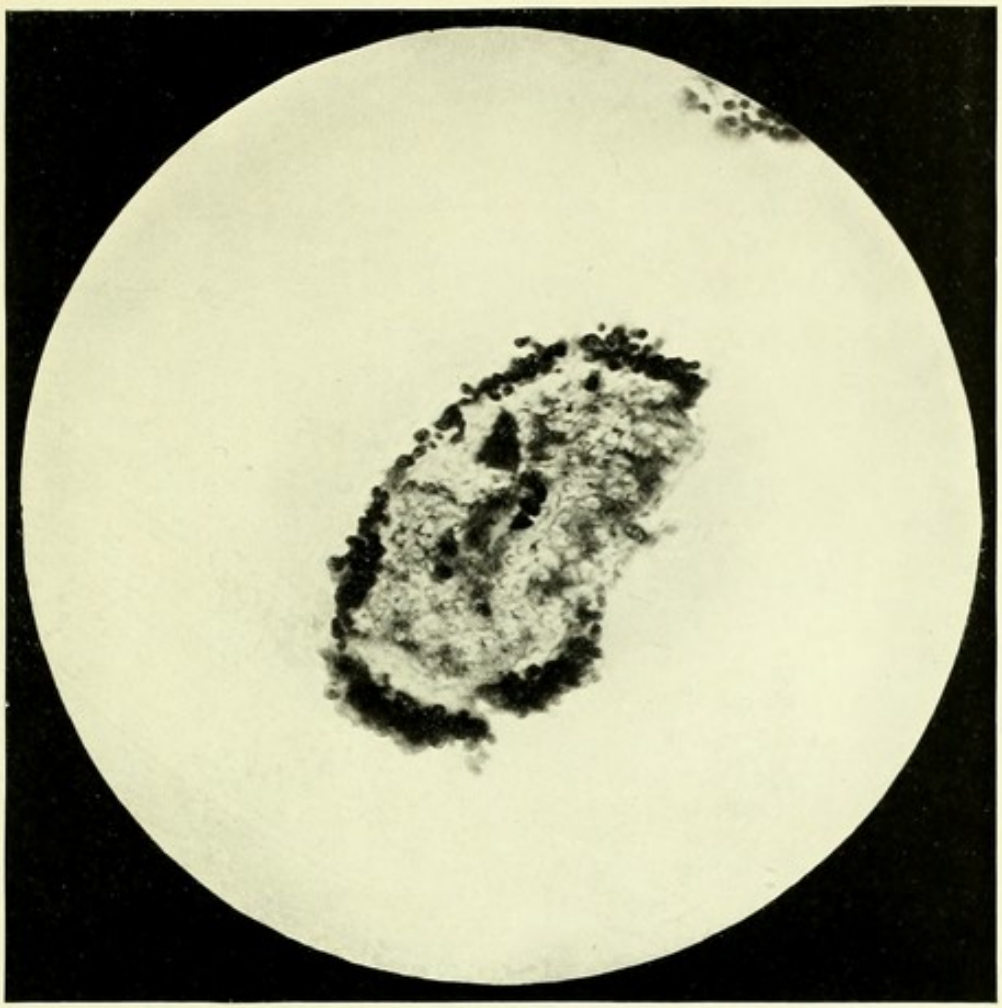

Fig. 7.

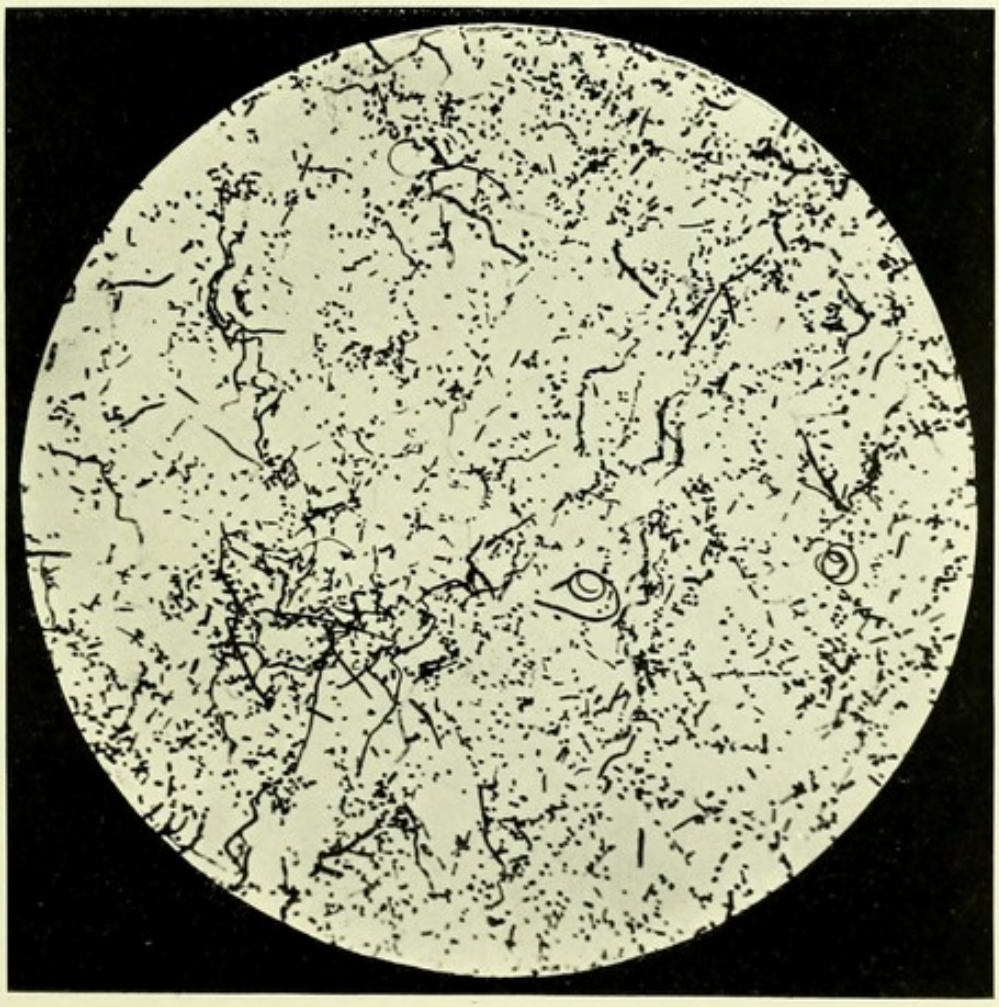

Fig. 8.

Fig. 9.—Hair of scalp: culture of fungus after eight days' growth (higher power).

Fig. 10.—Hair from scalp affected with kerion: spores scattered round hair; irregularly grouped; small amount of large-branched, irregularly-jointed mycelium, in every respect similar to small-spored fungus.

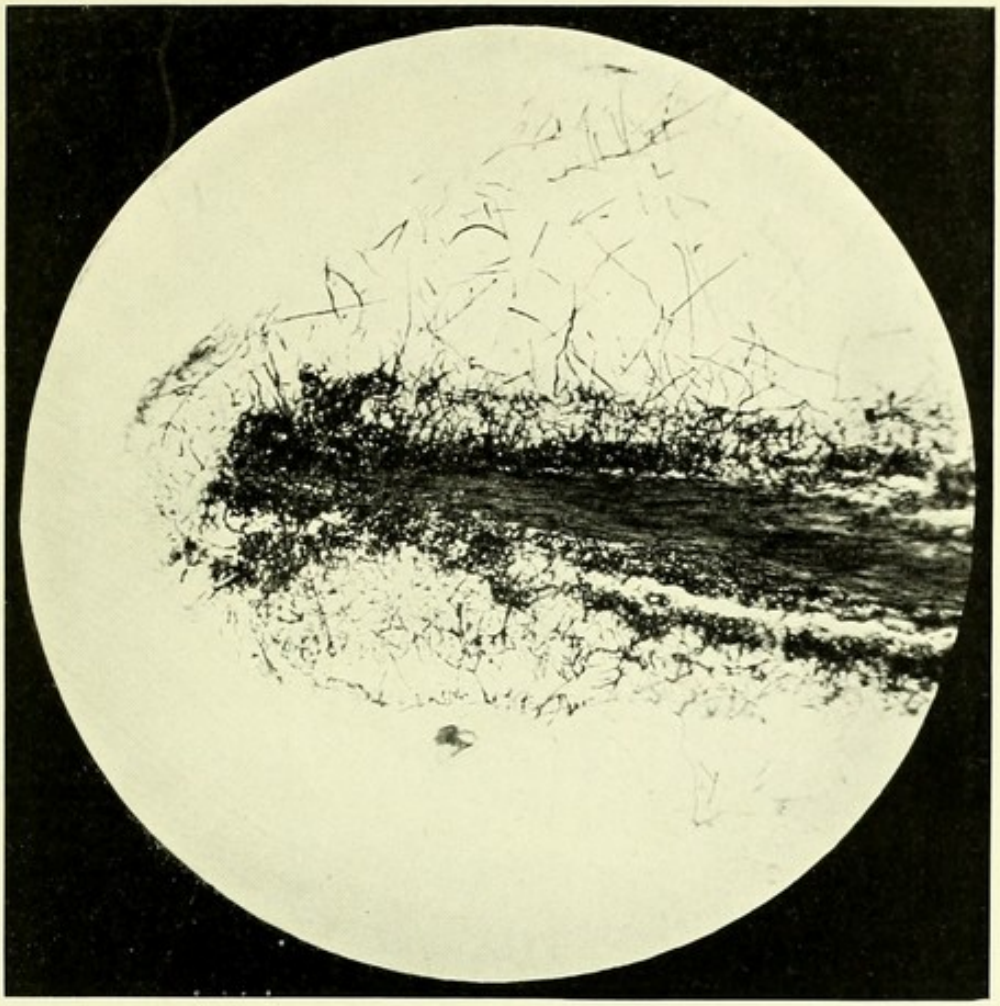

Fig. 9.

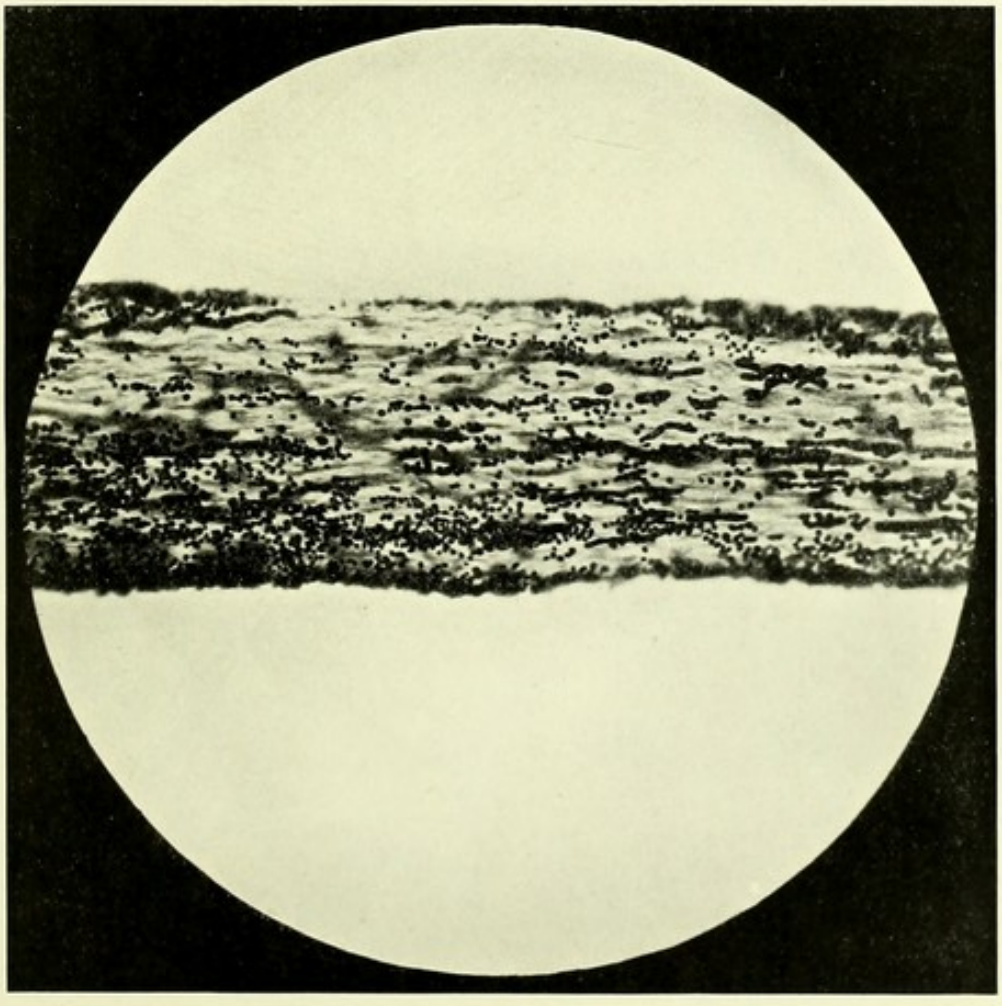

Fig. 10.

Fig. 11.—Hair from scalp affected with kerion: small-spored fungus; culture showing very fine branching mycelium growing from root of hair (× 33).

Fig. 12.—Same as above (× 72).

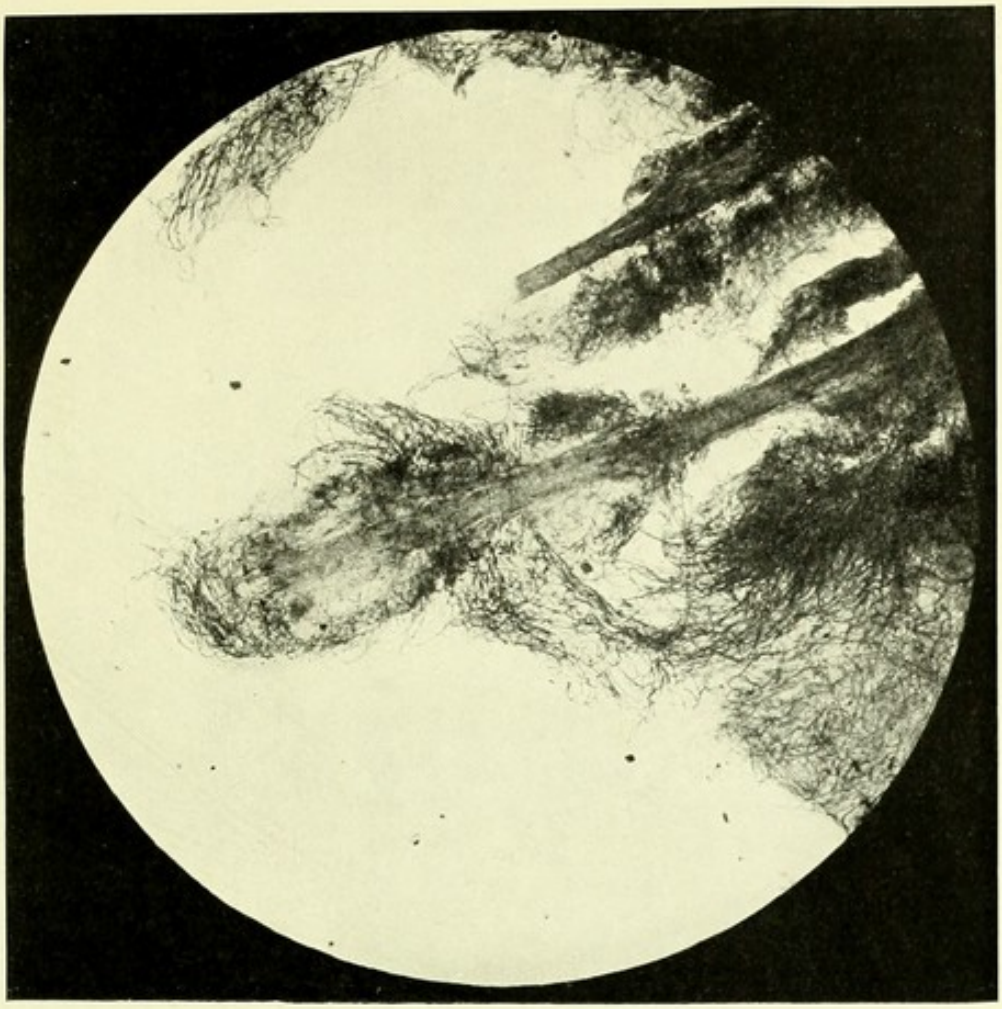

Fig. 11.

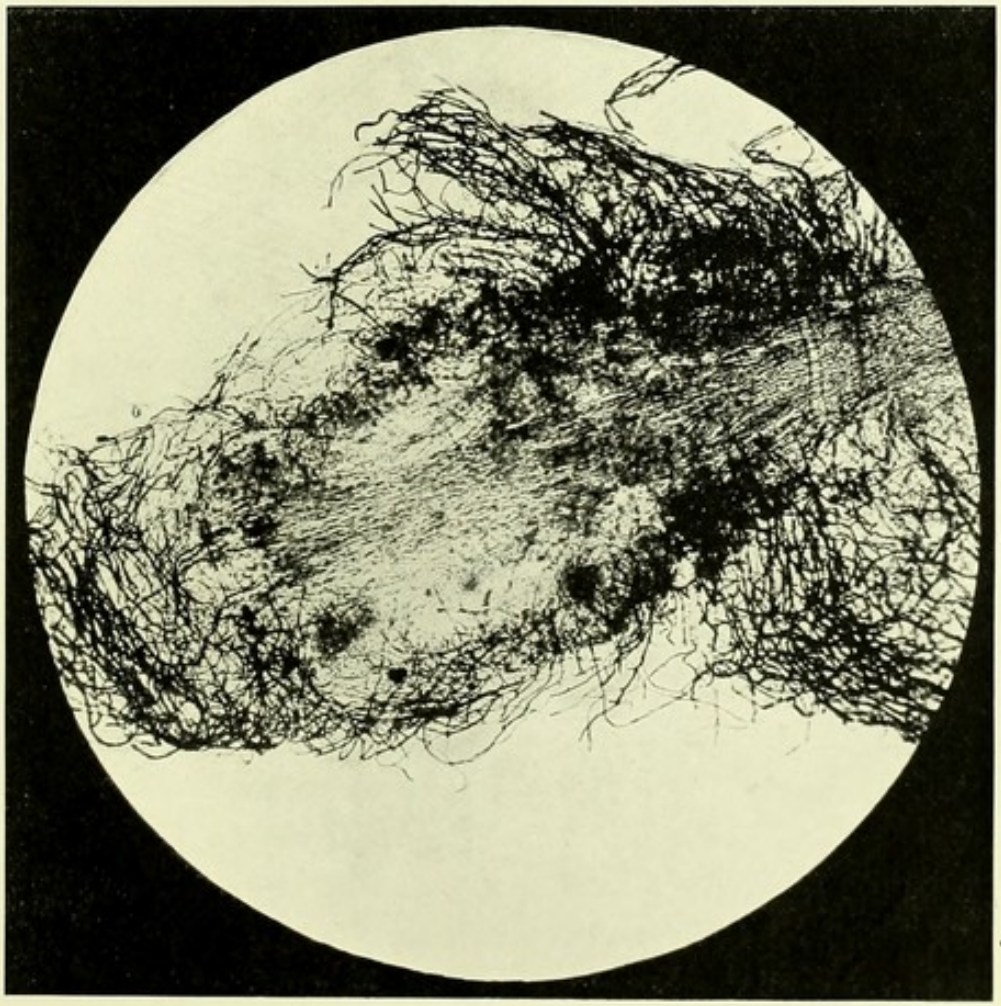

Fig. 12.

Fig. 13.—Scraping from epidermis (Tinea circinata), taken from child affected with ringworm of scalp: small spored fungus; few spores; abundant mycelium, branched, and refractile in substance.

Fig. 14.—Ditto, showing mycelium round the roots of lanugo hairs, not round shaft.

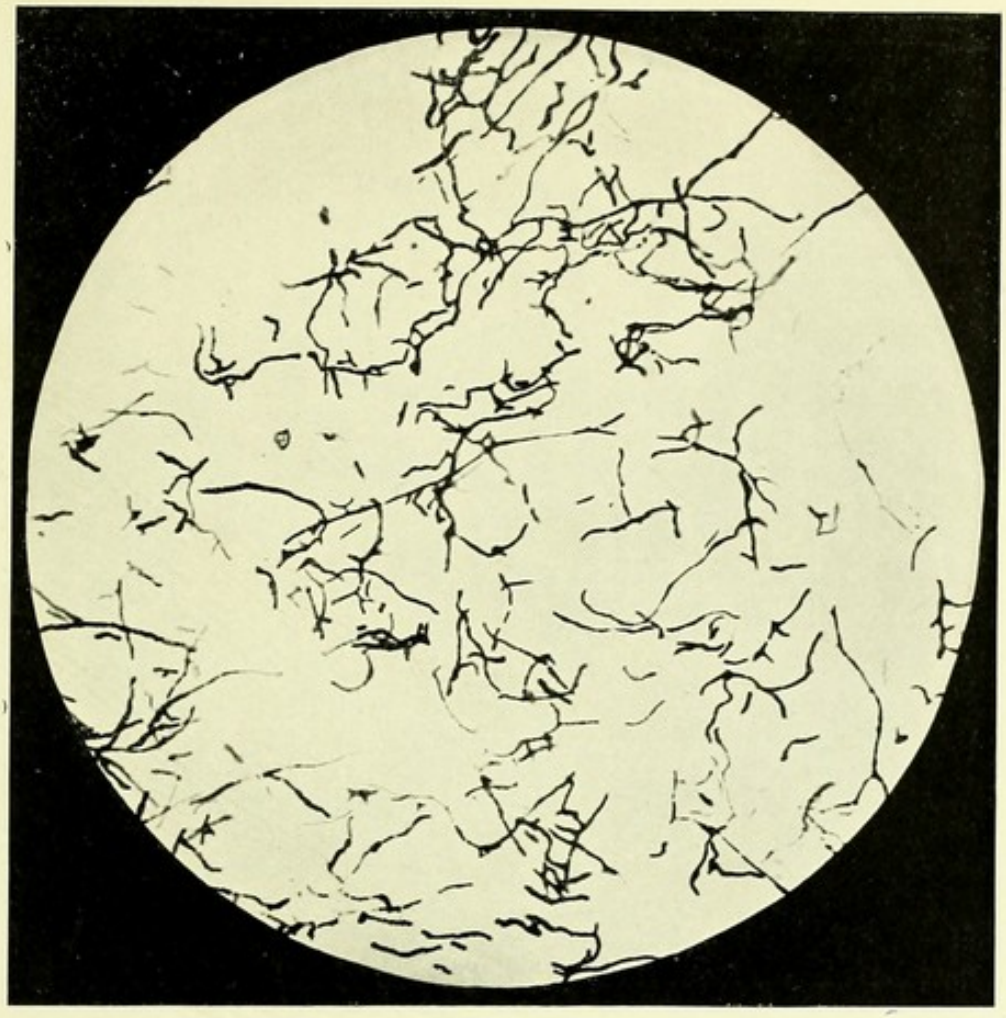

Fig. 13.

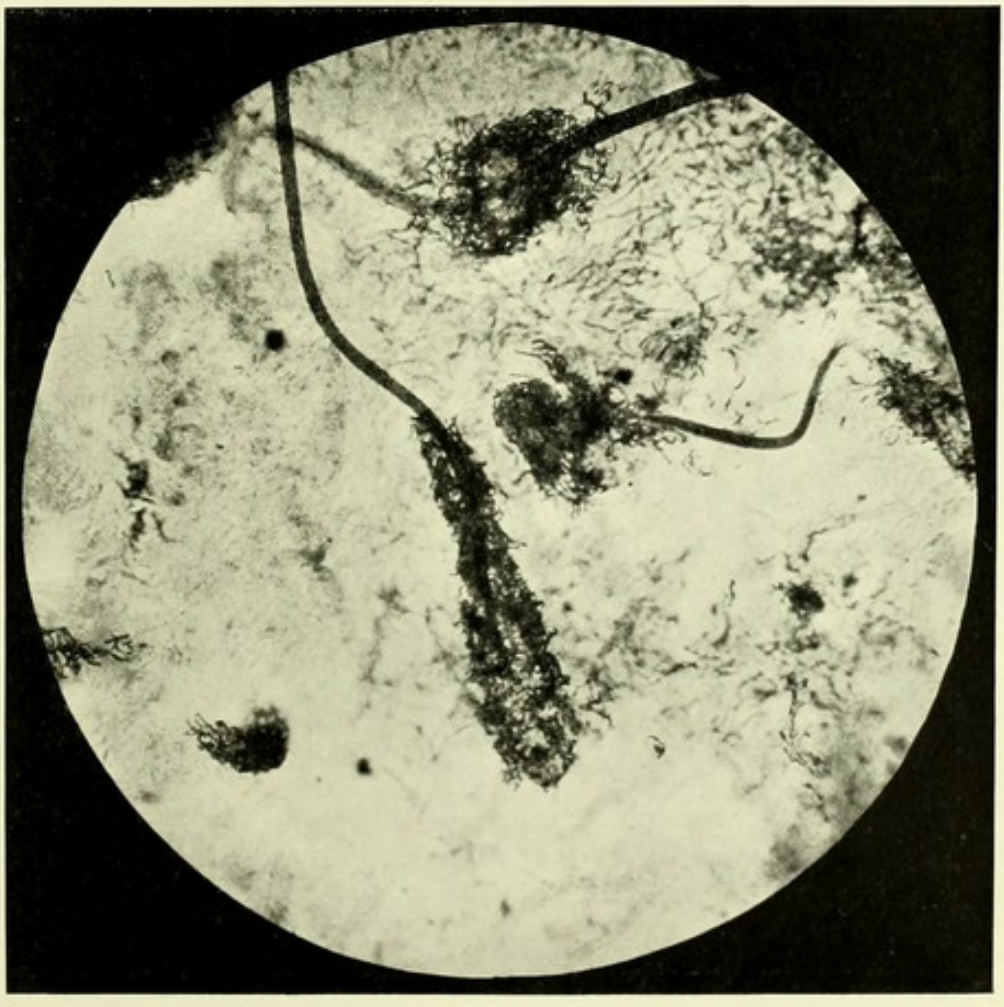

Fig. 14.

Fig. 15.—Tinea imbricata (Manson): felting of mycelium, with excessive branching.

Fig. 16.—Favus: mycelium large, long, and wavy.

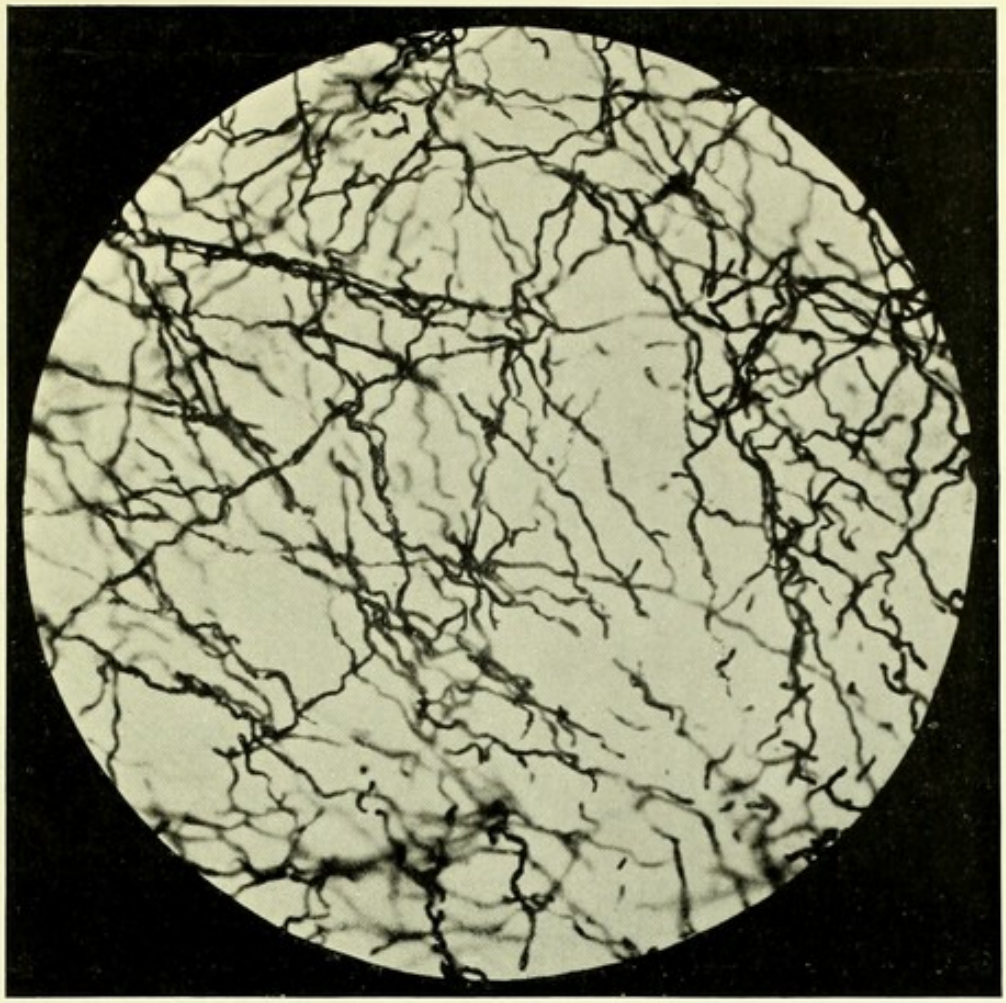

Fig. 15.

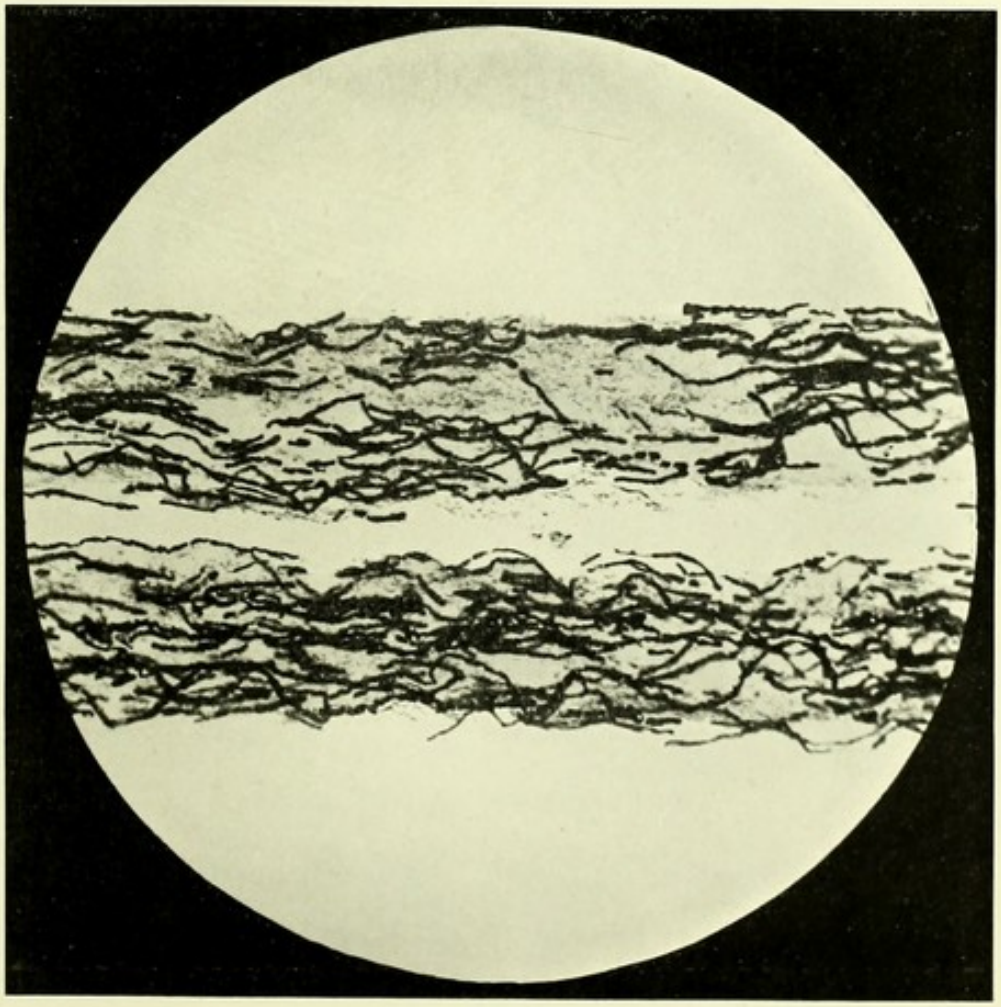

Fig. 16

Fig. 17.—Hair from scalp : large-spored fungus, spores in chains ; mycelium short and regularly jointed.

Fig. 18.—Hair from scalp showing portion of root sheath : large-spored fungus ; showing spores or chains in root sheath, and fungus in hair.

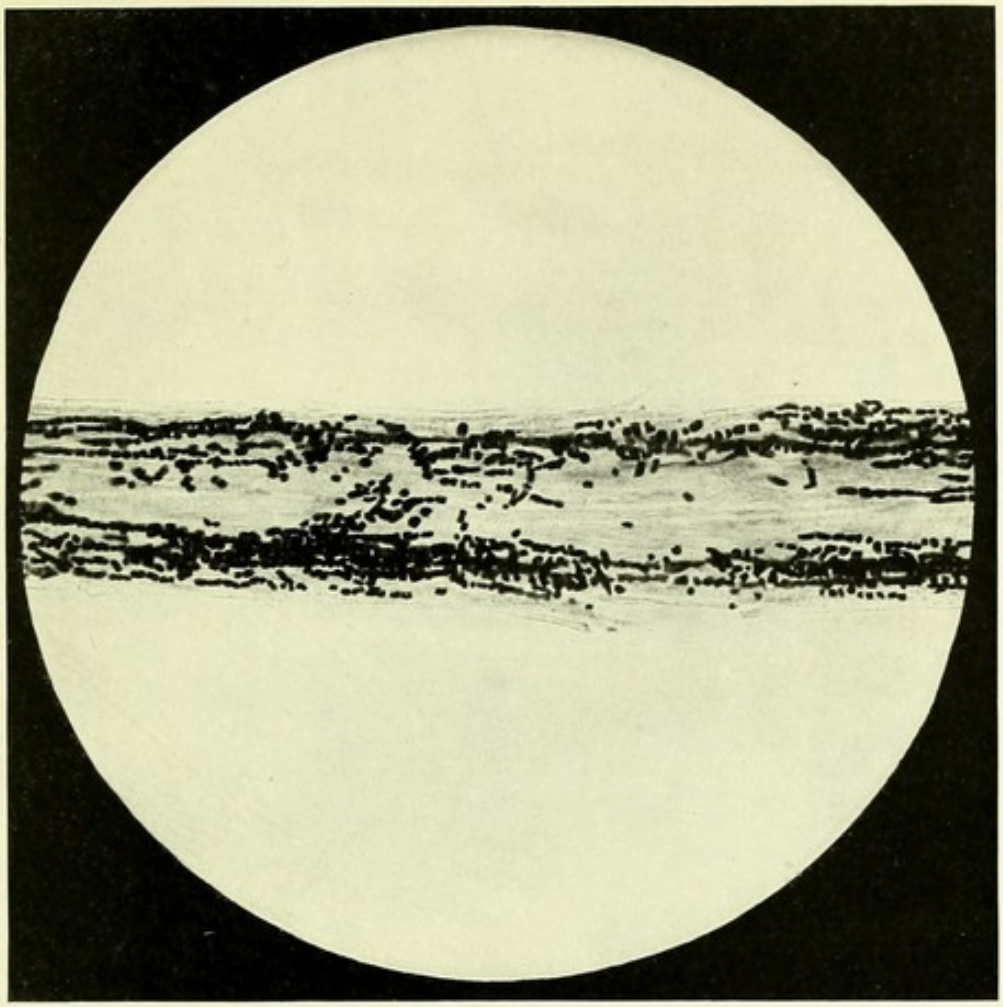

Fig. 17.

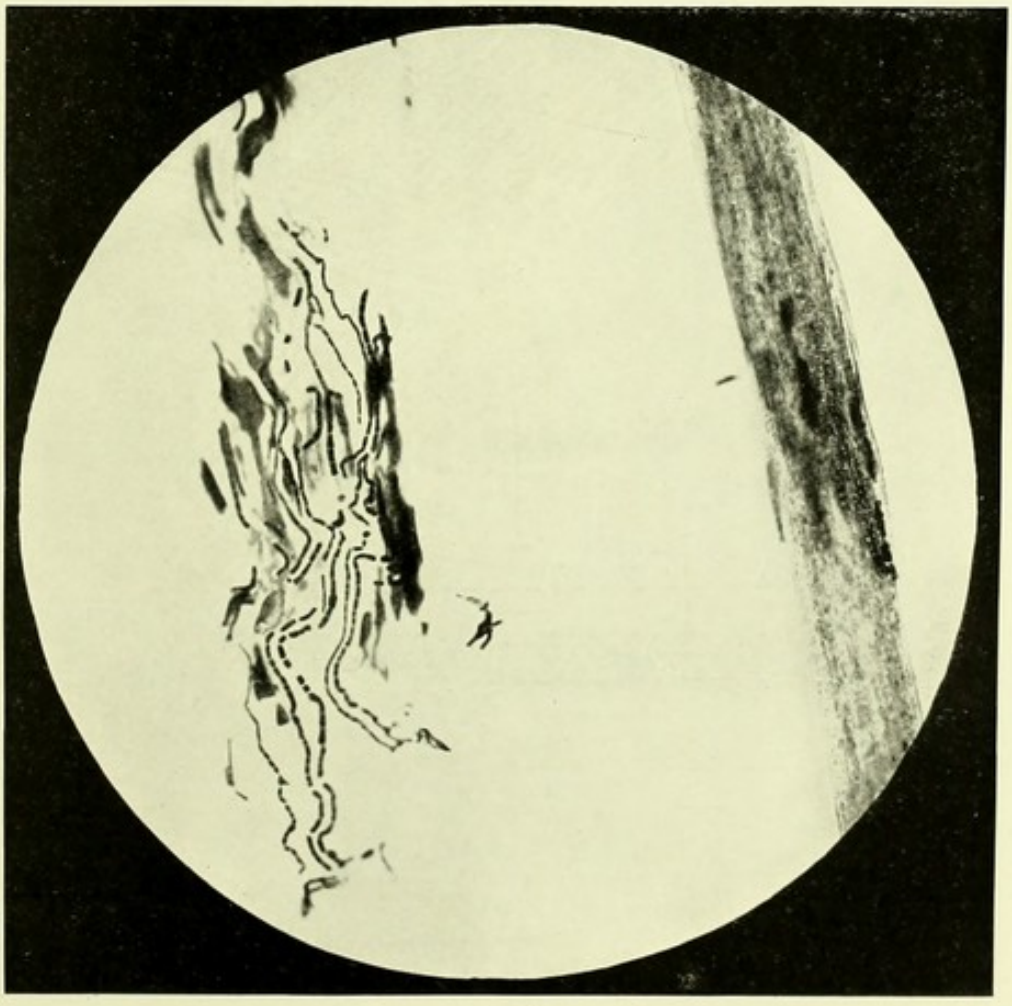

Fig. 18.

Fig. 19.—Hair from scalp: transverse section, showing fungus outside and also inside hair.

Fig. 20.—Same hair: transverse section, showing fungus inside hair only.

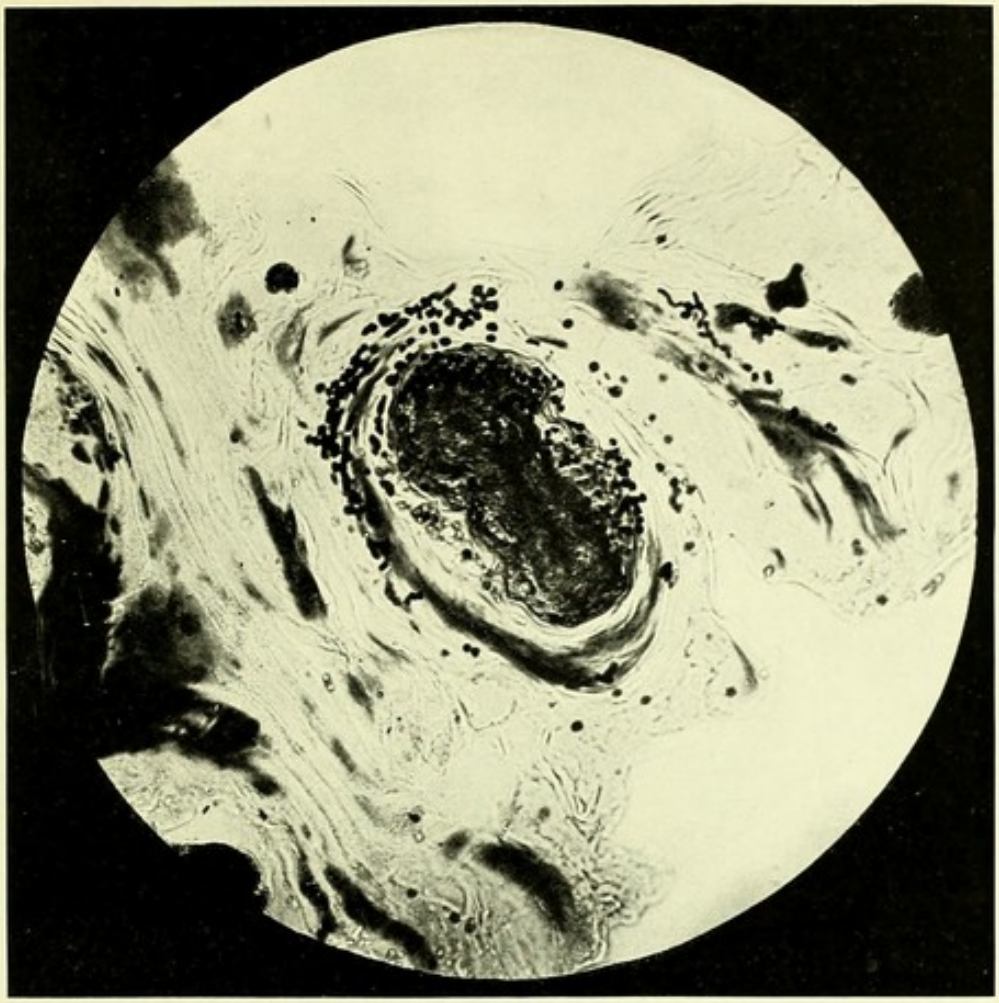

Fig. 19.

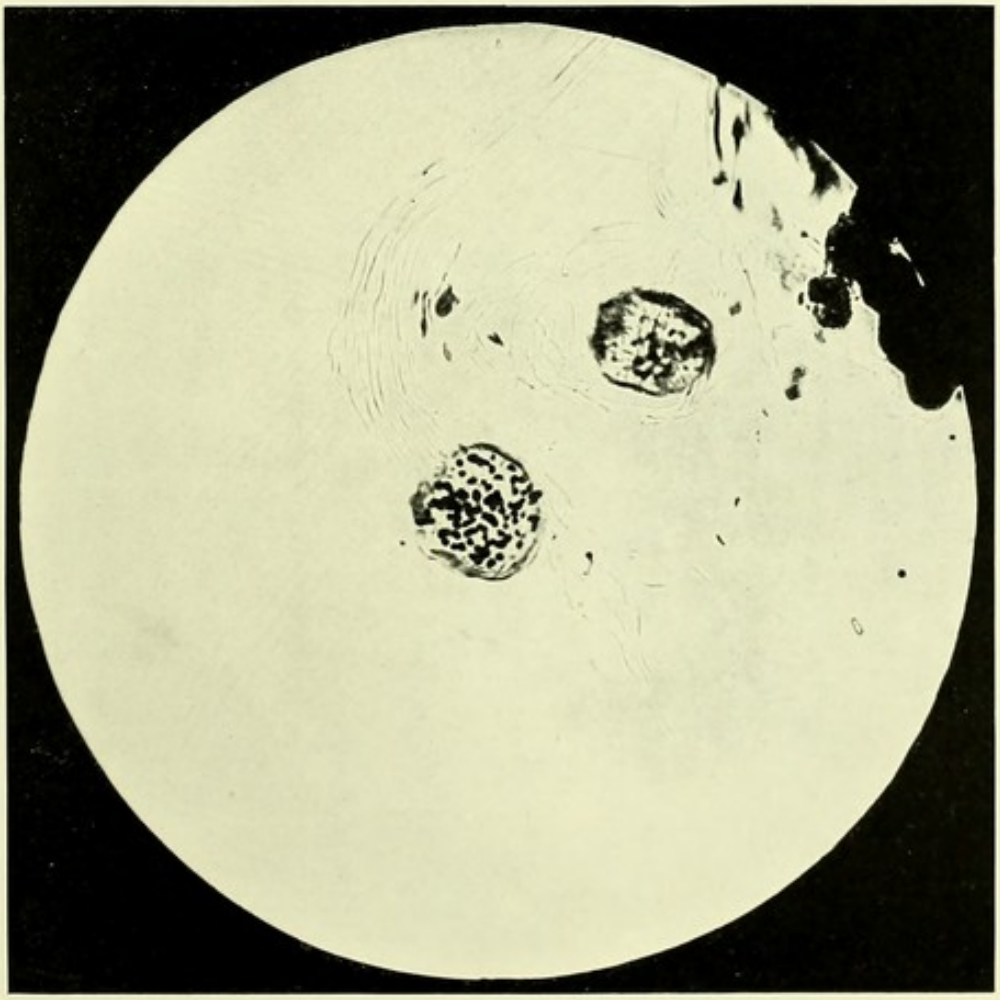

Fig. 20.

Fig. 21.—Hair from scalp: large-spored fungus; culture, after eight days' growth, showing mycelium growing from hair.

Fig. 22.—Section at edge of culture similar to above.

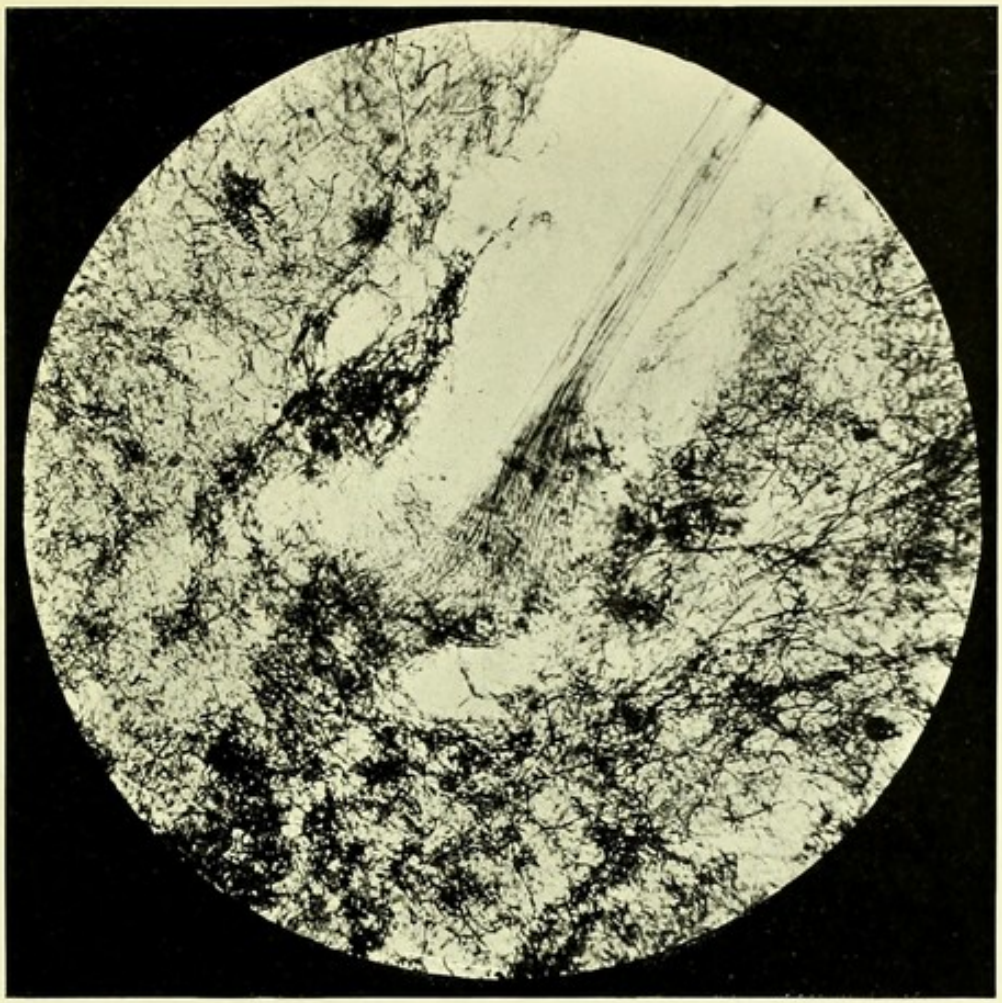

Fig. 21.

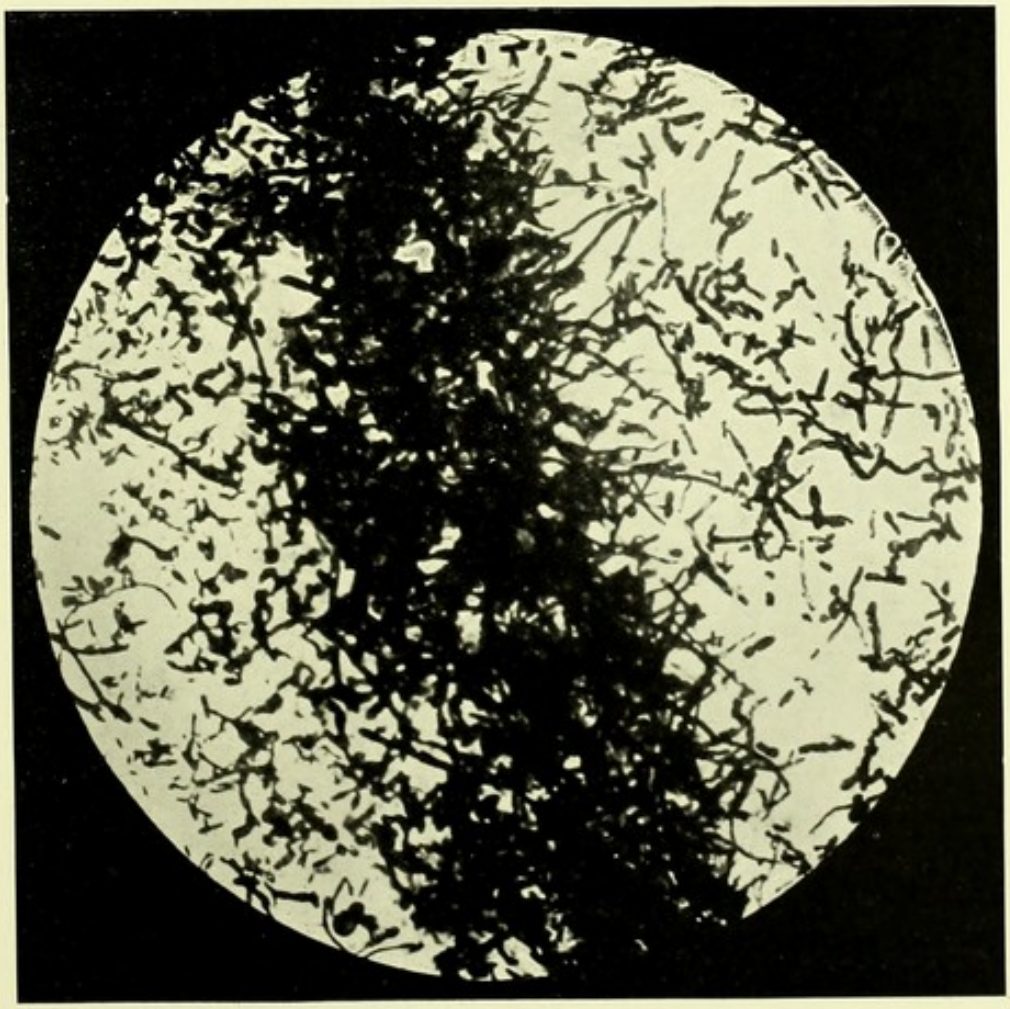

Fig. 22.

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