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ENTERIC FEVER

IN

CAMPAIGNS:

ITS PREVALENCE AND CAUSATION.

BY

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Enteric Fever in Campaigns—Its Prevalence and Causation.

BY

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The great prevalence of enteric fever amongst armies in the field, the very serious drain that it makes on the effective strength of the troops, not only from the number of cases, but from their prolonged duration and subsequent slow convalescence, and the high mortality, are so well known to all military medical officers, that there is no need to quote, still less to dwell on, the statistics of this disease as an accompaniment of modern warfare. In the campaigns undertaken by British troops in South Africa, in Afghanistan, in Egypt, and on the Upper Nile, in the great war of the Rebellion in the United States, in the French operations in Tunis,—in all these campaigns, enteric fever has been one of the most serious, and, in some cases, by far the most serious and fatal, of all the diseases to which the troops have fallen victims. Only in Burmah do the British appear to have been free from its epidemic prevalence. In like manner, in Tonkin, the French army seems also to have escaped from any serious visitation. It appears, therefore, that in operations of war undertaken in tropical or subtropical climates, enteric fever has been of almost universal prevalence in recent years.

These outbreaks under the conditions of camp life show a marked similarity in their principal features.

In the Galcaka-Gaika war in South Africa, the troops crossed the river Kei in December, 1877, in the hot and dry season. Diarrhœa and simple continued fever soon became prevalent, but the general health was good. In the middle of January, 1878, heavy rains came on. Several cases of enteric fever occurred towards the end of the month. In February sickness increased, consisting principally of diarrhœa, dysentery, and "common continued fever." Bowel complaints diminished towards the end of March, but as the cold weather came on enteric fever, at first mild and insidious, occurred throughout the country; and in May, it is reported, that "no place was free from it." It is stated by the Principal Medical Officer to have been "undoubtedly the most serious disease during the late war."

In the Zulu war, which commenced at the end of December, 1878, fever appeared at the headquarters at Helpmakaar, and at Rorke's Drift, in the middle of February, accompanied by diarrhœa and dysentery; the fever was thought to be "bilious remittent," or enteric, or a mixture of both. Helpmakaar became so unhealthy that the troops had to be moved to Utrecht and Dundee. Epidemics of enteric fever immediately broke out at both these places. At the beginning of May the rains ceased, and the sickness somewhat abated, but enteric fever continued at Utrecht. In June, the first division, operating in the low-lying swampy country near the coast, suffered exceedingly from fever, diarrhœa, and dysentery, while the second division on the healthy uplands suffered little.

In the Afghan campaign of 1878-1880, it is noted that cases occurred at almost all the stations occupied by European troops, stretching from the Indian frontier to Kabul and Kandahar. Some of these posts had probably never been occupied before, and many of these cases were quite isolated.

In the Egyptian expedition of 1882, there was great prevalence of bowel complaints, from the first landing of the troops in the latter part of July, diarrhœa, dysentery, and fever. Enteric fever occurred very soon, both at Alexandria and at Ismailia. When the troops arrived at Cairo, the disease increased gradually, but did not reach any great prevalence until October and November. During October, November, and December, out of a total of 319 deaths, no less than 223 were due to enteric fever.

In the Nile campaign, 1884–5, a great number of isolated posts were occupied extending over a large tract of country. Enteric fever occurred at all, or nearly all, of these posts, most severely at Assuan and Wady Halfa.

In the American War of the Rebellion, notwithstanding the great prevalence of typhoid fever during the first year, the epidemic was never general: it consisted of a series of local or regimental outbreaks.

During the French operations in Tunis in 1881 the disease was extremely prevalent, about one-fifth of the whole force being attacked. It has been stated that all the columns on the march and nearly every occupied post were attacked more or less. In some instances bodies of troops suffered from the disease who had not been in contact with other (infected) troops, and who had not occupied any old (infected) encampment.

The two points which I wish to gather from the preceding summary, and to make prominent, and which were observable, the one or the other or both, in all the campaigns referred to, are—

1. *The appearance of outbreaks of the disease in isolated spots, many of which had not previously been occupied at all.*
2. *The prevalence of diarrhœa and bowel affections both previously to and at the same time as the outbreaks of enteric fever.*

II.

The theories as to the causation of enteric fever are, broadly, three in number, the ***malarial***, miasmatic or climatic, the ***pythogenic***, and the ***specific***.

According to the ***malarial*** or climatic theory, the cause of the disease is a telluric poison or miasm, dependent on conditions of moisture and temperature not hitherto well-defined, and not connected in any way necessarily with decomposing fæcal matters, nor propagated by drinking water; the cause is supposed to be not a particulate poison, but a telluric influence, or miasm.

According to the ***pythogenic*** theory this disease "may be generated "independently of a previous case by fermentation of fæcal and perhaps "other forms of organic matter." *

According to the ***specific*** theory the cause of the disease is a specific poison or ***contagium***, and no case of disease can occur without the entrance into the affected body of this specific poison derived from a pre-existing case. Of late years the tendency of research has been to indicate, if not demonstrate, that this specific cause is a ***bacillus;*** and Eberth, Gaffky, and other observers have isolated the ***bacillus typhi abdominalis***, which is generally, though perhaps not universally, believed to be the specific cause of the disease.

The malarial or climatic theory need not further engage our attention; the question lies between the ***possibility*** of independent origin, according to the pythogenic theory, and the ***necessity*** of specific contagion from a pre-existing case, according to the specific, and *a fortiori*, the specific ***bacillus***, theory.

The pythogenic doctrine was formulated and advocated by Murchison in 1858. At the time when he wrote, and for many years after, this was the prevailing theory. In the second edition of his work on Fevers (1873), he quotes the opinion of Hudson, of Dublin (1867), that "Upon no subject in practical medicine is there a larger or more "constantly increasing mass of evidence than as to the power of fæcal "miasm to generate typhoid fever, and to the fact that it does so."† The doctrine that specific contamination was necessary for the spread of the disease was taught by Budd in this country (1856) and von Gietl of Munich. Of late years this view has gained ground in England, at the expense of the pythogenic theory, so that now nearly all of our received text-books of medicine teach that this specific contagion is necessary. I may mention Bristowe, Fagge, Liebermeister in Ziemssen's *Cyclopædia*, Hutchinson in Pepper's *System of Medicine*, Strümpel, Broadbent in Quain's Dictionary, W. Cayley in the 3rd edition of Murchison's treatise. Dr. F. T. Roberts, on the other hand, considers that spontaneous origination is by no means improbable. Nevertheless there has always been a number of observers in India and elsewhere, amongst military medical officers, who have been unable to satisfy

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* Murchison, *Continued Fevers*. 3rd edition, p. 499.

† Murchison, *op. cit.* 3rd edition, p. 498.

themselves that the disease can never originate *de novo* from pythogenic conditions.

In the Galeaka-Gaika war in South Africa, 1878, enteric fever broke out simultaneously in East London, King William's Town, and Fort Beaufort, gradually extending to other camps. Some medical officers thought contagion was conveyed from these towns to the camps; but the Principal Medical Officer, Dr. Woolfryes, reviewing all the circumstances, believed that the disease had an independent origin, due to the insanitary state of the ground in the vicinity of the camps, brought about by the filthy habits of the natives.

In the Zulu war, 1879, the condition of the camps was also very insanitary; they were overcrowded, the soil was often saturated with decomposing organic matters, giving off noxious emanations; the heat was intense. The Principal Medical Officer, Dr. Woolfryes, considered that two types of fever were present: a true remittent, and a typho-malarial, that is, enteric fever complicated by malaria; the latter might, he thought, have been induced solely by the drinking water, which was constantly fouled with both animal and vegetable matters, from the filthy habits of the natives, and from the fact that cattle frequently go into the rivers to die.

In Natal, in 1881, the water seemed also to be the cause of an outbreak. At Bennett's Drift the supply of drinking water was taken from a spring below the camp. The soil was porous, latrines near at hand, and contamination everywhere. At the camps at Ladysmith, and at Newcastle, fæcal defilement was of the most likely occurrence; importation by direct contagion was discovered, or considered probable, in some cases; but "fæcal pollution" was looked on as the most usual cause. "The climate, so far as the mechanical operation of the rain is "concerned, exerts a powerful influence in the production and propaga-"tion of enteric fever, by carrying sewage directly, or by soakage, into "the sources of water supply."* At Kimberley, where cesspits and wells are in close proximity, with fissured stratification intervening, a heavy rainfall is invariably followed by enteric fever, and they are looked upon as cause and effect.†

In the Afghan war, it has been pointed out by Surgeon-General Marston that "as the troops occupied several positions that had pro-"bably been never before occupied by human beings, and as, in some "instances at any rate, it was extremely improbable that the water "supply had been fouled, the campaign afforded an opportunity for "excluding the influence of an infected soil, or site, although not of an "infected corps."‡ As, however, enteric fever did break out at these isolated spots, and as importation, from the circumstances of their position, was improbable, the alternative explanation seems reasonable, that the disease was developed, owing to insanitary conditions in the camps themselves.

* A.M.D. Reports, 1881.—*Enteric Fever in Natal*, by Brigade-Surgeon W. Skeen.

† *Ibid.*

‡ A.M.D. Reports, 1879.—*Enteric Fever*, by Brigade-Surgeon Marston.

In the Egyptian campaign, in 1882, it is impossible to exclude the causation by importation; but this explanation seems quite insufficient to account for the wide diffusion of the disease in the later months of the year after active operations had ceased. The Principal Medical Officer (Sir J. Hanbury) remarks:—"To ascribe the genesis of enteric "fever to any one specific cause, would not in this case, I think, be "justified by reason or experience. . . . One of the most potent "was exposure under canvas, on ground in the neighbourhood of a "large city, whose conservancy arrangements are on the most primitive "system, and the habits of the lower classes filthy, acting on a body of "men, lowered by the privations, hard work, and exposure of a cam-"paign during the hottest and most unhealthy season of the year."*

In the Nile campaign of 1884–5, the camping grounds were separated from each other by long distances. As a rule, medical officers reported favourably on the condition of their respective stations; some, however, reported otherwise, the most notable exception being that of Wady Halfa, where the ground was very foul. At Assuan also the ground of a portion of the camp was very foul, and the troops there stationed suffered severely. There was hardly a station occupied from Assuan to Korti at which the disease did not prevail more or less, though many were most carefully chosen, and had not previously been used, either by Europeans or natives.

Coming now to the experience of the French in Tunis in 1881, it is stated† by M. Czernicki, that both in the first and in the second part of the expedition numerous bodies of troops were attacked, which had arrived from France free from infection, had never been in contact with infected battalions, and had never occupied stations that had been previously infected. He adduces two instances in particular, Ain-Drahan and Zaghouan, where encampments previously clean and healthy, and provided with good water, through overcrowding and insanitary conditions, became the seats of outbreaks of the disease. This writer's conclusions are disputed by M. Marvaud,‡ who considers that specific contagion could not be eliminated, and that this was the cause of the prevalence of enteric fever. He admits, however, that the great majority of medical officers in the Tunis expedition believed in the doctrine of its autochthonous origin.

In the Oran operations in 1881–2, the disease broke out in open desert in stations never before occupied. It was, however, thought to be imported.

A careful and impartial consideration of the circumstances of prevalence in the cases just noted leads us to believe, I think, that *the probabilities are in favour of a pythogenic origin*, at any rate, in some of them, rather than to insist or assume that specific contagion occurred in every instance. Absolute proof in either direction, from the circumstances attending these outbreaks in the field, seems impossible of attainment. There are neither the means nor the leisure needed for

* A.M.D. Reports, 1881.

† *Archives de Méd. et Pharm. Mil.*, 1883, ii. 401.

‡ *Ibid*, 1884, iii. 273.

making exact observations at the time. Subsequent investigation is difficult, and the *data*, whence conclusions might be drawn, often insufficient.

If the only alternative to origin by specific contagion were spontaneous generation in the sense formerly understood by this expression, that is, that a living entity can be produced out of something not living, that a plant or animal can come into being without a seed having been sown, or a germ fertilized, it would be an effectual argument against the pythogenic theory, that it is illogical and incredible, just as we believe that *ex nihilo nihil fit*. But I submit that the alternative does not lie between the two doctrines stated thus. Evolution is a factor that has to be taken into account, and I hope to show that a fair consideration afforded to this factor will render the pythogenic theory as reasonable and intelligible as it is easy of application.

III.

To bring this to bear upon the argument, I now proceed to the second point already referred to, namely, the prevalence of diarrhœa and bowel affections, both previously to, and at the same time as, the outbreaks of enteric fever.

This is noted in the account of the Galeaka-Gaika war, where diarrhœa appeared among the troops about the 20th January, very shortly after taking the field; enteric fever appeared at the end of the month. Diarrhœa and bowel complaints continued until the latter part of March, when they began to diminish; enteric fever continued to prevail much later.

In the Zulu campaign in the following year, fever, diarrhœa, and dysentery prevailed in the middle of February, a few weeks after the commencement of operations. Enteric fever very soon became prevalent, but it was not of well-marked character, and was not recognised as such at first. The general sickness abated in the beginning of May, but cases of enteric continued to occur.

The relation between diarrhœa and enteric fever in the Egyptian expedition of 1882 is thus adverted to by the principal medical officer (Sir J. Hanbury) in general terms, the accuracy of which will be admitted by all who had an opportunity of observing what occurred*:—
" Looseness of the bowels, under the name of camp diarrhœa, begins
" to be common almost as soon as an army takes the field. This is, in
" a large number of cases, compatible with apparently good health, and
" is doubtless attributable to the changed conditions of life. Soon
" cases of fever occur, some of very brief duration, which are classified
" as heat-fever, and some attended with diarrhœa, marking the
" commencement of enteric fever in the force. The development of
" this disease, and the proportions it will assume, will be merely a
" question of time and circumstances."

* A.M.D. Reports, 1882; Egypt.

An outbreak occurred at the encampment of Pas de Lanciers, near Marseilles, described by Dr. Duchemin.* In 74 days there were 1,560 cases of fever or diarrhœa out of 8,500 troops. The 62nd regiment of infantry had three cases of typhoid fever immediately on its arrival in camp, on the 15th May. There was no outbreak of the disease until the 11th June, but in this interval there were more cases of *embarras gastrique* in this than in any other corps; the febriculas and gastric fevers preceded the typhoid invasion, and their number described an ascending curve, parallel to that of undoubted typhoid. After June 15 there commenced to be a constantly increasing number of sick, passing through all the phases of the typhoid process. From May 15 to July 24, there were 610 cases of real typhoid, and 950 cases of so-called "abortive" or "benignant" typhoid.

A somewhat similar outbreak of typhoid, precede by cases of diarrhœa and *embarras gastrique*, occurred in the barracks at Condé in the department of the North, 1883–4.

It would be beside our present purpose to quote further instances of diarrhœa prevalence, precursory to outbreaks of undoubted enteric fever. I may just mention the case of Arundel† last year (1890), where there was an unusual amount of diarrhœa in August and September, and a well-defined outbreak of enteric in November, traced to drinking water fouled by fæcal contamination. Murchison also states‡ that "The ordinary autumnal increase, or circumscribed
" epidemics, of enteric fever, are usually preceded by a great prevalence
" of diarrhœa, the diarrhœa reaching its acme long before the fever
" does, and having greatly declined by the time that the latter is most
" prevalent."

Now in the above-quoted instances, either there was a connexion between the preliminary diarrhœa prevalence and the subsequent enteric fever prevalence, or there was not. If we believe in the origin of enteric purely and simply by specific contagion from a pre-existing case, then no amount of diarrhœa prevalence is of any consequence one way or another. But there are difficulties in the way of such a belief; in some cases, as has been said, "It would not be justified by reason or experience." Neither, I think, are we justified in declaring that the diarrhœa prevalence has nothing to do with the enteric outbreak. Let us assume for a moment, that there is, or may be, some causal connexion between the two, and try to figure to ourselves how such connexion could be brought about.

In the *first* place, the *actual records* seem to show that this connexion did exist in the instances quoted: a gradual development of definite enteric fever seems to have been observed from ordinary diarrhœa, the intervening degrees of feverishness, *malaise*, *embarras gastrique*, anomalous and ill-defined fever with diarrhœa, apparently being separated from each other by no distinct demarcations. Such a

* *Archives de Med. et Pharm. Mil.*, 1886, vii.
† Report by Dr. Charles Kelly, *Public Health*, June 1891.
‡ *On Fevers*, 3rd edition, p. 497.

connexion of course might be only apparent, not real; some connexion is at any rate obvious.

Secondly, in what way, if at all, may it be reasonably supposed that an enteric fever outbreak can originate from a prevalence of diarrhœa? It is well known that "camp diarrhœa" is of the commonest occurrence amongst troops shortly after taking the field, in a tropical or sub-tropical climate. Change of habits, change of food, improper or unsuitable food, bad water, heat and exposure to sun, and chill—these are all obvious factors in its causation; there is nothing in any way specific. Let us consider the sequel as regards the individual, and as regards his surroundings. The individual may in some cases remain in fairly good health and vigour, in spite of a continuance of bowel trouble; other individuals may suffer more, from the exposure, fatigue, and weakening effects of the continued flux. The surroundings may possibly be, and remain sanitary, the camp clean, the water pure; but in all probability the reverse will be the case, at any rate, in some instances: the water bad, the soil fouled, very likely overcrowding of the camp, with consequent difficulty, if not impossibility, of proper removal or disposal of fæcal matters. Under certain conditions of heat and moisture, favourable to the development and multiplication of low forms of vegetable and animal life, which is the more likely, or reasonable to expect? That diarrhœa in weakly and exhausted individuals should remain diarrhœa, and nothing more; or that with an increase of filth and decomposition, polluting soil, air and water, a development of filth-generated, pythogenic poison, should take place, capable of causing in such weakly persons a fever, with diarrhœa, a poisoning of the organism, producing pyrexia and inflammation of certain glands in the alimentary tract, in fact, a specific fever? Is this supposition of the evolution, gradual or rapid according to circumstances, of a disease poison, dependent on *increasing* conditions of pollution of soil, air, or water, either separately, or all three together, unreasonable or illogical? Would it not, on the contrary, be more unreasonable to suppose that, under such conditions, there could be no evolution at all? These conditions of camp-pollution undoubtedly exist, and tend to increase, in many instances; are they to have no effect? Is diarrhœa to continue as simply diarrhœa, or is evolution to come into action, and produce a new disease? New indeed, only because the causes necessary for its production are but just now brought into operation,—spontaneous only in the sense that water is of spontaneous origin, when from hydrogen and oxygen the electric spark has produced water, where no water was before.

Thirdly, is any support for this view to be derived from *analogy in other diseases?* In at any rate two other diseases, dysentery and diphtheria, a very considerable analogy can, I think, be traced. "The "independent production of the dysenteric poison by the putrefaction "of animal substances under certain conditions has been maintained "for centuries," and is doubted by no one. And yet the evidence of the contagious nature of the "dysenteric stool" appeared to Murchison

quite as strong as that of the typhoid stool.* Maclean also affirms the fact of the propagation of dysentery, through the practice of preserving the stools in the wards for examination.† As Parkes says, "this seems "to show the origin of a communicable poison *de novo*." I should prefer to express it as, "the production of a communicable poison, by "evolution under favouring conditions." It will probably be admitted by all observers at the present time, that the dysentery, which arises at an early period of camp life in any army in the field, will become contagious and assume an epidemic form, unless special disinfectant and precautionary measures are taken to prevent such an occurrence. Surely there is an analogy between this process and the assumed evolution of enteric fever now under consideration?

Similarly, in accounts of outbreaks of diphtheria, it is a matter of the commonest occurrence to see noted the prevalence of "sore throat," without apparently any special diphtheritic character, for some time previous to the actual outbreak. This appears to point to the gradual evolution of the specific poison.

Lastly, the growth or evolution of the typhoid poison is indicated in the fact, known to practitioners in the Western and Southern States of America, that "typhoid fevers are becoming more and "more frequent in places and settlements, and under circumstances, "where hitherto the ordinary autumnal remittents and intermittents "have prevailed extensively." Typhoid fever seems disposed to, as it were, displace endemic bilious fever, as the improvement of the agricultural districts advances.‡

From the fact of diarrhœa prevalence precursory to enteric fever outbreaks, which, as I have shown, is recorded to have taken place in many instances, and from the arguments as to probability, and analogy in other diseases, I submit that a theory of ***the pythogenic origin of enteric fever, by evolution of the disease-poison under favouring conditions***, is as reasonable and intelligible as it is easy of application.

IV.

So far, the evolution of the disease-poison has been alluded to in general terms, without attempting to particularise or define what the actual *contagium* is, or in what it consists. The tendency of modern research is to the belief that there is a specific parasite for each specific contagious disease; and in the case of enteric fever the ***bacillus typhi abdominalis*** of Eberth and Gaffky, though not actually demonstrated, is generally believed to be the cause.

Assuming that this organism is the specific *contagium*, is it necessary to believe that each bacillus, or group of bacilli, that give rise to a case of enteric fever, should originate immediately from a pre-existing bacillus or germ of the *same* species, and derived from a pre-existing

* Murchison, *op. cit.*, p. 484.

† Reynolds' System of Medicine, Vol. I.

‡ See *Medical History of the War of the Rebellion*, Part III., Vol. I., by Charles Smart, Major and Surgeon, 1888, p. 501.

case of the same disease? or is it conceivable to suppose that the bacillus should have developed its specific disease-producing properties from other varieties, or some one other variety, of bacillus, by a process of evolution, under favouring conditions? That the latter proposition is not only conceivable and logical, but also by no means improbable, I hope to be able to show.

There is considerable ground for believing that the ***bacillus typhi abdominalis*** of Eberth is causally connected with typhoid fever; but there is also no doubt that this is not the only bacillus connected with the disease. The question of the relationship of the various bacilli met with in the intestinal contents and viscera of typhoid patients is of great importance, but in the present state of knowledge is in a very unsettled condition. With regard to the ***bacillus coli communis***, which is met with in the ordinary contents of a healthy intestine, Messieurs Rodet and Roux believe that it is in reality another form of Eberth's bacillus; they have found the ***bacillus coli*** in the fæces, and Eberth's bacillus in the splenic blood of the same typhoid patient. Though there are differences in the morphological characters, and in the characters of the cultivations of the two forms, these observers do not consider them to be sufficient to differentiate two distinct species. They look upon the bacillus of Eberth as ***bacillus coli*** in a state of attenuation or degradation, and "considering "on the one hand the tolerance which the organism has for the ***bacillus*** "***coli***, as it commonly presents itself in the intestine, and on the other "hand the injurious nature of water contaminated by it, they are led "to the conclusion that, in the great majority of cases, it acquires "outside the organism its 'typhigenic' character."* This opinion appears to be much the same as a belief in the evolution of the specific character, under specially favouring conditions, from an organism which under ordinary circumstances has no such morbific properties.

Professor von Babes has quite recently shown that numerous ***atypical*** typhoid bacilli exist in the bodies of typhoid patients, resembling Eberth's bacillus very closely, and yet differing therefrom in some one or more cultivation characteristics, and in pathogenic properties. Von Babes considers that it is not only the ***bacillus coli communis*** that exists along with Eberth's bacillus, but that there are many forms, furnishing a series of gradations between the typical typhoid bacillus and the common saprogenic bacilli.†

Dr. Cassedebat‡ has also described various pseudo-typhoid bacilli closely resembling, and yet showing some differences from, the typical bacillus of Eberth. These differences are apparently very slight, and it is a matter requiring further observation and confirmation, how far they are constant and permanent.

* *Comptes Rendus de la Soc. de Biologie*, XI., 1890. Splenic blood yielded nearly a pure culture of Eberth's bacillus; fæces contained no Eberth's bacilli, but *bacillus coli* in enormous numbers almost as a pure cultivation. Eberth's bacillus appears to be the result of a modification of *B. coli* in passing through the organism.

† *Zeitschrift für Hygiene*, 1890.

‡ *Annales de l'Institut Pasteur*, Oct. 1890.

Prof. Victor Vaughan* isolated two bacilli from water, suspected of contamination with typhoid excreta, which, though presenting cultivation-characters differing from those of Eberth's bacillus, produced in animals lesions that were identical, and were more fatal in their effects.

This is not the place to enter into a discussion of the bacteriology, of enteric fever. It is seen from the brief statement I have just made, that there are skilled observers of the first rank, who do not consider that there is one, and one only, micro-organism connected with the causation of the disease; but on the contrary, that either the ***bacillus coli communis*** (until lately regarded as devoid of pathogenic properties), or, as is more probable, a considerable number of closely related organisms, play some part in its production. That these forms are not all distinct permanent species, but varieties, or races, or transition forms, is certainly by no means an unreasonable supposition.†

V.

The general conclusions which I venture to draw from what has been said may be expressed as follows:—

First, that although the doctrine at present generally held in this country, on the Continent, and in America, as stated in some of the most widely read and deservedly respected text-books, is to the effect that a specific ***contagium*** derived from a pre-existing case is necessary for the production of a case of enteric fever; there is, nevertheless, a widespread belief amongst military medical officers, English, French, and American, that the disease may originate spontaneously; and that this belief rests on a wide induction from a very large number of facts, which are very difficult, if not impossible, of explanation on any other theory.

Secondly, that although the general belief among bacteriologists is that enteric fever is produced by the specific organism known as ***bacillus typhi abdominalis***, and by this specific bacillus only; nevertheless, within the last year or so, some competent observers have arrived at the conclusion that this bacillus is not the only one concerned in originating the disease, but that other bacilli, closely connected with, and in some instances hard to distinguish from, ordinary saprophytic bacilli, have some causal connexion, though its exact nature is at present quite undetermined.

Thirdly, that the theory of pythogenic origin, or spontaneous origin ***de novo***, comes into line and agrees with the bacterial theory of disease production, if the idea of necessity for contagion by one single specific bacillus be abandoned, and the possibility of evolution of disease-producing properties, through successive generations of bacilli, be

* *Philadelphia Medical News*, 1890; and *Centralblatt für Bacteriologie*, June 1891, ix., 832. *See also* Paper by Theobald Smith, *New York Med. Journal*, Nov. 1890; and *Centralblatt f. Bact.*, 1891, ix., 606.

† Surgeon-Major D. D. Cunningham has this year made somewhat similar observations on the comma-bacilli found in cholera.—See *Scientific Memoirs of Med. Off. of Indian Army*, VI., 1891.

entertained. It is suggested that the diarrhœa prevalence so frequently associated with enteric outbreaks is dependent upon, and an expression of, this process of bacterial evolution.

Liebermeister has declared that specific infection is necessary. "No matter how well a field is manured," he says, "wheat will not "grow unless wheat has been sown." More lately, Strümpel (1887) declared the same, and affirmed that there was not the slightest proof that typhoid bacilli can be developed from any other micro-organisms. I would not venture to say that even now there is any *proof* that such is the case; but I venture to say that it is a reasonable supposition, taking into consideration the results of recent researches in bacteriology, and that it will afford a simple and satisfactory explanation of those outbreaks in camp life that have hitherto been so difficult to account for.

It is obvious that if this supposition be correct, a ready explanation is also afforded for the great variety of types of enteric fever that are met with; they may be considered as dependent upon the degree of evolution that the bacillus has reached. And that this is not fanciful, or illogical, must, I think, be allowed, when we bear in mind the extreme rapidity of propagation, and enormous number of generations of bacilli, that are produced in a very short time. No believer in evolution would deny that changes in form and function might take place in, say, 100 or 1,000 generations of a living organism, providing the environment is altered favourably, or the reverse, in one direction or another. But bacteria will pass through 100 or 1,000 generations in a few days; what difficulty, then, is there in supposing that the thousandth generation should have characters and properties different from the first, different as regards action on human beings, as well as in regard to cultivation media. The circumstances of the environment are all-important, and the co-existence of filth, organic matter undergoing decomposition, or fæces, with the most favourable conditions of temperature and moisture, may reasonably be supposed to bring about such a change in the nature of a micro-organism as to endue it with disease-producing properties, and so cause the production of a specific poison *de novo*. In this way, though wheat, as Liebermeister says, will not grow unless wheat has been sown, a bacillus capable of producing enteric fever may come into being, even though no ***bacillus typhi abdominalis*** were numbered among its ancestors.

I have not touched upon the mode of spread of the disease in the field, by water, emanations from polluted soil, and the like, as my object has been only to bring together, on the one hand, the facts observed by military medical officers in the field, and, on the other, some of the latest results of bacterial investigation, in the belief that the latter furnish a true explanation for the admitted difficulties in the former, and that a theory of origin, at the same time pythogenic and bacterial, yet not specific, except by evolution of specificity, will be found to meet the facts of the case.

"CAVALRY FIELD HOSPITALS": A SCHEME FOR RENDERING FIELD HOSPITALS CAPABLE OF ACCOMPANYING A CAVALRY FORCE IN THE FIELD.

By Surgeon-Captain Bruce Seton, 1st Central India Horse.

Journal of United Service Instn of India.

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The necessity for consideration of special medical arrangements, both as regards material and personnel, for masses of cavalry acting independently of an advancing army has not been sufficiently recognized in existing regulations for field service. It is true that, to a very limited extent, the principle has been admitted that a regiment of cavalry or a horse artillery battery does require some modification of the material supplied to other more slowly moving branches of the service, inasmuch as, when on the march or on field service, each of these units carries with it a specially designed "Cavalry Bag" of surgical necessaries as part of the regimental medical equipment.

But beyond this there would appear to be no recognition of the immensely important fact that the celerity of movement of the mounted branches and consequent increased distance covered by them are factors which necessitate a greatly modified ambulance system to that which suffices for the relatively slowly moving mass of an army. That this problem has not presented itself in a more pressing form, and has not been satisfactorily dealt with already, depends no doubt on the fact that, in the recent Frontier Expeditions, such as Waziristan and Chitral, there have been no cavalry operations on a scale sufficient to draw attention to the defects of the present system.

Now, it is laid down in Cavalry Drill, Volume II, that at the commencement of operations, long distances will have to be covered at a rapid rate by the body of cavalry, which is sent on in advance of the army; and, further, that several days march may separate the cavalry from the main body. This will apply equally in the case of a Cavalry Division in a European campaign, and of a single Brigade operating, for example, as a screen to an Infantry Division advancing through an uncivilised country beyond our frontiers. In either case such a force is bound to be independent and to act independently of the main body in the matters of transport and commissariat, and in its ambulance arrangements.

Moreover, the front of such a cavalry screen will extend for many miles, and the screen itself will consist of units (whether squadrons or regiments) separated from each other by appreciable distances; so that the problem of affording even temporary aid to the casualties, which must occur, is a far larger one than appears to have been recognized when the Equipment Tables now in force were compiled.

Recognizing to the full that, in the case of advancing cavalry, it may be necessary to sacrifice men who are sick and wounded to the exigencies of the service, and this to a greater extent than in the case of the more slowly moving infantry, the question still arises—How far are the arrangements at present laid down in any degree adequate to the fulfilment of the functions of the medical services, *viz.*, rendering aid to the greatest number possible of wounded and sick, sending them back to the rear, and relieving the fighting machine of the encumbrance entailed by the mere existence of men in other than a normal state of health?

To answer this question, let us consider briefly the medical establishment which would accompany a Brigade consisting of one British regiment, two native regiments, and one battery, royal horse artillery.

Each unit would have its regimental establishment, consisting of one medical officer, one subordinate, a very limited quantity of surgical equipment, and a dooly (two doolies in the case of British troops).

It is expressly laid down that this establishment is for the treatment of slight cases, the administration of first aid regimentally, "pending transfer to the field hospital."

There would be also two field hospitals, one for British and one for Native troops, for each Cavalry Brigade.

The personnel equipment of these may be roughly tabulated as follows:—

TABLE I.

Personnel and Equipment.	British Field Hospital.	Native Field Hospital.
Medical officers ...	4	4
Assistant Surgeons ...	8	...
Hospital Assistants ...	...	8
Ward-servants, etc. ...	47	19
Kahar establishment ...	About 129	About 129
Ambulance mules ...	80	80
Ambulance drivers ...	About 28	About 28
Surgical equipment ...	112 packages	92 packages.
Pakhal mules ...	4	4

Admirable as this establishment is, both as regards quantity and quality of its component parts, it is evident that its serviceability must depend on its power to fulfil the functions which are its very *raison d'être*, and these at the time and place where they are required.

Can any one who has seen a field hospital on the march, with its painfully elongated and heterogeneous line of doolies and kahars, ambulance mules and transport mules, followers of every class and laden camels, moving along at a pace which, slow at first, becomes hourly slower,—can any one, who has seen this sight conceive that such a body, however well equipped in itself, could ever be other than an encumbrance to a force the success of whose movements frequently depends on the rapidity of its advance? How could such a field hospital keep up with a Brigade advancing perhaps twenty miles a day for a number of days?

And if this argument applies to the main body of the Brigade, how much more is it apparent in the case of the regiment which is thrown forward to supply the advanced squadrons and patrols several miles further ahead, and which daily perhaps comes in contact with an active enemy.

With the best endeavours on the part of medical officers it is, on the face of it, *impossible* that under the present system adequate surgical assistance shall be forthcoming when needed.

But is it to be admitted that the mere fact of a body of troops being rapid in movement is to debar that assistance being afforded to its sick and wounded, to afford which the medical services exist? Not at all. The present system must be altered to suit the circumstances of the case. And this can easily be done.

In the first place, there must be a greatly extended recognition of the principle that the medical arrangements for a cavalry force *must* necessarily be far more mobile than those which amply suffice for infantry. In fact *Cavalry Field Hospitals* must be organized, differing from the ordinary field hospital in every particular requisite to ensure the great essential, mobility. If this can be done, as seems possible, without any increased expense, so much the better; but even were considerable outlay incurred to effect the purpose, better that outlay and efficiency than blind adherence to a sealed pattern, and failure at the crucial period.

Suggestions for the Cavalry Field Hospital.

1. The present arrangement into four independent sections is an admirable one. However, since with the existing scale

of equipment, any particular section detailed to accompany a small force would be seriously hampered by its large mass of stores, etc., even with the reductions (to be detailed) which might be made in these stores, it would be necessary to leave the more cumbersome articles with the heavy baggage of the Brigade. Any part, therefore, of its equipment over and above absolute necessaries should be left in charge of one section, which would throughout act as a "base" to the other three, would act as a reserve of drugs, etc., for them, would as far as possible relieve them of sick and wounded, and leave them free to accompany any unit, such as a squadron or a regiment, when on detached duties. This "base" section could either accompany the main body of the Brigade, or come on, as rapidly as possible, with the baggage.

2. *Ambulance Transport.*—This would appear to be the best place to consider this most important question, more especially for the reason that the creation of a mobile Cavalry Field Hospital at no extra expense to Government is rendered possible only by altering the whole system as at present existing. There are two available modes of transport in a field hospital; for "lying-down cases" 20 doolies are provided, and for such as can ride, 80 mules equipped with a new pattern of ambulance saddle. With a body of troops on the march, the majority of casualties will consist of cases of fever, dysentery, and collapse from exertion or heat. These will be carried in doolies for the obvious reason that they could not ride. Besides these, we must consider the possibility of men being wounded, or thrown from their horses, and having to be carried.

It may fairly be concluded, therefore, in the case of a cavalry force, that the majority of cases requiring assistance will be lying-down cases. From march to march the sick of previous days will also have to be carried, until arrangements can be made for sending them back.

To do all this a field hospital has 20 doolies. Each dooly is carried by six kahars, and the total establishment of these is 129.

Now, the dooly-bearer, or kahar, is popularly believed to be an untiring, patient, and, in his own way, skilful beast of burden. This theory has as much truth as most such popular beliefs.

When the Waziristan Force was mobilised, the greatest difficulty was experienced in raising kahars, even after depleting regimental hospitals down country. Men were swept in from the bazaars of Mooltan, Ferozepore, and similar places,

and, after passing a medical examination, were set to carry doolies. Many of these men, when questioned by the writer, admitted that the work was completely new to them. Add to this that even the old-time regular kahar was innocent of the very rudiments of ambulance work proper, and the result may be imagined.

It is in the personal experience of the writer that the average rate of progression of a laden dooly is certainly not above two miles an hour, and this with halts every quarter of a mile or less to change shoulders; however, the kahars frequently either stumble, or from sheer exhaustion let the dooly drop. This occurred, in the case of the writer, twenty-three times in one march.

It is obvious that lying-down accommodation must be provided; so that the dooly establishment would have to be replaced by some other means of transport. This could easily be done.

The establishment of doolies is a very costly item, as the following table will show:—

TABLE 2.

Cost of Dooly Establishment for a six months' campaign.

	Rs.
1. Cost of free kit for 129 kahars at commencement at (roughly) Rs. 3 a head	387
2. Pay for six months at an average of Rs. 8 a month (including batta)	6,192
3. Cost of free rations for six months at an average of Rs. 2-8-0 monthly	1,935
4. Pensions of drivers } No estimate possible.	
5. Transport of drivers } No estimate possible.	
Total .	8,514
or a monthly average of .	1,418

This establishment then, adapted to carry 20 doolies, costs Rs. 1,418 a month, or Rs. 8,514 for a campaign of six months' duration.

In place of these substitute mules, carrying litters. A cavalry baggage mule does day after day carry as much as three maunds of kit, and this without stumbling; and such a mule will cover long distances day after day, at twice the pace of a laden dooly, on the most meagre rations. Compare the cost of substituting mules for doolies, premising that each mule carries a pair of litters.

TABLE 3.

Cost of Litter Mule Establishment for six months.

	Rs.
1. Rations of 10 mules at, say, Rs. 12 per month .	. 720
2. Pay of five drivers at Rs. 9, including batta .	. 270
3. Rations of five drivers at Rs. 2-8-0	. 75
4. Free kit of five drivers at commencement of campaign at Rs. 3 a head	. 15
5. Pensions of drivers. } 6. Transport of drivers. }	
Total	. 1,080
A monthly average of	. 180

Supposing this mule establishment to be doubled, *i.e.*, 20 mules carrying 40 litters, with 10 drivers, the monthly upkeep should still only be about Rs. 360 as against Rs. 1,418 for the maintenance of 20 doolies, and the pecuniary saving would be *Rs. 1,058.*

The *Mark III* litter weighs 106 lbs. (roughly 1¼ maunds) per pair. It is evident that the mule which can carry a laden pair of these, or about five maunds, must be of a finer stamp than the ordinary undersized commissariat mule; mules of the type required, however, are to be found in every mountain battery, and the limited number required for a few cavalry field hospitals should not be difficult to obtain.

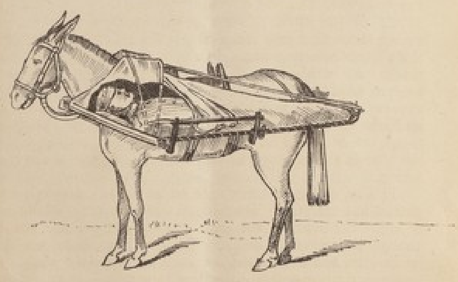
As to the initial expense of purchasing the mules. It is shown above that over Rs. 1,000 would be saved monthly by the suggested alterations. In six months a sum of Rs. 6,000 would have been saved. Now a mule of the type required can be purchased for from Rs. 400—500. Taking the higher price, the saving alone would buy 12 out of the suggested 20; and it must be remembered that at the end of the campaign these mules would be available for ordinary transport work. So that in the long run Government would gain on the transaction.

Finally, of the 80 ambulance mules already allowed, a proportion at least might be equipped with *cacolets*. Many cases of injury occur where men cannot ride, and yet are not bad enough to require a dooly. Cacolets for these would be invaluable; and here again, as each cacolet mule would carry two men if we can obtain the few larger and more powerful mules necessary, we should increase the carrying capacity of the hospital.

I.

CACOLET FOR CARRYING WOUNDED MEN,

Fitted with cushions, back and waist straps, slings and foot boards (weight 56lbs. per pair).



II.

HORSE OR MULE LITTER,

Fitted with straps, hood, pillow and apron (weight 106lbs. per pair).

To sum up, the following is the alternative now suggested, and by its side is shown the present establishment :—

TABLE 4.

Comparative Table of existing and suggested ambulance.

No. 1.—Existing Regulations.			No. 2.—"Cavalry Field Hospital."		
1. Doolies	20	Carrying 20 sick.	1. Litter mules	20	Carrying 40 sick.
Bearers	129		Drivers	10	
2. Ambulance mules	80	Carrying 80* sick.	2. Ambulance mules—		
Drivers	24		A.—Cacolet mules	40	Carrying 80 sick.
			B.—As in No. 1†	40	Carrying 40 sick.
Total		100 sick.		80	120
			Total		160 sick.

* All these would be riding cases, *i.e.*, on the ordinary ambulance saddle.

† Riding cases, as in No. 1.

So that the Cavalry Field Hospital would be able, in an extreme case, to deal with 160 sick and wounded, and each "Flying section" recommended above, with 40 cases. Finally, in the case of a troop being detached, it would be possible to send with it at least a litter and cacolet mule, whereas a dooly would be conspicuous to the enemy, slow, unwieldy and invariably lagging behind.

3. *Personnel.*—There are too many followers in a field hospital. Though the substitution of 10 drivers (for the litter mules) for the 129 kahars would make a very great difference, the defencelessness of the hospital would still exist.

The drivers should be enlisted soldiers, exactly like those in mountain batteries. Had there been 50 armed drivers in the two field hospitals at Wano, instead of some 250 defenceless followers, the mortality would have been less and the Waziris would not have been able to cut up half the hospital transport as they did. The actual expense of having soldier drivers would be very little more than that of the same number of commissariat drabies; while in peace time they could be fully and most usefully occupied in learning stretcher drill, "first aid," etc. It is, perhaps, unnecessary here to point out that a kahar is not trained in any way; and yet on him will devolve the duty of lifting sick and wounded men into doolies.

The whole of the drivers, whether ambulance or transport, would, if armed, form a most useful defence to the hospital; and from the fact of men being soldiers there would be no chance of their not being forthcoming in action, as occurred at Wano, when, after the first volley into the hospital camp, not a kahar could be found, and the medical staff had to bring in the wounded.

4. *Equipment.*—The latest alterations in the equipment of field hospital are excellent in every way. The total number of packages has been reduced, and heavy drugs have been in many cases replaced by lighter or less bulky ones. If only this were extended, and the excellent "soloids," "tabloids," etc., obtainable nowadays more generally substituted for made up "tinctures," etc., a still greater reduction in weight could be effected.

If litter mules were introduced in place of doolies, a surgical havresack or field medical companion could be carried by each, and boxes No. 3 and 4 done away with.

The stationery is on an unnecessarily liberal scale; and two No. 12 boxes, instead of four, would amply suffice for the whole four sections. The same applies to box No. 11. Again, as flying sections could not carry with them all the clothing and blankets allowed in boxes 13 and 17—22 (British Field Hospital) and 15—19 (Native Field Hospital), the quantity supplied should be halved, two of each only being supplied. In this way, without any loss in efficiency, the total number of packages would be reduced to 72 in the case of a British and 60 in a native field hospital.

The tentage for a Cavalry Field Hospital ought to be certainly not more than half the amount now allowed, if the amount of mule transport is not to be very largely increased. A British hospital contains some 30 tents for sick, and a native hospital 19, besides some dozen tents for subordinates, drivers, kahars, etc. Tents for the sick could be halved in number, and, if necessary, regiments could temporarily supply tents for the use of their own sick. This, however, is merely a matter of transport.

Operating tables, chairs, and office tables, except one of each, are unnecessary.

5. The transport must be entirely mule carriage. Camels are out of the question. All packages and boxes are limited to 80 lbs. weight, and could therefore be carried on mules.

The following table gives a rough estimate of the transport required :—

TABLE 5.

	British Hospital.	Native Hospital.
1. Number of mules to carry the surgical equipment, as suggested above (roughly) . .	36	30
2. Tent mules (roughly) at reduced scale recommended	10—15	8—12
3. Drivers and followers' kits	6	4

With such a hospital as has been roughly outlined above it would be reasonable to expect that a cavalry force would be fairly equipped from the medical point of view. No doubt with every improvement that experience can suggest, men will still have to bleed to death unattended in the next big campaign, more especially in advanced squadrons, on patrols, etc.; but when the number of such victims *can* be reduced by a system of rational, relatively cheap, and certainly more efficient method of transport than at present exists, it would seem to be only fair to the service and to the individual that steps should be taken to bring about that end.

NOTE.—The value of the proposals in this paper turns to a great extent on the possibility or otherwise of obtaining a sufficiency of mules capable of carrying, say, five maunds. In reply to a question on this point the author of this article wrote to the following effect :—"I quite see that my suggestion regarding mules might be challenged as impracticable. I am aware that 270 lbs. is the outside weight in a mountain battery even. However, I enclose two drawings, one of a cacolet and one of a litter mule, with weight. These drawings are from the catalogue of the makers who supply Government, and they are identical with the drawings shown in 'The Manual for the M. S. Corps' and in Sir Thomas Longmore's 'Gunshot wounds.' So much for the litter and cacolets; and I think it is fair to assume that if mules can carry them at home, in Cyprus (as they did after the Egyptian war), and in the French operation in Algeria, that they could carry them out here." It was further objected that doolies would still be required for the more serious cases. Against this objection the writer had some practical experience to offer: he wrote:—"As to the necessity of doolies being employed for bad cases, I most decidedly say they are not necessary. I may appear heterodox in my views, but having been carried miles in a dooly in a ghastly country, I know what it means when I was wounded through the knee; I actually had to get out and ride my own horse, as preferable to being upset every few yards. I saw a dooly carrying a man with double pneumonia upset while crossing a stream, and the patient died of the shock."

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LOCAL GOVERNMENT BOARD.

PAPERS

with

An Introductory Report by the Medical Officer of the Board:—April 1886.

REPORT.

TO THE RIGHT HONOURABLE THE PRESIDENT OF THE LOCAL GOVERNMENT BOARD.

SIR,

OUTBREAKS of disease related to local milk-supplies have for many years been the subject of study by local sanitary inquirers; and in almost every year since the constitution of your Board, your Medical Department has been called on to investigate such occurrences. Sometimes the disease has been enteric fever, sometimes scarlatina, sometimes diphtheria; and within the experience of the Board there have been fifteen instances where one or other of these diseases has been shown upon sufficient evidence to have been distributed with the milk-service of the families invaded. In the case of the scarlatina outbreaks it was inevitable that infection of the milk by human agency should present itself as the readiest explanation of the facts; but as successive epidemics have occurred and have been found capable of more exact study, distrust of this explanation has arisen, and the means by which the milk receives its infective properties has come to be regarded as unknown—as possibly being related to the milk as a secretion of the cow.

A scarlatina epidemic in St. Giles and St. Pancras in 1882 was the subject of investigation by Mr. Power for the Board; and the disease was here distributed with a milk-service derived from a Surrey farm. In this case two facts could be affirmed: the one that a cow recently come into milk at this farm had been suffering from some ailment, seemingly from the time of her parturition, of which loss of hair in patches was the most conspicuous manifestation; the other that there existed no discoverable means by which the milk, which had coincided with scarlatina in its distribution, could have received infective quality from the human subject. The circumstances of the milk-service did not, indeed, in this case permit of a relation being established between ailment of any particular cow and the disease spread from the farm. But the facts were so far suggestive that, at the instance of the Board, some experimental observations were made by Dr. Klein as to the concern of animals with human scarlatina; and it was found that a definite disease was producible in the cow by means of scarlatina-infection, producible most readily when the cow was in milk.

The experiments were not at the time carried farther than the production of this disease, and the recognition of certain of its characters; among these the most interesting was its quality of communicability from one animal to another by inoculation.

The investigations with which the present papers are concerned were directed by the Board, last December, in view of information furnished by Mr. Wynter Blyth, the Medical Officer of Health of Marylebone. This officer had observed a sudden outbreak of scarlatina in his district to be associated with the distribution of milk by a particular retail dealer, and that this dealer obtained the greater portion of his supply from a farm at Hendon. Mr. Blyth had found reason for believing that the disease had prevailed exclusively among customers furnished with milk from that source.

Mr. Power, to whom the Board entrusted the duty of making more extended inquiry into the facts concerning milk-supplies from this Hendon farm, presently learned that a similar prevalence of scarlatina had occurred about the same time in other parishes of the metropolis that were furnished with milk from the same farm; and that in those parishes, as in Marylebone, the prevalence of the disease had been very much restricted to consumers of this milk.

I refer to Mr. Power's report for the steps by which he first established a presumption that the Hendon milk had been the vehicle of scarlatina to its London consumers; by which he afterwards excluded pre-existent human disease at and about the Hendon farm, and excluded also anything of the kind commonly known as "sanitary" conditions there, as having had concern with the infectivity of the milk; and by which he came successively to regard certain sections of the milk-supplies within the farm, and eventually certain cows, as having to do with the observed results. The whole of Mr. Power's report on these matters will have to be studied before the exactness of his observations and the validity of his inferences can be duly apprehended. In the end he has demonstrated, beyond reasonable doubt, the dependence of the milk-scarlatina of December on a diseased condition of the milch cows at the farm; a condition first introduced there in the previous month by some animals newly arrived from Derbyshire; and he finds strong circumstantial evidence for believing that the later phenomena of this dependence were brought about through the extension of the diseased condition of one set of animals to another set, after the fashion of an infection. Mr. Power leaves to others to give a full description of the phenomena of disease observed in the cow. Its manifestations, he tells us, were not particularly conspicuous, and one of the more prominent, namely, sores on the udders and teats, was very possibly common to it and to other less important states observed in milch cows.

The second report of the present series is by Dr. Klein, whose services were invited by the Board, as soon as circumstantial evidence had established a relation between scarlatina and the consumption of Hendon milk. Dr. Klein records his early investigations into the intimate nature of the ailment present among the cows. In its own province Dr. Klein's report is as important and as interesting as Mr. Power's, and its more immediate significance lies in the complete harmony between the conclusions obtained from Mr. Power's etiological researches and the inferences as to communicability and other characters of the Hendon cow-disease that follow from pathological inquiry. By the inoculation into calves, either directly of the discharges from cow-ulcers, or indirectly of sub-cultures of those discharges artificially prepared, Dr. Klein has succeeded in producing, now local, now general, disease in the calf; disease having unmistakable affinities, under some conditions with the Hendon cow-disease, under other conditions with scarlatina in the human subject:—on the one hand, ulcers on the skin of the calf anatomically identical with the ulcers on the teats of milch cows: on the other hand, general disease in the calf, at first of inconspicuous nature, but passing on to serious changes in the internal organs, more particularly in the kidneys of the calf; the more characteristic of these changes being anatomically identical with those resulting in the human subject from the operation of the scarlatina poison.

It is intended that Dr. Klein's report on this subject, as it will appear in the Supplement to the fifteenth volume of the Board's Reports, shall be illustrated by some drawings of the microscopical appearances which he describes. And it is also proposed that during the forthcoming year a portion of the grant annually made by Parliament for the scientific purposes of the Board shall be allotted to further study of the relations that exist between human scarlatina and diseases of animals. But as it has already been judged desirable to publish Mr. Power's report convicting the animals of a milk farm of participation in the distribution of scarlatina to consumers of their milk, so on receipt of Dr. Klein's paper, your Board has thought proper that the two shall without delay be published together. They will properly form a starting point for fresh observation and experiment, not only by your Medical Department, but by all who have the opportunity of investigating the new and promising fields of research that are opened by the recent experiences of Hendon.

I am enabled, by the favour of the Epidemiological Society, to reproduce here, as a third paper, an account of the phenomena of the Hendon cow disease, recently presented to that Society by Dr. Cameron, the Medical Officer of Health for the district and the medical adviser of the Hendon farmer. His account consists partly of observations actually made by himself among the cows of the farm, and he brings these down to a later date than the completion of Mr. Power's etiological inquiries. But further, with the aid of people familiar with cows and who thought they recognized in the disease at the farm one stage of a disease which they were able to describe as a whole, Dr. Cameron has drawn up what he and his informants together would regard as a connected clinical history of the disease. I have thought that, provisionally, his paper will have practical value to the milk-farmer.

I have the honour to be,
Sir,
Your obedient servant,
GEORGE BUCHANAN.

April 1886.

PAPERS.

No. I.

MILK-SCARLATINA in LONDON in 1885: being a REPORT by Mr. W. H. POWER on certain observed relations between SCARLATINA in various DISTRICTS of LONDON and MILK supplied from a DAIRY FARM at HENDON.

No. I. On Milk-Scarlatina in London; by Mr. W. H. Power.

Statement to Board.

ON December 18th, 1885, Mr. A. Wynter Blyth, Medical Officer of Health of St. Marylebone, personally reported to the Board a sudden and extensive outbreak of scarlatina* that appeared to be associated with the distribution of milk from a particular retailer in South Marylebone. He described this retailer as obtaining his supplies from two farms, and the coincidence of the retail milk distribution with Marylebone scarlatina as being limited to that one portion of the milk supplies derived from a certain dairy farm at Hendon. Mr. Blyth further stated that he had visited this farm and had conferred with Dr. Cameron, the Hendon Medical Officer of Health, but that neither he nor Dr. Cameron had been able to discover, in the sanitary circumstances of the farm or in the health of those employed about the farm, any sort of clue to the means by which the milk had become infective. He had not heard of any veterinary examination of the cows.

Hereupon I received the Board's instructions to make inquiry into the whole case, and if occasion should arise, to investigate the conditions at the Hendon farm that might have a bearing on the question of production or dissemination of scarlatina by milk; and further, if any sort of malady among the cows should appear to require investigation, I was to obtain the co-operation of Dr. Klein in such pathological study as was needful.

Personal inquiry.

Inquiry was commenced simultaneously in London districts and at Hendon. The experience of South Marylebone, as observed by Mr. Blyth, was compared with the corresponding facts for other London districts receiving supplies of milk from this Hendon farm. At the same time at Hendon search was made for cases of disease, not only of scarlatina, but of any disease resembling scarlatina; and not only among the families of those employed about the farm, but among their neighbours and in the district generally. The Hendon farmer was made acquainted with the general nature of the inquiry that was going on, and his help was invited in any investigation of his farm and his business that might afterwards become requisite.

Scarlatina found in certain milk businesses;

In the course of a few days, by December 23rd, inquiries in the foregoing sense had been made. It had been learned that milk from this Hendon farm had been distributed by retail in St. John's Wood, in St. Pancras, in Hampstead, and at Hendon, as well as in South Marylebone; it had been distributed in these districts only; and from every one of these several districts—except from St. John's Wood—the same general story was forthcoming. Until the end of November or beginning of December 1885, the district had been for some months exceptionally free from scarlatina; about this date scarlatina had undergone sudden and notable increase in the district; and then and thenceforward

* The diagnosis of "scarlatina," in the cases with which this Report will be concerned, was made without hesitation by every practitioner who had charge of the cases, alike in the metropolis and at Hendon.

a strikingly large proportion of the recorded cases had occurred among persons who proved, upon inquiry, to be customers of a milk retailer dealing in the particular Hendon milk.

At this early time of the inquiry, no special importance could be attached to the circumstance of scarlatina not having been noticed among the customers of the St. John's Wood business.

probably in consumers of Hendon milk

In each of the milk-districts (as I may call them) of South Marylebone, St. Pancras, and Hampstead, other milk besides milk from Hendon had been distributed by the retail dealer vending the particular Hendon milk; and as soon as special prevalence of scarlatina in those several milk-districts became apparent, it was of course seen that, instead of the Hendon milk, these other milks might be in question. This was possible though not probable. For these other milks had come from two different farms (from one to South Marylebone, from the other to Hampstead and St. Pancras), situated in widely separate counties, and distribution of scarlatina with milk not being an every-day occurrence, it was much less likely that absolutely distinct farms thus widely separated had at one and the same time been supplying to neighbouring districts in London milk having the same special concern with disease. It was much more likely, therefore, that the Hendon share of the milk, being common to the three businesses, had been the responsible agency.* And further, Mr. Blyth had ascertained in regard of the South Marylebone milk business that certain customers supplied with Hendon milk, *and Hendon milk alone*, had suffered scarlatina.

from a particular farm.

Then, as for antecedent disease among the Hendon population, of a nature to have had concern in the distribution of scarlatina with the Hendon farmer's milk it had, by December 23rd (thanks to Dr. Cameron's thorough knowledge of his district), come to be regarded as out of the question that any infection of the milk by such disease outside the farm could have taken place. It could be said that no scarlatina, nor any illness at all like scarlatina, had affected any of the persons employed about the farm, their families or neighbours, at any such time or in any such way as to influence the farm or its produce. Such few cases of scarlatina as could be heard of at Hendon during 1885 had occurred at a distance from the farm and in families that had nothing whatever to do with the farm.

The foregoing experiences of different districts, and the considerations here presented as arising out of them, were held to constitute a notable presumption that the Hendon farm had been concerned with the scarlatina prevalences. It was a presumption that nowise amounted to proof, especially when it was seen to be an essential element of the problem that outside human agencies had to be set aside as not having been operative. Yet it was enough to give precedence to the Hendon farm as the place where search after conditions of milk infection might most profitably be made; and investigation of the circumstances of the Hendon farm was accordingly commenced without loss of time.†

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* As the inquiry advanced, and the exemption of the St. John's Wood consumers of Hendon milk was seen to be definite and beyond question, the fact appeared for the moment greatly to change the above probability. But on the other side there was the circumstance of a peculiarly intense incidence of scarlatina at Hendon among people who got no milk except from the Hendon farm. More about these occurrences will appear in the sequel.

† Though precedence was given to this investigation, it was not without much hesitation that the inspection of the dairy farm was begun. For ere now it has happened that official visits for purposes of knowledge have been confounded by the public with condemnation of the common sanitary doings of the farmer, with the result of unwarranted disaster to his business interests; and I had Dr. Cameron's assurance that in this case any such condemnation was very far from being deserved.

Conditions observed at Hendon.

In passing to consider the possible relations between this farm and the outbreaks of scarlatina which had occurred in the milk districts of various retailers deriving parts of their supplies from the farm, I had the advantage of Dr. Cameron's assistance. This officer had had previous experience of disease associated with the consumption of a particular milk, and as my inquiry at Hendon proceeded he proved himself a very able coadjutor. In what follows respecting the Hendon dairy farm I may claim that my methods and conclusions had throughout his consent and confirmation.

Sanitary state of farm.

The dairy farmer, though willing to afford and though indeed desirous of affording us every assistance, was utterly incredulous of the presumptive evidence tending to connect disease with the milk supplied from his farm, and till a late period of the inquiry he remained so. His cowmen were perfectly incredulous also. And truly, having regard to the facts that we first elicited, as to freedom from illness of those at the farm and as to the peculiar care given to the sanitary affairs of the farm and its dairy, the farmer's incredulity could not but be regarded as justifiable. He had certainly done his best to avoid known conditions of danger, and had not suspected that any such condition, known or unknown, had been present on his farm. The farm was found to have had especial pains taken to render it, as the phrase is, sanitarily perfect. At the instance of one of the London retailers with whom the farmer had dealings,* the place had for several years been the subject of special supervision by the medical officer of health of the district, my coadjutor in this inquiry, Dr. Cameron. He had seen that the West Middlesex Company's water was laid on to the farmhouse, to the dairy, and each of the several cowsheds; he had seen specially to the wholesomeness, as regards drainage, cleanliness, ventilation, and the like, of the house, the farmyard, the cowsheds, and the dairy; securing for the last all needful appliances for effectual cleansing of dairy utensils by hot water or steam; and, month by month, he had inspected the farm premises with reference to these and similar details, for the express purpose of safeguarding the milk against contamination of any detectable kind. Further, under the same arrangement, Dr. Cameron had specially attended to the health conditions of those employed about the farm and their children, with a view to early detection of any malady among them that might by chance injuriously affect the milk with which they had to do. He had even undertaken to observe and to report to the London retailer, by whom his services were retained, on any occurrences of infectious illness in the neighbourhood of the farm, even though it did not directly affect the families of people employed there. The farmer too who had consented to the exercise of this supervision over his doings, had attended to every suggestion made to him, and had taken every precaution to secure his farm and his milk against any known sanitary fault or misadventure. He had a separate shed for any sick animal, and a separate shed for the observation of newly arrived animals.

Provisional hypothesis of cow disease.

Thus, with Dr. Cameron's aid, the point was speedily reached at which it could provisionally be affirmed of the Hendon farm milk that, if indeed it had caused scarlatina among its consumers, it had not acquired the ability to do so in any commonly accepted way, such as

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* This retailer owned the St. Pancras and Hampstead businesses, and will be mentioned in this Report as Mr. Y. He has for some years shown the same solicitude in respect of the other farms from which his milk is brought to London. In other ways, too, he has habitually been on the alert to secure his customers from any risk of milk-infection, and to place his business above suspicion. His attitude towards sanitary matters in their wider aspect has been much in advance of his fellows; and thus the abundant aid he has furnished to the present inquiry has been correspondingly of the greatest value.

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through unwholesome conditions of water or drainage, or through careless handling of milk or milk utensils by persons carrying scarlatina infection. Nor, during the long subsequent acquaintance with the farm gained in the course of this inquiry, did any reason appear for modifying this conclusion.

It was not long, therefore, before we found ourselves confronted with the alternative, which thenceforth constituted itself into the hypothesis which we had to examine, that the cows themselves must have had something or other to do with any scarlatina which had been distributed along with their milk.

Our reliance for the discovery of such a something, and for an understanding of its nature, lay in ascertaining in detail every parallel between the doings at the dairy farm and the observed scarlatina.

Relations of scarlatina cases to farm operations.

From the point of view now reached, every peculiarity of scarlatina incidence on the various districts supplied with milk from the Hendon farm acquired a new importance. Exemptions, specialities in point of time, and of extent of prevalence, now claimed to be considered under the aspect of possible relation with the operations of the farm. The history of the observed scarlatina, thus investigated with all attainable exactness, is given in summary in the table subjoined. Leaving to the health officers of the several districts to narrate, in the health interests of their districts, the local characters of the outbreaks, I here show for each retailer of the Hendon milk the locality of his operations, the amount of this and of other milk distributed by him, and the dates of notable incidence of scarlatina on the consumers of milk delivered from his shop, together with such facts as are to be had about the relative amounts of scarlatina in the customers of the several businesses. I designate the retailers by letters rather than by their names.

Retailers of Hendon Milk.	Milk-District situated at	Total Amount, in Barn Gallons, of Milk distributed Daily.		Date of Notable Incidence of Scarlatina on Customers of Retail Business.	Degree of Incidence at one and another Period.
		Hendon Milk.	Other Milk.		
Mr. X -	South Marylebone.	63	10	End of November and early December to date of inquiry.	Customers suffered heavily and in increasing numbers up to date of inquiry.
Mr. Y (1*)	Hampstead -	18	25	End of November or early December, and Mid-December.	Customers did not suffer nearly so heavily as Mr. X's customers. They were attacked in two groups, one a small group, limited in time at the beginning, the other a large group, from the middle of December to the date of inquiry.
Mr. Y (2*)	St. Pancras -	6 or 7	45	Early December and Mid-December.	Comparatively few customers suffered. Attacks, however, grouped in time much as in Y (1) business.
Mr. Z -	St. John's Wood.	20	4	—	No scarlatina among customers up to date of inquiry.†
Mr. P -	Hendon -	1 or 2	—	Early December -	Number of families consuming the milk day by day not a dozen. Two of them suffered; the earliest invaded being attacked near end of first week of December.

* Mr. Y. had two retail milk establishments, Y (1) in Hampstead, and Y (2) in St. Pancras. Hendon milk was delivered to him at his Hampstead place of business, and there only; from hence some of it was transferred by his own men to his St. Pancras establishment.

† But see page 13, para. (c.)

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Specialities of London scarlatina.

Of the special phenomena that were learned about the scarlatina outbreaks, and that are shown in summary on this table, those which established the most important claim to recognition by the inquirer into the farm operations, were seen to be as follow :—

(*a.*) In those four districts (the milk districts of a former paragraph) wherein scarlatina had shown an extravagant incidence upon the milkman's customers (probably, as we have seen, upon the consumers of the Hendon milk), the disease had begun its peculiar incidence *at one and the same time*, namely, *about the end of November or beginning of December.*

(*b.*) In one of those districts (that of Mr. X) scarlatina continued *day by day, and with increasing force up to the date of the inquiry*, to attack the customers of the retail business.

(*c.*) In two other of those districts (those of Mr. Y's two businesses) scarlatina behaved in a different fashion. In each district, after attacking in some number *for a few days at the end of November and beginning of December* the customers of the business, the disease showed *no fresh attacks for about ten days* (the period of intermission was short, but was quite clearly and sharply defined), and then *about the middle of December attacked them again in larger number, and continued to do so up to the date of inquiry.*

(*d.*) In the fifth district (that of Mr. Z's business) *no scarlatina whatever*, either at the end of November or subsequently, *down to the time that the investigation was proceeding*, had been learned of by the best inquiry that could be made in the parish.

In the study of the farm operations, which was now set on foot for the detection of conditions parallel to these special phenomena, the most striking phenomenon—one which, indeed, demanded explanation if any relation of the Hendon milk to the disease were to be upheld—was this definite exemption of the St. John's Wood people who had dealings with Mr. Z. It was, indeed, a remarkable fact. Mr. Z got five-sixths of his milk from the Hendon farm, and distributed an ample quantity of it among numerous customers. Yet there was a total absence of scarlatina from among these customers.

Their connexion with new conditions at farm:

Examination of the circumstances of the cows at the Hendon farm was now directed to ascertain whether *any new condition pertaining to the cows* had arisen in the farm or had been contributed to the farm business at such time and in such way as to be coincident with the ability of the milk to produce scarlatina in its consumers, first, at the end of November in four milk districts, afterwards, throughout December, in Mr. X's milk district, and after an intermission in December, in Mr. Y's two milk districts; while the condition in question was absent from the cows that furnished milk for Mr. Z's business.

The process of inquiry was tedious, involving investigation of a variety of circumstances, such as food of cows, calving of cows, health of cows, arrival and departure of cows, and so forth; and, up to a certain point, it proved barren of result. For a long time nothing could be heard of that was new or changed. During many weeks, or even months, before the scarlatina outbreaks among milk consumers, no change had been made in the food of the Hendon cows; much of this food had been the produce of the farm; the source of other kinds of food had remained unaltered, the quality of the food had not (the farmer averred) changed or deteriorated. So too, as regarded calving of cows, and health of cows. The business did not include the rearing of calves; it was a milk business, pure and simple, the cows being "stall-fed" all the year round, and, as matter of fact, no cow had calved at the farm since September. As to health of cows, it was confidently affirmed that, for months past, not one of them had suffered any illness; indeed, with the exception of everyday trivial ailments, the cows had been, it was stated, particularly free from all maladies to which stall-fed cows are admittedly more liable than other cows.

among newly arrived cows.

But upon passing to consider in detail the comings and goings of cows to and from the farm, some important information was forthcoming, and the inquiry began to assume a more hopeful aspect. The business of the farm being an affair of milk production only, had required a high average yield from the cows kept there; so that cows, as they "dried off," had been in practice replaced by fresh and "newly-calved" cows purchased as occasion required from the country. And it turned out that on the 15th November, three newly-calved cows, purchased from Derbyshire, had been received into the business.* Before November 15th, no new cows had been received since the middle of October; and after November 15th, none had been received until December 4th, when four additional cows had been purchased from Oxfordshire.

In the addition to the dairy farm on November 15th of three newly-calved cows, there appeared a circumstance eminently worth further exploration. For (*a*), it was seen that the arrival from Derbyshire of those newly-calved cows (November 15th) did in fact shortly precede the first occurrences of scarlatina in the four milk districts, namely, at the end of November or beginning of December; so that the cause of scarlatina (whatever it was) was actually manifested in these four districts just after† the time when the milk of those cows came to be included in the produce of the farm. Accordingly, the next questions that arose were, had there been anything (*b*) in the distribution of the milk of those particular cows, or (*c*), in the subsequent relation of those cows with the new-comers of December 4th, or of either set with other cows in the herd, parallel to the observed specialities of scarlatina incidence upon the four infected milk districts? Going on to seek answer to these questions in the facts of the dairy farmer's procedures, some further very interesting and suggestive correspondences were presently obtained.

As regards the concern which the several retail milk businesses had with the milk of newly-imported cows, it has to be premised that such cows were not at once added to the stock in the general cowsheds of the farm. In accordance with a custom instituted for the purpose of guarding against the introduction of foot-and-mouth disease, the new-comers were at first placed in what is known as "the quarantine shed," a little removed from the farmyard. New cows are here kept until their freedom from that disease is regarded as assured, usually for a week or ten days. As matter of custom, their milk is not used in the business immediately after calving, but after a while and before the cow is removed from the quarantine shed, it is judged permissible to use the "quarantine milk." At the expiration of this quarantine period newly imported cows are taken from their special shed and distributed according to the requirements of the general business in the three several sheds of the farm along with the other cows already there.

The particular batches of animals received on November 15th and December 4th were dealt with on this plan. The precise period of

* The dealer who was believed to have purchased these cows in Derby market, and who sold them to the Hendon farmer, resolutely refused all information whatever.

† It was necessarily "after"; for with scarlatina as with other infectious diseases, there is an interval between the date of reception of the infection and the first manifestation of the disease. In scarlatina this interval is known to be less than a week.

quarantine in the case of each batch had not been recorded, but it was believed by those about the farm that the 15th November cows had stayed in the quarantine shed longer than usual; the 4th December cows for not more than a week.

Specialities of distribution of their milk

At the date—the third or fourth week of November—at which the milk of the farm, if it had any infective ability, must have acquired that ability, the cows at the farm numbered 90 or 100, distributed in the several cowsheds as follows:—in the "large shed," 40 or 50; in the "middle shed," 30; in the "small shed," 20. At this date, the 15th November cows were still in the quarantine shed. A few days later, somewhere about the end of the month, the 15th November cows were transferred into the general cowsheds, and very shortly afterwards their places in the quarantine shed were taken by the cows received from Oxfordshire on December 4th. These in turn were transferred to the general cowsheds about December 11th.

At the date in question, the distribution among the London retail dealers (I defer for a time further mention of Hendon consumers) of the milk of the cows in the several sheds was effected with much uniformity, each morning and evening, as follows:—

From the "large shed," Mr. X and Mr. X only, was supplied. The milk of the shed did not indeed suffice for his whole requirements, and the balance was made up by a varying quantity of milk from the "middle shed."

From the "middle shed," Mr. X and Mr. Y received their supplies, and not any other dealer. Mr. Y received all the milk from this shed, except what was required for Mr. X, and in so far as this quantity was insufficient for Mr. Y's requirements, the supply to him was made up from the "small shed." As before said, all milk of the farm received by Mr. Y for his two businesses was delivered to him at one place, namely, at Hampstead.

From the "small shed," Mr. Y and Mr. Z received their supplies, and not any other dealer. Mr. Z received all the milk from this shed, except what was required for Mr. Y, and Mr. Z received milk from no other shed.

From the "quarantine shed," milk was being distributed at the date in question: on some days it went to make up Mr. X's supply, on other days to make up that of Mr. Y, frequently perhaps to both of them on the same day. But rarely, if ever, had it been added to churns destined for Mr. Z, for in the routine of the farm his churns were seldom brought out of the small shed before the quarantine milk had been disposed of.

parallel to distribution of scarlatina.

Now as we have seen, the chief facts as to time-incidence of scarlatina on the four milk-districts of South Marylebone (X), Hampstead and St. Pancras (Y (1) and Y (2)), and St. John's Wood (Z), were as follow:—

Mr. X's customers began to suffer at the end of November and continued to suffer in increasing number up to the date of inquiry.

Mr. Y's customers, in the districts of both his businesses, suffered slightly at the end of November and beginning of December. Then for a while they ceased to be attacked; but about the middle of December they were again attacked in greater numbers and more persistently than before.

Mr. Z's customers had not suffered at all, so far as could be heard of, up to the period that the inquiry had reached.

It will be evident to the reader that, in our search for new conditions within the farm corresponding to the appearance of the milk outbreaks in London, we had now succeeded in finding one such condition, namely, the distribution of the particular milk furnished by the newcoming 15th

November cows. Scarlatina among Mr. X's customers appears soon after the milk of the 15th November cows in the quarantine shed comes to be added to the milk delivered to Mr. X. Scarlatina among Mr. Y's customers appears in Y's two milk districts soon after the milk of these same cows comes to be added to the milk delivered to Mr. Y. Scarlatina among Mr. Z's customers is absent; no milk from these cows is added to the milk delivered to Mr. Z. But this was not all.

Peculiarities of time-distribution of scarlatina

Having in view the other specialities observed in the local behaviour of scarlatina in the several milk districts, it came to be seen at this stage that if the above concurrence was in truth indicative of cause and effect, we must be able to set down *a priori* certain other parallel events which, if they had occurred, would greatly strengthen the inference. This was accordingly done, and when certain probable events had been formulated, inquiry was made as to their actual occurrence.

Taking as a postulate that the likeliest method by which a result producible by the milk of particular cows would become varied or modified, was by variation or modification of the relations of the cows themselves within the business of the farm, the following three propositions were set out as matters of probability:—

(*a.*) In the last days of November or the earliest days of December, a change had probably been made in the manner of distributing the milk produced by the 15th November cows, and most likely this change had consisted in the transference of those cows themselves, or some of them, into the "large shed" and delivery of their milk thenceforward along with the milk of the other cows in that shed.

(*b.*) About the second week of December, some of the 15th November cows, or some of the 4th December cows (which up to December 11th had occupied the quarantine shed), or some other cows that had been during early December in close relation with the 15th November cows, were probably transferred to the "middle shed," and their milk delivered from thence.

(*c.*) It was not probable that at any time up to the end of the second week in December, any of the 15th November cows, nor any of the 4th December cows, nor any cow that had been in close relation with such cows, had been transferred to the "small shed."

parallel to peculiarities of time-distribution of milk.

These probabilities were formulated in view of the special time-distribution of scarlatina in Mr. X's district, and in Mr. Y's two districts, and in view of the continuous exemption of Mr. Z's district. They were not announced in any way to the farmer or his men; and in the search after facts, care was taken to avoid putting leading questions to the people who had been engaged about the cows. Once or twice indeed a statement was made by way of interrogation—to receive the assent of a cowman, who could not divine whence our information had come. In the outcome, it was found that, as matter of fact:—

(*a.*) The three 15th November cows had been, towards the end of November, transferred to the "large shed." Here they all still remained at the date of inquiry, and their milk had been delivered from hence.

(*b.*) The four 4th December cows had been transferred about 11th of December, two of them into the "large shed," the other two of them into the "middle shed"; and in these sheds they were found at the date of inquiry, their milk going into the general supply of the respective sheds.

(*c.*) At no time up to the date of inquiry had any of the 15th November cows nor any of the 4th December cows, nor any other cows been transferred to the "small shed."

In short, what had been seen to be a succession of probabilities if the scarlatina in London districts were indeed the outcome of the milk distributed from the Hendon farm, was now established as a succession of facts.

We had thus reached the point of excluding external scarlatina, of associating the importation of particular cows into the Hendon farm with presence of scarlatina in London districts, and of connecting by a series of parallel events the milk furnished by those cows and by related cows, with the peculiarities of scarlatina prevalence among consumers of the Hendon farmer's milk. Under these circumstances, it was not judged necessary to go beyond the Hendon farm and to inquire at the two other farms that also sent milk into the London districts of South Marylebone, Hampstead, and St. Pancras, in search of the cause of scarlatina in those districts. Henceforward, until anything to the contrary should appear, an influence, competent to produce scarlatina among the consumers of the milk, was held to have operated from those cows which were received into the Hendon farm on November 15th, and the further concern of the inquiry was with the nature of such influence.

Relation of scarlatina to certain cows established.

Nature of morbific quality in cows.

Adhering to the design of the inquiry to proceed altogether upon the circumstantial evidence obtainable within the actual epidemic before making any comparison with former experiences, investigation of the probable nature of the influence by which the Hendon milk had operated to produce scarlatina in its consumers was now begun. After much thought about alternatives it was found necessary to accept, provisionally, the belief that the influence in question, having belonged in the first instance to the 15th November cows, had belonged *to the constitution* of the cows:—was in fact some species of cow disease. And the acquisition of this influence by other cows had become so very probable, that a corresponding probability arose that any such disease in the cow had been in fact an infective disease communicable from cow to cow. The considerations of circumstance that forced these beliefs on acceptance were cogent, no alternative to them was discernible, and we could not see that feeding well and milking abundantly were reasons against the hypothesis of such disease.

Seeking for any exact circumstantial evidence that might possibly exist, indicative of a particular cow or cows having been at fault, the only morsel of such evidence that tendered itself was a specially promising one, but it proved disappointing. A friend of the farmer who had by favour been supplied with the "milk of a single cow," had had his family very heavily stricken by scarlatina at Hendon about the end of the first week in December. A specially fine cow had been designated for his service; but it presently appeared that the milk of that same cow, being regarded as peculiarly rich in quality, had also been taken for the children of people employed about the farm, and among these children there had been no scarlatina whatever. Thus the expectation of identifying that cow as a disease-producer was at an end, and another sort of interest in her arose. The cow was at the beginning of December living with other cows in the large shed away from the 15th November cows in the quarantine shed. It was not for some days later that the facts about this theoretical "one cow" supply were learned: the practice had certainly been less inflexible than the intention; and it was found to have been perfectly possible, to say the least, that on some occasion in early December (when the farm bailiff's back was turned) the supposed "one cow" supply had indeed been dipped out of a common churn in the large shed, in such a way that those who drank it would be in precisely the same relations to the milk service of the

Notable experiment at Hendon during inquiry.

farm as the consumers of the Hendon milk who were living in South Marylebone.

During the further study of the doings at the farm, some days of Christmas intervened, and immediately on the resumption of inquiry it was found that a most instructive but pitiful experiment had been going on at Hendon. In this Christmastide, medical men practising in the district had been called to case after case of scarlatina occurring in separate houses and obtaining the proportions of a little epidemic. The houses were at Child's Hill and elsewhere near the farm, and were occupied by people of the labouring class and the poor. The first case had dated from December 20th. Upon inquiry as to the milk supply of those families it was ascertained that they, one and all, had shortly before their invasion been exceptionally furnished with milk from the Hendon farm under circumstances as follows:—On December 15th the whole of Mr. X's milk, 63 barn gallons, mainly derived from cows in the large shed, had been returned on the farmer's hands with an intimation by the Marylebone Health Officer that he believed the milk, or some of it, to have been causing scarlatina in his district. Hereupon the farmer, though discrediting the allegation, determined not to seek for a new market for that section of his milk. The returned milk went to the pigs. For the rest, those of his customers, he said, who still desired his milk could if they chose continue to take it and be served as before, but he gave orders that the section of his produce which he regarded as being under suspicion, namely, all the milk of the large shed, should, with the exception of some to be used for pig-feeding, be thrown into a pit freshly dug in one of his fields. His instructions, however, were not completely carried out by his cowmen. It became known in the neighbourhood that milk from the farm was being thrown away, and at once a number of poor neighbours put in an appearance and begged for it. To most of them it was refused, to all those who applied to the farm bailiff; but by special grace of certain cowmen some of these neighbours received gratuitously on December 16th and subsequent days, a portion of the produce of the large shed that would otherwise, as they and the cowmen believed, have been wasted. It was among these people that scarlatina appeared about a week afterwards. It invaded some half dozen families, forming an unknown (but certainly a large) proportion of the families to whom the milk had been given, and it attacked no family to whom it was not supplied.—Conversely, upon subsequent inquiry in South Marylebone, it was found that in the period about Christmas when these Hendon families were falling ill of scarlatina new cases ceased, almost suddenly, to appear among the families supplied by the South Marylebone milk seller, and afterwards there were no fresh attacks except what were referable to spread from previous sufferers.

The experiment was complete and confirmed the inferences which had before been drawn from the distribution of scarlatina in metropolitan districts. No more of the inculpated milk was sent to London throughout the whole period of the inquiry, and of course none of it was given to neighbours after the relations of it to scarlatina at Child's Hill had been seen.

There is little more to tell of the relations that were found to exist between the Hendon cows and human scarlatina, but that little is of interest.

Observations on cow ailments

In the last days of December after the foregoing circumstantial evidence had been, in essentials, worked out, the 15th November cows were still in the large shed: the two 4th December cows which had been put into the large shed on December 11th were still there; and the other two 4th December cows which on 11th December were placed in the middle shed, had been taken therefrom and put into the large shed,

because circumstances had by this time thrown suspicion on their milk.

At this time, examination of the cows was made with a view to the detection of any, even the slightest, disease among the cows; and it was found that several in the large shed were suffering from vesicles and ulcers on the teats and udders, and that the cow most severely affected was one of those received into the farm on December 4th.

Dr. Klein, whose assistance was now invited, visited the farm with Dr. Cameron and myself on December 31st and following days, and we found that these sores on teats and udders were very general among the cows of the large shed, in the several cows being of different degrees of intensity and recency. The 15th November cows were not suffering, but on close examination of their teats and udders scars were found on two of them of a kind that satisfied us of their having shortly before suffered from the malady. Of the four 4th December cows two were suffering from the disease, one (transferred from the middle shed) had it badly, other cows in the shed had it in a more recent form. In the middle shed there were several recent cases and in the small shed two early cases of it were at this date detected.

An outside observer knowing something of cows had perceived just before Christmas certain cows in the large shed, particularly on the left-hand side of it, to be suffering from "bad quarters." He did not attach any importance to the fact, except for the unusual quantity of the ailment. The cows on the left-hand side of this shed, however, at that date included the cows imported to the farm on 15th November, and two also of those imported on 4th December.

Our belief in the existence on this farm of a constitutional disease among the cows competent to produce scarlatina among human consumers of the cows' milk was now becoming unreserved. The identity of the disease and its more obvious characters and its communicability appeared to have been demonstrated. Also, in the phenomena of the disease itself, Dr. Klein found reason for regarding it as more than a local complaint affecting the skin of the teats and udders. He regarded it as a general or constitutional disease; one that might, probably enough, be communicable from cow to cow.

Dr. Klein took with him for experimental purposes samples of milk, contents of vesicles and discharges from ulcers of two affected cows (I. and II.); and afterwards two of such cows (III. and IV.) were purchased and conveyed to Dr. Klein at the Brown institution for further observation and for pathological investigation there. He will report on the clinical features* and on the pathology of the disease.

No deference to Dr. Klein's belief, any more than the now admitted concurrences of human disease with milk consumption, weighed in any degree with the people employed about the farm to induce them to credit the notion that the health of the cows had been in question. Had not the cows eaten well and given full yield of milk, they asked, and how then could they be ill? If they had any ailment, it must be, and it was, of no consequence, and it could not have been connected with disease in man.

So they reasoned, and it was doubtless this disbelief that occasioned a little reticence among the cowmen. But one day a certain cowman who had undertaken to point out for Dr. Klein the most recent case he could find of sore teats, mentioned his having first seen such early beginning of the complaint in the case of one cow, that he very well knew, and on being requested to point out that cow he led his questioner to the large shed and showed him one of the Derbyshire cows that had come to the farm on November 15th.—It was now admitted on all hands that this cow had been the first to suffer from the malady and that she suffered very badly; that not long afterwards, other cows in the large shed and a 4th December cow in the middle shed were also found

and demonstration of cow first attacked.

* The clinical characters of the disease are the special subject of Dr. Cameron's paper, No. III. —G. B.

No. 1. On Milk-Scarlatina in London; by Mr. W. H. Power.

affected; and that latterly the disease was known to have spread abroad in the large shed and in the middle shed and now to be invading the small shed. To the last however the cowmen were all sure that the disease was of no possible importance whatever and could not have affected the quality of the cows' milk.

Episode.

Our discovery of this extended prevalence of the cow disease, now, on January 1st, in all the sheds of the farm, was a very disquieting circumstance, for the middle and small sheds were still furnishing milk to London consumers. We felt it necessary to advise the farm bailiff (in the temporary absence of the farmer through illhealth) at once to seek out every cow that now was or that might become affected with sore teats or udder, or any other sort of ailment; to isolate every such cow, and to keep all her milk out of the business; and to prevent cowmen employed in the tending or milking of sound cows from having anything whatever to do with the cows thus set apart. These precautions were taken after January 1st, and we had good reason to think, only just in time to prevent disaster from a repetition of the events of December. For, in gathering up the later facts concerning the various local epidemics of scarlatina in their relation to the Hendon milk service, the following facts appeared:—

(*a.*) In South Marylebone, as has been told, the new outbreaks had ceased shortly after the delivery of milk to Mr. X had ceased; and at Hendon, up to the end of December, no fresh outbreaks had occurred after those above recorded as following on the use of milk refused by Mr. X.

(*b.*) In Hampstead and St. Pancras milk districts, where Mr. Y continued to supply milk from the Hendon farm, a diminution if not a temporary cessation of fresh outbreaks had taken place about Christmas, but in the first days of January they were again becoming somewhat numerous. The reduction and the recrudescence had corresponded well with the removal of the two December 4th cows from the middle to the larger shed; and with the appearance, shortly after, of new cases of the cow-disease among the animals of the middle shed.

(*c.*) Just about the same time, in the early days of January, milk from the small shed, which had previously been without share in scarlatina production appeared, almost suddenly, to be implicated. The daughter of one of the cowmen who was employed in this shed, and who by permission took home milk from the small shed, but from no other, was attacked by scarlatina the day after her arrival in London on a visit; and, almost simultaneously with the fresh attacks among Mr. Y's customers, the customers of Mr. Z, in St. John's Wood milk district, began to suffer from scarlatina. These events corresponded to a nicety with the appearance for the first time of the cow disease among the animals of the smaller shed.

Thus the precautionary measures enjoined on the farm bailiff were not in time to prevent the beginnings of another manifestation of scarlatina in London. Their value in preventing further and more extended outbreaks in the several localities could not be estimated. For, on these fresh appearances of illness among their customers, Messrs. Y and Z at once discontinued all supplies from the Hendon farm. The whole milk of the farm was now thrown on the farmer's hands, and was given to the pigs or buried.—While this report is in preparation, I have made inquiry of Messrs. Y and Z as to any further scarlatina, peculiar to their customers, and I find that none has occurred in the milk districts of Hampstead, of St. Pancras, or of St. John's Wood since the beginning of January.

No. II.

REPORT on a DISEASE of COWS prevailing at a FARM from which SCARLATINA had been distributed along with the MILK of COWS; by DR. KLEIN, F.R.S.

No. 2. On Milk-Scarlatina; by Dr. Klein.

IN a recent report to the Board, "On certain observed relations "between scarlatina in various districts of London and Milk supplied "from a Dairy Farm at Hendon," Mr. Power has related the circumstances under which I became associated in inquiry at the farm in question; and, while briefly indicating certain provisional inferences of my own as to the nature of the malady discovered among the cows there, Mr. Power goes on to promise an account by me of the special features and pathology of the disease. This I now proceed to give.

Disease observed at Hendon Farm.

Its clinical characters:

The cows (I. and II.) which were the first subjects of my investigations had on the teats and udder several flat, irregular ulcers, varying in diameter from $\frac{1}{4}$ to $\frac{3}{4}$ of an inch; some ulcers were more or less circular, others extended in a longitudinal direction on the teat. The ulcers were covered with a brownish or reddish-brown scab, which when scraped away left exposed a granulating slightly indurated base. The margin of such ulcer was not raised, nor was there any perceptible redness of the skin around. But where I afterwards got the opportunity of watching the earlier stages (especially in animal IV.), it was noticed that a small vesicle made its appearance on a greatly swollen and red teat, in the course of a couple of days assuming the character of the above ulcers. In another cow an ulcer, about $\frac{1}{4}$-inch in diameter, was becoming covered in its central part with a scab, while at its margin vesiculation was still distinctly visible.

local

As a rule, *i.e.*, in most animals, the disease affected the teats, but in some there was also on the lower part of the udder here and there an ulcer. In such animals patches denuded of hair were noticed on various parts of the skin, the tail and back particularly. In these patches the epidermis was scaly, and the cutis more or less thickened. The animals looked thin, but not strikingly so, except in one or two cases of animals that had only a few weeks ago been admitted to the place, and which therefore had calved comparatively recently (see Mr. Power's report). As regards the feeding capacity of affected animals, their milking power, and their body temperature, nothing abnormal could be detected.

and constitutional.

Two animals (to be referred to as cow III. and cow IV.) became the special subjects of study after they had been removed from the farm to the stables of the Brown Institution.

The temperatures (Centigrade degrees) of cow III. were as follows:—

	Morning Temp.	Evening Temp.
January 4 - -	38·8°	38·7°
" 5 - -	38·9	38·9
" 6 - -	38·8	38·3
" 7 - -	38·9	—
" 8 - -	39	39
" 9 - -	38·8	38·7

The temperature afterwards remained as above without alteration.

The temperatures of cow IV. were:—

January 6 - -	38·4	38·3
" 7 - -	38·7	—
" 8 - -	38·4	38·8
" 9 - -	38·6	38·5

In animal III. the ulcers were present, and on January 4 were at their full development and covered with crusts. They gradually died away, and subsequently healed up by January 10, leaving, however, a whitish indistinct flat scar.

When this animal was received there were noticed on its coat several patches where the hair was gone, and the epidermis was rough and scaly.

Animal IV. when received showed several scabs in the skin of the back; it had also muco-sanguineous discharge from the vagina (the animal was in the third month of pregnancy), and redness and excoriation of the mucous membrane of the vagina. One teat, which was much swollen and inflamed, presented in several places brownish crusts. These when taken off left an infiltrated firm sore, from which, when squeezed, a thickish lymph oozed out. Similar crusts were found on other teats and on the udder. The greatest development of the sores in this cow was on January 7. On January 9 the sores were decreasing; the animal was then killed.

Post-mortem characters.

On opening the chest it was found that both lungs exhibited in the upper posterior lobes numerous petechiæ under the pulmonary pleura; the peripheral lobules of these parts being much congested. There were numerous adhesions by recent soft lymph between the lower lobes of the lung and the costal pleura, particularly laterally. In the liver there were several reddish streaks and patches, reaching from the surface of the organ to a depth of about $\frac{1}{4}$ of an inch. In these patches the liver tissue was much softened. The spleen and kidneys, with exception of slight congestion, appeared normal. In the placenta there were numerous petechiæ.

Cow III. was killed on March 12. For some days previously the animal had been getting very thin, notwithstanding its ravenous and excessive eating. On post-mortem examination the following appearances were found:—

In the lungs there were numerous lobules, especially in the peripheral parts, which showed great congestion; there were in addition pleural adhesions; the cortex of the kidney was congested, but its medulla was pale.

Direct inoculation into calves.

Experiments were now made with the matter of the ulcers, with a view of ascertaining whether or not the disease was transmissible to other animals.

On January 7, when the ulcers of cow IV. had reached their maximum development, I took scrapings from some of the ulcers on the udder and teats, having first removed the crust, and inoculated in several places the skin of groin and inside of ear of two calves (1 and 2.) For inoculation a superficial small incision (not longer than about $\frac{1}{4}$-inch) was made, passing in an oblique direction through the superficial part of the corium, and into this pouch a particle of the scraping was rubbed.

On January 9, with scraping of ulcers of the cow before she was killed, I inoculated two calves (3, 4), introducing the matter as before into the corium of the groin and of the inside of ear.

Calves 1 and 2 showed during the first three days after insertion of the matter no change at the seat of inoculation.

Four days after inoculation:—There was in calf 1 one place in the groin which promised to become an ulcer. Calf 2 showed on the ear one promising place, the other places of inoculation having nearly healed.—At the same distance of time after inoculation calf 3 showed two promising places on the ear, and calf 4 showed two promising places in both groin and ear. Calf 3 also showed a kind of vesiculation at the margin of the spot inoculated and commencing formation of a crust in

the centre. What I call promising places of inoculation were spots that had become swollen and tender, the other and not promising places were spots that seemed healing or were already healed and dry.

On the sixth day:—Calf 1 showed four successful places in the groin; the places had become swollen and enlarged with imperfect vesiculation at the margin and formation of crust in the centre.—Calf 3 had four successful places on the ear; and calf 4 had the same number in the groin.

On the seventh day:—In calf 1 all places except one in the groin had nearly disappeared. This place was now a distinct ulcer covered with a crust, on removing which a granulating infiltrated base was exposed. In calf 2 all places of inoculation were decreasing, covered with small scabs, easily detached.—In calf 3 the sores on the ear had enlarged to about $\frac{1}{4}$-inch in breadth, each of them covered in their whole extent by a brownish crust. In calf 4 all except one place on ear were healing.

On the eleventh day:—Calf 1 had still one ulcer in groin not yet healing. Calf 2 had one ulcer on ear not quite healed up.—Calf 3 had four big ulcers still progressing; crusts thick, and corium much indurated. Calf 4 had one ulcer on ear much diminished in size.

By the eighteenth day:—The ulcerations in calf 3 (one ulcer had been cut out for microscopic examination) had all healed up and become converted into flat scars. In the other animals the healing was completed at an earlier date.

Simultaneously with the above experiments several inoculations with materials of the ulcer of cow No. IV. had been made into the skin of the groin of ten guinea-pigs and of three dogs. In the guinea-pigs no result was obtained; but in one of the dogs one place of inoculation appeared swollen and inflamed on the third day. On the fifth day this place was an oblong ulcer of about $\frac{1}{4}$-inch in diameter; the margin was red and swollen, but the centre was without crust (the animal had been frequently seen to lick it). On the seventh day the ulcer was much smaller, and it had nearly healed up by the tenth day.

Summary of results.

From these experiments there can be no doubt whatever that by inoculating a particle of matter from the sores of an affected cow a positive result has been obtained in all four calves. In calf 3 this result was best and most striking. After an incubation of about three days the places of inoculation became swollen, tender, and spreading; on the fifth to the sixth day the change was distinct, the successful places having become sores; in the marginal part showing vesiculation, and in the centre formation of crusts. The sore enlarged during the next few days, and on removing the crust a raw surface was exposed, the corium itself being found infiltrated. According to the intensity of the process the retrogressive change sets in later or sooner; in slight cases the healing begins about the ninth or tenth day, in severe cases (calf 3) not before the end of the second week.

Having thus demonstrated this disease of the cow to be directly communicable from animal to animal, I set to work to study its minute anatomy.

Minute anatomy of the disease: of skin ulcers.

The microscopic examination of fine sections through the ulcer of the cow shows the following conditions:

The corium throughout the whole extent of the ulcer is infiltrated with round cells. This infiltration, though densest in the central portions of the ulcer, is sufficiently pronounced even in the peripheral parts, but it gradually fades away on passing from the ulcer to the normal skin. The infiltration in the deeper parts of the corium is limited to the vascular branches, but in the superficial parts is more diffuse, the papillæ becoming at the same time thicker. This thickening of the papillæ fades off towards the periphery of the ulcer.—The most noteworthy changes are, however, present in the epithelium. In the peripheral portions of the diseased part there are present in the superficial layers of the stratum Malpighii close to the stratum lucidum, as also in the stratum lucidum itself, numerous cavities of different sizes. These cavities lie closely side by side; the most superficial ones are either covered by the stratum lucidum or extend between the layers of this stratum. The former cavities descend into the depth of the epithelium; at the very margin of the diseased part they are smallest, and they do not in depth comprise more than the superficial third of the stratum Malpighii. They enlarge in depth gradually as we pass from the periphery of the ulcer towards its centre; at its very centre they involve the whole thickness of the stratum Malpighii. At the same time it is to be noticed that, at the marginal parts, the cavities, although closely placed side by side, are well separated from one another by thicker or thinner trabeculæ composed of epithelium; while at or near the centre of the ulcer these trabeculæ get destroyed, and the cavities become confluent, and the covering layers of the cuticle having here also given way, their contents extend on to the free surface of the ulcer. These contents, which go to form what has been above mentioned as the crust, spread thus gradually over the surface, not only of the centre, where the stratum lucidum has become lost, but also over the rest of the ulcer. In the marginal positions, *i.e.*, where the superficial layers of the cuticle are still present as cover of the above cavities, this layer (*i.e.*, the stratum lucidum) separates the contents of the cavities from the crust. The contents of these cavities consist (*a*) of an albuminous fluid looking, in hardened sections, uniformly granular or containing also fibrinous threads; (*b*) of a few red blood corpuscles; and (*c*) chiefly of round cells or pus cells, the nuclei of which, near to and on the surface, gradually break up into amorphous granular matter.

In the central parts of the ulcer the whole exudation undergoes degeneration into débris, and not only in its superficial, but also in its deeper portions. While some cavities contain very few cells and are filled chiefly with albuminous fluid (granular or fibrinous), others are almost entirely filled with pus cells closely packed together. In the papillæ near the cavities the blood vessels are engorged and there is also escape of red blood discs.

> On a careful examination it is evident that the origin of these cavities is in enlargement of and exudation into the tissue of the papillæ, but only of those portions nearest to the stratum lucidum, and from hence arises formation of cavities in the cuticle. The whole anatomical details of the distribution and arrangement of these cavities recall vividly the conditions observed in the vesicles of cow pock and of sheep pock, and on comparing under a low power of the microscope a section through a sheep pock with a section through the ulcer of the cow now under consideration, the similarity is very striking indeed.
>
> There are, however, anatomical differences between the two diseases. The infiltration of the corium is slighter in the cow ulcer than in the sheep pock, and in the cow ulcer the cavities form in a more superficial stratum of the epidermis.

There is in the disease we are now considering a good deal of infiltration of the epithelium by round cells derived from the cavities, not only into the stratum Malpighii, but also, and particularly in the marginal parts, into the cuticle; the round cells burrowing in great

numbers between the scales of this stratum, and ultimately reaching the free surface to join those of the crust.

Fine sections made through the ulcer artificially induced by inoculation in the ear of calf 3, proved its complete identity in anatomical respects with the ulcer in the cow. The infiltration of the superficial corium; the formation of cavities, filled with exudation cells and fluid, in the superficial layers of the epithelium, particularly between the layers of the cuticle; the final destruction in the centre of the ulcer of the covering cuticle; and the extension of the exudation over the free surface to form here the crust, are the same in both instances.

Microscopic examination of the internal organs of cow IV. revealed facts as follow :—

In internal organs.

In the lung.—Sections made through the portions above mentioned as containing much congested lobules, show not only great congestion of the blood vessels, large and small, but a large amount of hæmorrhage; blood in substance being present in the air vesicles and infundibula, in the lymph spaces of the interlobular septa, and in the tissue and lymphatics of the pleura. In the latter membrane numerous diplococci are to be met with. Here and there the same diplococci occur in the alveolar wall and in the tissue of the interlobular septa.

Sections through *the liver* show a great deal of change. Under the capsule, as well as in the substance of the liver, there occur, in connection with the interlobular branches of the portal vein, larger and smaller foci of inflammation, consisting in the presence of numerous round cells. Some of these foci are several millimetres in diameter, others are very small. From the interlobular tissue the inflammation extends into the lobules between the liver cells. The liver cells of these lobules involved in the inflammatory process are swollen up, and many of them are undergoing disintegration. In some of these foci, particularly those situated in the vicinity of the capsule, the round cells are so much crowded that given foci look almost like miliary abcesses. The blood vessels are much distended and filled with blood.

Numerous diplococci and short coccus-chains occur in the parts surrounding the inflammatory foci. These are particularly numerous near the capsule in the vicinity of inflamed parts.

Sections through the *kidney* showed well-marked glomerulo-nephritis; infiltration of the sheath of the cortical arterioles with numerous round cells; the epithelium of the convoluted tubules swollen, opaque, and in many places disintegrating.

The lungs and kidney of cow III. showed on microscopic examination the same appearances as in cow IV.; in addition there was a good deal of round-cell-infiltration in the wall of the infundibula and bronchi in the lung, and around the cortical arterioles in the kidney. In the bloodclots filling the alveoli and small bronchi of the lung there were present larger and smaller clumps of micrococci.

Search was now made for micro-organisms inhabiting the tissues of the ulcer of the cow, with a view of ascertaining what were present, and afterwards whether any single kind of those found had the power, when dissociated from the diseased tissues and inoculated into healthy animals, of transferring the disease.

Micro-organisms discovered in the ulcer.

Removing the crust, scraping off the most superficial layer, then squeezing the ulcer so as to collect a droplet of lymph, I spread it in thin films on cover-glasses, and dried, stained, and mounted the several specimens in the usual manner. Such a specimen, examined under the microscope, revealed a number of red blood discs, mixed up with large numbers of pus cells, each of which contained two, three, or four small

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nuclei and remnants of epithelial cells. Amongst the pus cells numerous dumb-bells of micrococci (or diplococci), and a few short chains of the same, were met with. In size, these micro-organisms do not differ from those described in connection with foot-and-mouth disease. In many sections—stained in fuchsin, or in methyl blue, or in gentian violet—through the diseased tissue of the cow, as well as that of calf 3, there were found the same diplococci and chains in the contents of the superficial cavities, as well as in the depth of the epithelium. In the latter stratum they were met with abundantly throughout the whole extent of the marginal portion of the ulcer, but not beyond it. In the superficial parts, namely, in the contents of the cavities in the stratum lucidum, the same chains were to be found, provided the pus cells were not too closely packed. They were very numerous in the tissue of the crust, and also in the superficial central portions of the ulcer that had undergone degenerate change. There occurred also in the crust and in the necrotic parts of the ulcer numerous clumps or zooglea of micrococci; but these micrococci are not to be confounded with the chains of streptococci to be presently described, nor yet with those streptococci which are found occurring singly.

have special characters when grown in nutritive media.

From the deeper parts of an ulcer of cow IV. material was obtained with which tubes containing either solid nutritive gelatine, or Agar-Agar mixture, were inoculated. After some days, and in both media, a micrococcus appeared, the growth of which was extremely characteristic. These are its characters, in the nutritive gelatine: after 3—6 days incubation at 20° C., the growth made its appearance at the point or line of inoculation, in the form of small points or granules, whitish in colour and tolerably closely placed. During the next few days their number and size increased. At the end of a fortnight the line of inoculation was visible as a streak of whitish granules or droplets, some large others small, more or less closely placed. On the surface of the gelatine the growth, like a film of granules, spreads slowly in breadth, but even after months remains small. When inoculated into the depth of the gelatine, the channel of inoculation becomes visible as a whitish streak, made up of smaller and larger droplets. The gelatine is not liquefied by the growth. The same characters are assumed by the growth in Agar-Agar mixture, and in solid serum. The general aspect of the growth in gelatine, in Agar-Agar, and in serum, is very similar to that presented by the *streptococcus* of foot-and-mouth disease (see my report of this year upon that malady*), but with this difference, namely, that in gelatine tubes the streptococcus of foot-and-mouth disease is a little faster in its growth, and its component granules are a little more distant. Nevertheless, I have tubes of both kinds of organisms in gelatine and in Agar-Agar—tubes which cannot be from their general appearances easily distinguished. In faintly alkaline broth, or in broth and peptone, the micrococcus of the cow ulcers grows readily, and in the same manner as that of foot-and-mouth disease. But there is one test by which the two kinds of organism can be very readily distinguished: the streptococcus of foot-and-mouth disease, when grown in milk, does not affect the fluid character of the milk, whereas milk inoculated with the organism obtained from the cow's ulcer will, if kept for two days in the incubator at 35° C., have been turned completely solid. This difference is a very striking difference, and a few days' growth in milk suffices for distinguishing without fail between the two.

Streptococcus.

Speciality of growth in milk

* To appear in the Supplement to the Fifteenth volume of the Board's Reports.—G. B.

No. 2.

On Milk-Scarlatina; by Dr. Klein.

The microscopic examination of a culture in broth peptone, in gelatine, or in Agar-Agar mixture shows that the growth consists of spherical micrococci, arranged as diplococci, and as shorter and longer straight, wavy, or curved chains—streptococcus,—these latter sometimes of great length. As regards the shape of the micrococci, the mode of their division, the branchings of the chains, the presence here and there in the chain of a large element amongst the smaller ones, the organisms of the ulcers hardly differ from the description which I am preparing of the streptococcus of foot-and-mouth disease. The elements of a coccus-chain of the foot-and-mouth micro-organism are, however, smaller than those of the disease under consideration.

The streptococcus chains of a growth in broth are short during the first few days; but later on, when the growth settles down more into the deeper parts of the broth, the chains become of great length. So also in Agar-Agar tubes of one to two or more weeks' incubation.

appears absent from udder-milk.

> A curious fact, to which importance must provisionally attach, is this: In a cow having several of the ulcers on the teats, the fingers of the milker pressing over the ulcers would constantly rub off from the latter particles of matter, and the fingers and the teat being kept moist, this matter would easily mix with the milk as it passes from the teat. To learn whether the milk *while in the udder* contained the streptococci, the following experiment was made: A teat free of any ulcer was milked so as to obtain a few ounces of milk, and from this milk a large number of gelatine and Agar-Agar tubes were inoculated; a second teat of the same cow, affected by an extensive ulcer, was milked to the same extent, and from the milk thus obtained a large number of other gelatine and Agar-Agar tubes were inoculated. In the first series no single tube showed the growth of the above-described streptococcus, whereas in the second series one gelatine tube and one Agar-Agar tube were found to develop the typical growth of the streptococcus.

We cannot draw any certain inference from this one observation, but evidently the experiment deserves repetition.

Effects of inoculating its sub-cultures.

With a cultivation (a third sub-culture) in Agar-Agar mixture of this streptococcus, I, on February 1, inoculated subcutaneously in the groin two calves (5 and 6). On February 27 calf 6 was found dead. The subcutaneous tissue at and for some distance around the seat of inoculation showed much effusion, and the inguinal glands were swollen and red. There was peritonitis, with sanguineous exudation, congestion, and hæmorrhagic spots in omentum and in the serous coat of the stomach. The spleen appeared small and its capsule thickened. The liver was greatly congested. Kidneys were large and much congested. The ileum was much congested in its mucous membrane, and the epithelium detached in flakes. The mesenteric glands belonging to the ileum were greatly enlarged and hyperæmic. Both lungs were congested, the superficial lobules showed so much congestion that they looked almost solid, and were of a deep red colour. A few petechiæ under the pleura. Bronchial glands enlarged and congested. There was pericarditis, and the heart was distended by and filled with coagulated blood. The organs of the throat were found much congested. The hairy parts of the skin were not examined.

Calf 5 showed on March 7, around the nostrils and lips of the mouth, and on hard palate and gums, numerous irregularly outlined patches not raised above the level of the skin. These patches had a discoloured, brownish, very slightly raised margin, and a paler centre; they were round or irregular, some as small as $\frac{1}{8}$ of an inch, others four to six times larger. The animal was killed on March 8. On post-mortem examination the following appearances were noted: Congestion of some of the peripheral lobules in both lungs; the pleura pulmonalis slightly opaque, numerous soft lymph adhesions between it and the costal pleura; in the spleen several hæmorrhagic patches under the capsule in the shape of bullæ filled with semi-congealed blood; spleen pulp softened and very congested; kidney congested; organs of the throat congested.

to produce a specific disease.

There can then be no doubt that a definite disease has been produced in both animals, of which the affection of the lungs is a conspicuous feature, and coincides with, though more pronounced than, the lung disease noticed in cow IV.

having characters in skin and elsewhere:

In calf 5 there was, in addition, the disease of the skin and in the mouth, which, as the microscopic examination proved, is in a certain degree similar to the disease in cow IV. and calf 3. More in detail, this is what is found as regards the skin: The tissue of the papillæ and of the superficial corium is infiltrated with round cells, and the blood vessels of the papillæ are distended and filled with blood. In their peripheral portions, their most superficial parts, the papillæ are very much distended by extravasated blood and round cells;—in fact the first rudiments of cavities are forming in them. The same condition, but more pronounced, obtains in the cuticle, where between its layers there are present small cavities filled with blood and round cells or only fluid and a few round cells. There is, in addition to this, a general infiltration with round cells of the layers of the cuticle. The brownish reddish colour of the marginal parts is due to this condition. In the central part the cuticle is loosened by the formation of such cavities containing fluid and a few round cells; by this its layers were separated and ultimately detached. In the cavities of the cuticle occur very fine diplococci and chains. So also in the infiltrated and enlarged papillæ, and in the deeper layers of the epithelium in the whole extent of the diseased skin, diplococci and short chains are present.

In neither of these cases of subcutaneous inoculation was there found any rent or breakage of the stratum Malpighii, *i.e.*, no real ulcer. The anatomical features here described in many respects resemble the lesion of the skin in human scarlatina (see my report for 1876). I did not, unfortunately, look at other (the hairy) parts of the skin to see whether there were any such patches in this calf. (Some observations on the kidney of calf 5 are noted in the sequel.)

Examination of the organs of calf 6:

(*a.*) *The lung.*—Congestion of all blood vessels, large and small. Transudation of fluid and hæmorrhage into the alveolar cavities of part of some lobules of the lung while the rest of the alveolar cavities are collapsed, the capillaries around them very much congested; infiltration with leucocytes of the interlobular septa, extending also into the inter-alveolar septa. In some of the lobules next to the pleura the engorgement of the capillaries is extremely great, blood *en masse* filling the alveoli to the extent of producing a state of red hepatisation. The pleura itself is thickened by exudation of fluid and leucocytes. The bronchi do not show any distinct alteration. Numerous diplococci and a few chains are met with in the pleura and in the congested parts of the lobules, in the alveolar wall, and in those alveolar cavities which contain exudation and blood. The bronchial glands show great changes: the capsule and septa being much thickened by exudation and leucocytes; the lymph-vessels everywhere filled with round cells; the tissue of the follicles and medulla much swollen.

(*b.*) *The liver* shows extreme congestion of all vessels in all parts, inter- and intralobular. The liver cells are opaque, granular, and atrophic.

(*c.*) *The ileum.*—The epithelium of the surface detached and gone; the epithelium of the Lieberkühn follicles loosened, and in most places detached; the mucosa shows great congestion and infiltration; in the superficial layers the villi show hæmorrhage, the tissue being filled with blood corpuscles, fibrin, and leucocytes; and in many spots the superficial layers of the mucosa are necrotic.

The Peyer's glands are much swollen and inflamed; the central portion of their follicles are breaking down.

Micrococci and bacilli pervade everywhere the tissue of the mucosa. The mesenteric glands in relation with the ileum have their capsules, septa, follicles, and medullary cylinders much congested and inflamed.

in kidney.

(*d.*) *The kidney.*—The changes in this organ are highly interesting, since they completely coincide with those in acute scarlatinal nephritis in man: great congestion of the cortex, leading in some parts to hæmorrhage into the parenchyma; glomerulo-nephritis with exudation of albuminous fluid and blood into the cavities of the Malpighian corpuscles; granular or opaque swelling of the epithelium of the uriniferous (convoluted) tubules, with degeneration into granular débris of many of the epithelial cells; miliary foci of aggregations of round cells around small blood vessels; congestion of the medulla.

[The kidney of calf 5 was also examined microscopically, and the changes were exactly the same as those found in the kidney of calf 6, viz., congestion of the glomeruli, glomerulo-nephritis, transudation of albuminous fluid and red blood corpuscles into the cavity of Bowman's capsule; opaque swelling of the epithelium of the convoluted tubules, granular disintegration of the epithelium in many places; infiltration with round cells around some arterioles of the cortex; and congestion of the medulla.]

(*e.*) *The heart's blood* was examined for organisms, and in it, by the staining with Weigert's gentian violet, a few diplococci and a few chains could be distinctly detected.

Cultivations were made with this blood in tubes containing Agar-Agar mixture, and a growth of the streptococcus was obtained in all respects identical with the streptococcus that had been employed for inoculation of this animal.

Relation of disease with streptococci.

In view of the whole of this evidence, I consider it conclusively established that this streptococcus is identical with the virus of the cow disease.

Its strong resemblances to human scarlatina.

We have, then, inoculated subcutaneously with sub-cultures of the streptococcus these two animals, calves 5 and 6, with the result of producing a general disease, which in many respects bears a close resemblance to human scarlatina. The minute anatomical characters of the eruption on the skin around the nostrils and mouth in calf 5 is of much significance in this connection, as also is the disease in the liver in both animals, and above all, the disease in the kidney. This latter organ corresponds so closely with a kidney of an acute case of human scarlatina, that sections made of the one and compared with those of the other, of which I preserved a large collection from my former investigation into the anatomy of human scarlatina (see Medical Officer's Report for 1876), show no difference whatever.*

* Referring to the commencement made in 1882 of investigation of the results producible in the cow by inoculation with the material of human scarlatina, see p. 67 of report of that year, I would propose that this study be extended without loss of time.

No. 2.

On Milk-Scarlatina; by Dr. Klein.

The outcome of the investigation thus far, and it is of importance until further differentiated observations shall have been made, may be stated thus:—By inoculating the virus directly taken from the local disease (the ulcer on the teats) of the cow into the corium of the calf the same local disease is produced, namely, a change in the skin, which commences as a congestion of the papillæ and corium, and an exudation of fluid and leucocytes. This leads in the superficial parts of the epidermis to the formation of cavities, which, enlarging and extending and opening on to the surface and extending into the depth, ultimately lead to the formation of an ulcer. But the virus, in the form of an artificial cultivation of the streptococcus derived from the above ulcer of the cow, when inoculated into the subcutaneous tissue, that is, when introduced almost directly into the vascular system (for all matter injected subcutaneously is easily absorbed by the lymphatics and carried into the blood system) sets up a general disease resembling to a considerable degree in its anatomical features human scarlatina.

Furthermore, as respects the concern that cow's milk may have in the communication of disease—the consideration which led to the present investigations—we have some facts which appear to me to afford very suggestive indications for further pathological study. As I have pointed out on a previous page, it would seem that the milk pure does not contain the organism, but (whether or not this observation be confirmed) the milk during the act of milking is pretty sure to become contaminated by the fingers of the milker bringing down into the milk particles from the ulceration on the teat. The organism contained in these particles would find in the milk a good medium in which to multiply. Such milk would then practically correspond to an artificial culture of the streptococcus, such as we have found capable of setting up a general disease, when inoculated subcutaneously into calves. It is true we have as yet no experience of the inoculation of a known milk sub-culture into the human subject, but in the case of calves, we have learnt that the general disease resulting from inoculation of an Agar-Agar sub-culture had characters closely allied to, if not identical with, human scarlatina. Then, feeding of animals with the cultures has not yet been tried, so that at present we are without information as to the characters of any disease that may be produced in calves by that means; whether or not calves fed with milk sub-culture of our streptococci exhibit the same pathological states as we have found to be produced by inoculation of calves with an artificial culture,—states that bear so marked a resemblance to those of scarlatina in the human subject. In order completely to understand these and other relations, more experiments are required, and these I hope soon to have an opportunity of making.

Until I am in a position to state at greater length the peculiarities of the infective phenomena of the disease under consideration, I refrain from further comment on its various interesting and promising aspects.

No. III.

No. 3.

Dr. Cameron's Observations.

EXTRACT from a PAPER to the EPIDEMIOLOGICAL SOCIETY (Session 1885–6), entitled OBSERVATIONS on a certain MALADY occurring among COWS at a TIME when the MILK produced by them disseminated SCARLET FEVER; by JAMES CAMERON, M.D., Medical Officer of Health of Hendon.

Cow disease at Hendon.

I WISH to lay before you a short description of a cow disease which has been the subject of investigation by Mr. Power, Dr. Klein, and myself during a recent inquiry into an outbreak of scarlet fever which occurred in the districts of St. Marylebone, St. John's Wood, Hampstead, and Hendon, amongst consumers of milk derived from a dairy farm situated within my sanitary district.

* * * * * *

Description.

In entering upon a description of this cow-disease, it is necessary to note that what I have to say has not all of it been the result of personal observation. Especially is this the case as regards some of the earlier symptoms, which, of necessity, have been learnt from other persons. The account of these, therefore, though I have taken great pains to sift the statements made to me in this connexion, and, indeed believe them to be fairly accurate, must be held liable to future correction or modification. But the account I give of the course of the disease after the appearance of the eruption on the teats and udder is my own, and is, I think, less subject to qualification in the above sense.

From my own observation, together with what I can learn respecting it, the disease would appear to be capable of general description as follows:

General.

A specific contagious and infectious disease, occurring usually in the first instance amongst newly-calved cows, and capable of being communicated to healthy cows by direct inoculation of the teats with virus conveyed by the hands of the cowman after milking a diseased cow, and perhaps by discharges from the mouth, nose, and eyes of infected cows coming in contact with the manger at which other cows may feed. It has been communicated to man* by inoculation with virus from the vesicles on the teats and udder, and seemingly, it is communicable, *though perhaps in another form*, through the medium of the milk. In the cow it is characterised by general constitutional disturbance; a short initiatory fever; a dry, hacking cough; sometimes quickened breathing; sore-throat in severe cases; discharges from the nostrils and eyes; an eruption on the skin around the eyes; an eruption on the hind quarters; vesicles on the teats and udder; alteration in the quality of the milk-secretion, and well-marked visceral lesions. The actual disease may continue in the animal for from four to six weeks, and it would seem that in some cases subsequent ill-health may last for from two to three months, or even longer, causing great emaciation and debility. It is difficult to speak of the fatality of the disease, but it would appear that sometimes,

* A trustworthy informant received the virus of this disease into a recent scratch upon his forefinger while milking a diseased cow. He suffered from general weakness, malaise, and loss of appetite. About four or five days after inoculation a vesicle or small blister appeared on the finger. This became broken and several others formed on the back of the hand. The whole hand and the fingers became swollen and inflamed, the inflammation extending in broad lines as far as the elbow. The general disturbance lasted a fortnight.

No. 8. — Dr. Cameron's Observations.

though rarely, cows have died in its course, perhaps from affections of the internal organs.

Besides attacking by preference newly-calved cows, the disease is especially prone to attack cows that have been in low condition of health before calving, and cows which have slipped their calves. In cows where, after calving, there may have been retained portions of membrane or placenta, and where the cleansing has been imperfect, with an offensive lochial discharge, it is apt to appear within the first fortnight after the calving.

Dealt with in greater detail, the phenomena* of the disease appear to be as follow:

Febrile.

Fever.—At the commencement of the illness the cow is somewhat feverish, the nose is brown and dry, the coat is rough and staring. This fever may last, in severe cases, from seven to eight days; in slighter cases, from three or four days to a week.

Skin and mucous membranes.

Two or three days after the commencement of the fever, the skin around the eyes, in cases of severe attack of the malady, becomes puffy and swollen, and in another two or three days, *i.e.*, about the fourth to sixth day of the fever, a minute red rash, about the size of pin-heads, and slightly raised above the level of the skin, appears upon the skin around the eyeballs. The cuticle on this part usually peels off about three or four weeks after the rash appears, leaving the skin hereabouts devoid of hair.

Discharge from the Eyes and Nose.—About the time that the rash appears on the skin surrounding the eyes, a yellow mattery discharge comes from under the eyelids, and collects in the inner corner of the eye. This discharge is, in particular cases, sometimes so severe that it is necessary to cleanse it away with a sponge. In severe cases, too, the discharge may continue for some time, and is believed to be contagious. A nasal discharge of a similar nature is apt to appear about the same time, and is believed, also, to be contagious.

Cough.—A dry, husky, hacking, irritative cough, with bronchial rales and quickened breathing, frequently comes on with the initiatory fever. The cough may last, more or less, as long as the cow is ill, and the quickened breathing may continue for a fortnight, or longer in some cases.

Sore-throat.—Sore-throat is stated to occur in severe cases, especially in newly-calved cows, attended with puffiness and swelling under the jaw. It comes on with the irritative cough, and is, in some cases, so bad that the cow has to be fed with gruel. In slighter cases the sore-throat has not been particularly noticed, and may or may not have been present.

Bowels and Urine.—In very acute cases the bowels are inclined to be loose. The urine is sometimes scanty and high-coloured, and the cow loath to pass it.

Teats and udder.

Teats and Udder.—From five to seven days, more or less, after the commencement of the illness, one or more teats become enlarged, swollen to nearly double the natural size, and slightly œdematous.

* *Mem.*: Many of the above constitutional phenomena, particularly any rise of temperature indicative of fever, were absent from the cases observed among Hendon cows by Mr. Power and Dr. Klein. In these parts of his description, Dr. Cameron is probably relying on the statements of others as to what they have observed in cases which they consider to be of the same nature as the Hendon cases.—G. B.

On fingering the teat there is no feeling of induration or hardness. Vesicles or bullæ next appear upon the swollen teats, and upon the udder between or near the teats. In number they range from two to four on a teat, varying in size from a pea to a horsebean, and containing at first a clear fluid. The first vesicle frequently appears between the two fore-teats, close to the abdominal vein, and is usually as large as a good-sized horse-bean. This vesicle is not preceded by a hardened papule as in cow-pox, but is in the first instance a vesicle or bulla.* These vesicles usually become rubbed and broken in milking, leaving raw sores, sometimes red, in other cases pale in colour, with raised, ulcerated-looking edges. Sometimes a few smaller accessory vesicles are formed around the margin of these ulcerated sores. The lymph from these vesicles in this stage can seemingly be conveyed by the hands of the cowman to healthy cows, and so propagate the disease by direct inoculation of their teats. Shortly after the vesicle has been broken, a brown scab forms upon the sore. These scabs may remain attached for five or six weeks, or may fall off in ten days or a fortnight, a smaller one forming afterwards. A thin, watery fluid exudes from under the scab, and the sore ultimately heals under it.

I examined the teats of several cows five or six weeks after they were attacked. The scabs then varied in size from a shilling to a florin; they were about one-eighth of an inch thick in the centre, thinning off towards the edges. On picking off some of these, the recently-healed skin was of a pearly-blue colour, with a slight tendency to bleed when the scab was forcibly detached; but there was no depression or pitting of the skin. After the vesicle had become broken and the scab formed, the swelling of the teat gradually subsided.

Distinction from other conditions.

Difference between Cow-pox, Chapped Teats, and these Vesicles.—As, in the course of our inquiry, it was strongly asserted by several people who examined the cows, that they were suffering from cow-pox, it is worth noting some of the differences between cow-pox and this disease. Both appear on the cow's teats and on the udder, at or near the bases of the teats, but in *cow-pox* a hardened *pimple* first appears, and this pimple becomes a vesicle, which, if it remains unbroken by the hands of the cowman, develops into a globular or oval acuminated *pustule*. A central depression forms in the vesicle, with raised, pearly-looking edges, with hardening round the margin, and with a distinct areola. —In the *cow-disease now in question*, there is no hard pimple preceding the vesicle and there is no subsequent formation of pustule; there is no central depression of the vesicle, no marginal induration, no areola, and when the scabs fall off there is no pitting of the skin.—It deserves mention that some persons who examined the cows affirmed that the sores on the teats were of the nature of *chaps*, caused by exposure to cold winds when the teats were moist. This was an altogether unsatisfactory explanation, because, although some of the animals stood opposite the doors (which were usually shut), many others affected with the same disease were not so exposed; and, moreover, the chapped teats, resulting from exposure to cold winds, commonly bleed in milking. These sores do not bleed in milking, unless when very roughly used.

Phases of eruption.

Skin Eruption.—I have already mentioned that one of the early symptoms of the disease is puffing of the skin around the eyeballs, with a minute red eruption or rash upon it about the size of pin-heads. This was insisted on in an account given me by a competent and

* But see Dr. Klein's account of the anatomy of the eruption; particularly in the case of animal IV.—G. B.

seemingly very accurate observer. But besides this rash an eruption appears upon the top of the hind-quarter, on one or both sides, extending, in some cases, down the outside of the leg as far as the hock, in others to the fetlock joint. I am inclined to think that the first stage of this eruption appears about the same time as the first appearance of the vesicles upon the teats; but, on account of the difficulty of seeing it upon a cow's skin, it is impossible to say so with absolute certainty. It was most difficult to find amongst the cow's hair any eruptive spots in the first stage, but on careful searching one was found upon the skin of a cow which we supposed to be in that stage. The spot was circular, about the size of a split pea, red, not raised above the level of the skin, but with a slightly thickened base. About 14 days after the commencement of the illness, this eruption on the hind-quarters has arrived at its scabbing stage, and the severity of the eruption has appeared to correspond, to some extent, with the severity of the attack, and the number of vesicles upon the teats and udder. In cows whose teats and udder showed numerous vesicles, the eruptive spots were plentiful and close together; in cases where the vesicles were few in number, and the animal evidently suffering from a slight attack of the disease, the eruption was not so well marked, but showed more in isolated spots, ranging in size from a split pea to a shilling. This eruption was confined entirely to the rump and outside of the hind quarter, there being none under the tail, on the back, or behind the ears. The skin eruption in its later stages consisted of patches of eczematous-looking crusts. When a crust was picked off, the hair came off with it, exposing a raw, moist sore, the crusts and the sores looking exactly like eczematous scabs and sores. In some cases, where the scab had been forcibly detached when newly formed, the sore looked bloody. In more advanced cases, the scab, when picked off, showed the skin healed under it, but devoid of hair. There was no pitting of the skin.

The milk of affected cows.

The Milk.—In a specific disease affecting the constitution of the cow shortly after calving, it might be expected that the milk, being an animal secretion, would be in some way affected by the disease. Specific virus circulating in the cow's blood is obviously likely to contaminate the milk produced by her, and through this medium to convey the disease to human beings. Early in the disease the milk of cows suffering in this way, if set aside for some hours, as matter of fact is apt to become ropy, or, as I have heard it described, "ropy," "slimy," or "as thick as a pudding." This condition of the milk may occur, it is said, even before the vesicles appear upon the teats and udder, or the eruption on the hind-quarters. It shows itself in milk that may have been set aside for from six to twelve hours for the cream to rise, and it ought to be looked for in all suspicious cases of cow illness. In some cases, when the cow is being milked, the first few "draughts" of the teat may bring thick or knotty milk, but afterwards there is nothing abnormal to be seen in it. In many cases there is nothing particular discernible about the milk as it comes from the cow; it flows freely, and looks exactly like ordinary milk. As the milk from this dairy farm was sent direct from the farm to the milk shop, and immediately distributed to the customers, this peculiarity would not have had time to show itself; and, further, as the cream is now usually removed by "separators," this milk would not, in all probability, have been set aside for the cream to rise. In cases where, at a dairy farm, only one or two cows are suffering from a mild attack of the disease, this ropiness might not show itself if the milk was mixed with a quantity of milk from

healthy cows, although this mixed milk might very well be capable of injuriously affecting those who consumed it.*

I believe that this ropiness of milk appears in several cow diseases. Its precise nature, and the causes which give rise to it, require careful investigation. It was particularly noticed, and described to me by several persons, as having been observed by them about three years ago, in milk supplied from another dairy farm in this district a few days before a severe outbreak of diphtheria among consumers of the milk. This ropiness of the implicated milk was the subject of much discussion at the time, and was attributed by the farmer to feeding the cows on too much clover hay. He admitted the fact of the ropiness of the milk, and took, he said, milk from each individual cow, to see, if possible, which animal gave ropy milk, but he did not set the milk aside to stand awhile, and so failed to detect the culprit. Unfortunately, in this instance, several of the cows were removed and killed before there was a chance of examining them, and so an opportunity of gaining, perhaps, important information was lost. This outbreak was the subject of special inquiry and report by Mr. Power. [*See* Medical Officer's Report to the Local Government Board for 1883, p. 42.]

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[Dr. Cameron concludes his paper to the Epidemiological Society by suggesting to farmers and cowkeepers certain precautions which they may advantageously take, while the current knowledge of the subject remains as it is.]

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* Observe in this connexion, the results obtained by Dr. Klein of inoculating milk from which teat-discharges are excluded.—G. B.

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TRANSACTIONS

OF THE

SOUTH INDIAN BRANCH

OF THE

BRITISH MEDICAL ASSOCIATION.

Is Strychnine of any value as an Antidote to Krait, Daboia or Echis poison. SURGEON-CAPTAIN ELLIOT, M.B.

Madras:
PRINTED AT THE LAWRENCE ASYLUM PRESS, MOUNT ROAD.
1895.

Is Strychnine of any value as an Antidote to Krait, Daboia or Echis Poison. By Surgeon-Captain Robert Henry Elliot, M.B., B.S., *London*, F.R.C.S., *England*, D. P. H., *Cambridge*, &c., I. M. S., Acting Professor of Biology, Presidency College, Madras.

Last October it was my privilege to read before this Association, a paper on the value of Strychnine as an antidote to Cobra poison. To-day I propose to lay before you the work, which I have subsequently performed in an endeavour to ascertain, whether the reputed antidote was of any value, in the treatment of the bites of the other common poisonous snakes of Madras, which, as we all know, are the Daboia, Echis and Krait. There is a further point that leads me to address you again, *viz.*, that since the publication of my last paper, a number of fresh cases have appeared. These consist of scattered records in the various journals, and also of a most interesting series of cases by Surgeon-Lieut.-Colonel Joshua Duke, in his paper read before the Medical Congress last December. I propose, Gentlemen ! after describing to you the results of my recent experiments, to critically review these different cases.

In order to obtain a stable basis, on which to work, let me premise my remarks, by a few words on the symptoms, etc., of poisoning by the Krait, Daboia and Echis. A comparison of the experiments in Appendix I. with those recorded in my previous paper will show how strikingly similar are the symptoms of all the various forms of snake-poisoning.

To begin with that of the Krait. In this a marked feature is a great tendency to tremulousness, twitching and convulsions, a condition being thus attained, which so closely simulates strychnisation, that in cases, where the alkaloid had been injected, it was at times difficult, if not impossible, to be sure whether the symptoms of motor excitement observed were due to the drug or the venom. To this very important point I shall again allude later on. Salivation, as a symptom, was conspicuous by its absence, but in some of the monkeys, peculiar chewing movements were noticed, which suggested that the animal had something in its mouth, which it was trying unsuccessfully to expel. Possibly this was viscid saliva.

The typical symptoms of Cobra poisoning in monkeys, as described in my previous paper, were repeated exactly in the Kraitpoisoned animals. I refer to the drowsiness, the drooping of the eyelids, the drunken-like inco-ordination, and the apparent delusions. Where life was sufficiently prolonged, intestinal hæmorrhage occurred. This was rarely manifested during life by blood in the stools, but a *post mortem* constantly revealed submucous extravasations of blood, except when the animal died almost at once, from an overdose of the snake-poison. A subcutaneous jelly-like bloody extravasation around the wound, was also a constant feature.

Now as to the symptoms and signs of Daboia-poisoning :—

Here again one finds a tendency to motor excitement as the result of the injection of the venom, but I must confess that this phenomenon was not so well marked as the records of other observers had led me to believe. Nor was I able in any case by tapping the forehead, or by any sign the animal exhibited to ascertain the presence of 'the severe frontal headache of viper-bite.' The snakes I used were very fine Daboias, and the poison was injected usually about three days after its expression from the dissected glands. The symptoms noticed in a dog bitten by a Daboia were precisely similar to those observed in the animals, into which the poison was injected by a syringe. I confess myself at a loss to explain the difference between my own observations and those of other writers, and can only record facts and leave them as they stand for the present. One more point there is and on this I speak with less hesitation. I refer to the fact that dilatation of the pupil was in my experiments very far from a constant sign, whilst others have laid much stress upon it. When the animal survives long enough, hæmorrhage from the bowel takes place, and if life is still further prolonged most offensive melanic stools are passed. Salivation though noticed in one case was by no means, the rule.

In monkeys, the classical symptoms already alluded to were constantly present.

A very striking point was the extensive spread of the local lesion. The red currant jelly-like substance was far more plentiful than in cobra-poisoning. It tracked for a great distance along the lymphatics and apparently also spread directly in the planes of cellular tissue. Even where it appeared to follow the lymphatics, the cellular tissue surrounding these showed marked changes of

the same inflammatory character, presumably from the direct osmosis of the poison through the vessel walls. This venom appears to me to be both more irritative and more diffusible than the colubrine poison.

From the above brief review of the leading symptoms of snake-poisoning, we turn to the consideration of the effect of Dr. Mueller's antidote.

Surgeon-Lieut.-Colonel D. D. Cunningham in his excellent paper on this subject, before the Medical Congress at Calcutta, made the following incisive remarks :—"There is one somewhat quaint point in regard to the belief in the efficiency of the salts of Strychnia as antidotes for snake-venom. Its adherents seemingly regard these salts as constituting a universal panacea against the action of all kinds of venom. But this implies a belief that in some cases they act homœopathically, and in others allopathically, for in cases of acute viperine poisoning, the symptoms in many cases are those of extreme irritation of the nervous centres, whereas in cases of cobra poisoning, they are indicative of nervous depression. The symptoms of acute viperine poisoning in many cases are practically identical with those of acute strychnia-poisoning, and yet it is seriously proposed to endeavour to induce the latter in order to cure the former."

These words I can heartily endorse, and my grounds for so doing I will now show you. A reference to the cases in Appendix I. will show that the strychnised animals died sooner than those which were allowed to cope with the snake poison alone ; but this is not all, and to the following point I particularly beg your attention. In this series of experiments I was determined that strychnine should have its fullest chance ; accordingly the experiments were made in pairs or in fours, and the venom was equally divided between the two or four animals. In each set of experiments the animal which suffered first and most severely was made the control snake-poison experiment, while the animal which by reason of greater body-weight, greater life force, or other circumstances, was the slower to feel the effects of the poison, and which, therefore, *cæteris paribus*, would have been the longer in dying was used for the antidotal test. This method of operating brought out a very striking point, and absolutely supported Dr. Cunningham's remarks, for in every case, very soon after the alkaloid was administered, the animal rapidly became markedly worse, and as you will see, generally died before its weaker neighbour. I may say that these experiments were carried out before I saw Dr. Cunningham's paper, and I had the honour independently to arrive, on practical grounds at the same conclusion that that observer's acumen led him to adopt from theoretical considerations. I shall best illustrate my point by referring you to a striking pair of experiments, *viz.*, Experiments V. and VI. of the Daboia series, Appendix I. B.

The weight of the animals were practically identical, they were both in good health, the snake-poison was accurately weighed, and evenly divided between the two dogs. Strychnine was given to one, on Dr. Mueller's plan of full doses, and the animal whose hap it was *to be treated*, succumbed to the combined influence of venom and alkaloid.

The remaining animal fought its battle uninterfered with. In twenty-four hours it was as well as ever, and at the end of a week it rejoined its village companions, in decidedly better condition than when it entered my compound! Needless to say I refer the improved condition to regular food, and not to the snake-poison.

While one animal apparently owed its death to the combination of virus and remedy. I can confidently state that, from beginning to end, I never saw one atom of benefit derived from the administration of strychnine. In no single case were the symptoms even temporarily removed, and I do not hesitate to say that, while I believe the so-called antidote to be useless or worse than useless in cobra poison. I go farther, and consider that, with the facts before us, its administration in krait or viperine poisoning must be, if not malpraxis, at least a grave surgical error very difficult to defend. I am aware than I am speaking strongly, but I have chosen my words after careful thought, and in the belief that in so doing, I am discharging a duty, which I may not leave undone.

Now a few words on the Echis. There seems always to have been a good deal of dispute about the virulence of the venom of this snake. Fayrer considered it a dangerous viper; some of his correspondents called it deadly, others have thought lightly of its

bite. The Echis of these parts seems to be a much smaller animal than the specimens met with up North. Fayrer speaks of a fine specimen 22½ inches long. Babu Banerji kindly sent me several specimens, which are considerably larger than those met with in these parts. Out of seven specimens I have secured here the longest measured 15 inches. Dr. Browning and Dr. Henderson tell me that their usual size in Madras does not exceed this measurement. The Echis is a very vicious little viper and can always be relied on to bite at a minute's notice.

I endeavoured at first to extract and inject the poison as I had done with the other snakes, but the combined venom of three specimens of Echis was only sufficient to kill two guinea-pigs, and that too after a delay of about seven hours. I accordingly experimented on dogs, making the vipers bite the dogs (Appendix IV). In no case did I succeed in killing a dog by means of the bite of a single viper, though one dog bitten by four vipers in different places succumbed in 8½ hours.

With the exception of the local swelling, the symptoms in this case were by no means pronounced. The dog became ill and died, much in the same way as if cobra-bitten, but as it was not closely watched in the last 4 to 4½ hours of life, I would not lay stress on the absence of convulsions, etc.

I may mention lastly an important point which is, that in the course of a talk with a gang of snakemen, I asked if they considered the Echis—a specimen of which they had just brought me—deadly or not. They ridiculed the idea of a man dying from its bite, and prophesied that a dog bitten by these snakes would not die, the damage being confined to great swelling of the bitten part. My results which you may see in Table IV. amply justified their confidence. In order to prove to me its harmlessness, one man volunteered to be bitten by an Echis. I asked each of the four present in the gang, if they would consent to be bitten, and received a willing affirmative in each case. Thinking that they might be 'bluffing,' and not wishing to push the matter too far, lest they really should be bitten, I gave them another test by saying—'No, I don't want to see you bitten by the Echis, but will you let that snake (a Daboia) bite you!' The answer was a most emphatic negative. They began to think me dangerous, so I reassured them by saying that I did not wish them to be bitten by any snake. They seemed a little disappointed, for I believe, that there floated in their minds dim visions of a not unremunerated *otium cum dignitate*, within the precincts of my compound till such time as convalescence should be established.

I believe their statement most fully, and I should have no serious fears, were I myself, bitten by an Echis, but I did not allow their propositon to be carried out, as I think a stronger case is necessary to justify *vivisection on man*.

With these facts before me, I did not consider it worth while to try the influence of Strychnine as an Antidote to Echis poison for I am satisfied that the Echis, as met with down here is not a deadly snake, and I am unable to obtain specimens from the North. Throughout my experiments with this snake, I have failed to make out either the frontal headache or the dilated pupil, on which some writers have laid so much stress.

I come now, gentlemen, to a discussion of the cases published, since my last paper, and in so doing, I adopt my old plan of classification. The cases fall under two heads, those in which the snake was *identified*, as a deadly one, and those in which it was *not so identified*. The latter being again sub-divided into those, which show signs of true snake-poisoning, and those which do not. This is, however, not the classification adopted by all writers for Dr. Duke in his paper before the Indian Medical Congress, as reported in the 'Englishman' of Janury 9th, said : "It is a habit and *a bad* one, where the snake has not been killed or properly viewed, to class recoveries under strychnia as the result of the bite of *a harmless snake*, etc." I would add a rider to that statement and say—'It is also a habit, and a *worse one*, where the snake has *not* been identified, and where distinct and undoubted signs of Thanatophidial poisoning do *not* exist, to assume that the *snake is a poisonous* one, and by including such cases in statistics to absolutely vitiate the value of those statistics." Gentlemen, I leave you to judge which mistake is the more dangerous one. Surely this is the last country where one would accept unhesitatingly a man's statement that he has been bitten by a poisonous snake. Every bite a native receives, in which the offender is unseen is a 'snake-bite', and every snake a native sees, be it the harmless Dryophis or the deadly Daboia is to him a *most poisonous snake*.

No case should be included in our statistics, unless a reliable observer identifies it carefully, or unless there is good and clear evidence of Thanatophidial bite, such as drooping of the lids, incoordination with feeling of drunkenness and drowsiness. How uncertain our results may even then be will be best learned by a reference to the cases in Appendix IV.

I myself saw a large powerful Daboia strike fairly at a dog, hold it, shake it, and only let go, when the dog had fled yelping several yards, dragging the snake along the ground. The part bitten was soft and fleshy, the bite was apparently a fair one, the glands of the snake, when dissected, though emptier than usual, both proved to contain poison. From one gland alone I obtained more poison than another Daboia emitted through a leaf in a vigorous bite.

Add to all this, that there was well-marked subcutaneous extravasation around the bite, and the case seems perfect. I was on the point of trying Strychnine as an antidote, but fortunately a '*laissez, aller*' plan was adopted, and the animal, though it became rather ill, did not die. (Appendix IV., case 1).

Eight days later the same animal was fairly struck by a vicious Daboia, the bite being almost instantaneous in its shortness, and this time the victim died in less than three hours. (Appendix IV., case 2).

Surg.-Major Browning met with a similar case, and knowing the interest I take in these things, he very cou.teously wrote to me about it. I will read you his own words—"A healthy cobra bit a dog in two places with no result—another bite from the same cobra on the same animal resulted in death." Dr. Browning also sent me the notes of an interesting case, published in Appendix V. in which a grass-cutter girl bitten by an Echis 10 inches long recovered with the aid of only local treatment.

Add to these cases the results of the experiments on Echis bite in Appendix IV. and you will, I think, be with me, gentlemen, when I say, that in collecting evidence of cure for snake-poison, "all is not gold that glitters."

Let us take the new cases seriatim. You will find them in Appendix II, and will see I have continued the numbering from my last paper.

Cases 48, 49 and 50 are by T. A. Manickam Pillay, C. M. S. All these cases were lacking in identification of the snake, and in symptoms of Thanatophidial bite. In two out of the three signs of strychnisation appeared.

Case 51 is another death. There were undoubted symptoms of snake-poisoning. Strychnine was liberally given, ·24 gr. being administered in ½ hour to a child of 10. No improvement was noted, and the child died. One cannot but notice two points in this case; one is that local treatment is not even alluded to, and the other that Strychnine convulsions closed the child's life.

I come now to a case, which has been made a good deal of, *viz.*, Case 52. To my mind it is by no means convincing. Let me draw attention to the following points:—(1) Dr. Baker speaks of the snake as a full-grown one, 3 feet long. Full grown Cobras run from 5 to 6 feet in length: this was therefore a half-grown specimen. (2) The man was a snake charmer. It is a not uncommon practice among these men to extract the poison before removing a fang. This man was engaged in removing the fang, and it is significant that the tooth he was busy on had an empty poison sac, while the other fang, which was *hors de combat* from an old injury, had a full sac. It is at least probable that the man had emptied the dangerous side before he commenced operations. (3) The symptoms came on slowly, and, as the notes show us, were not removed by the Strychnine. In fact after each fresh injection we learn that there was 'no improvement.' At last after a long continuance of this state of things, the tide turned, and the man *gradually* recovered. The obvious interpretation seems to me to be, that the patient received a small dose of cobra poison, and rallied from it by his own natural powers in spite of the Strychnine, which is not proved to have benefited him at all.

Case 53 seems to have been bitten by an Echis. The patient struggled on for a day and a half and then Strychnine was given. Death closed the scene about an hour after the new course of treatment was commenced.

This case gathers in force when considered along with case 73 in which the patient survived for 24 hours before Stychnine was given. Within an hour of the first administration of the alkaloid the

man was dead. I do not say that the Strychnine killed the patients and I bear in mind that both of them were very ill before the alkaloid was given but the coincidence is worthy of attention.

Cases 71 and 72 are by Dr. Jones.

In 71 the bite seems to have been undoubtedly inflicted by a Cobra. The thanatophidial symptom are typical; the patient when admitted was well under the poison but was not in extremis Strychnine was freely given (1·35 gr. in ¾ hr.), but without the least advantage.

Case 72 is far from convincing. The snake was only seen by an agitated native woman whose daughter had just received a wound which she probably deemed a most dangerous one, and yet the description she gives is almost worthy of a scientist sitting at his desk with a specimen before him. Granting the validity of her description, however, the snake is as likely to have been a Lycodon which closely resembles the Krait in appearance, as it is to have been a Krait. At all events the Krait is not a *viper*, (the recorder is in error here) but is one of the poisonous colubrine snakes, and as such, would not be likely to have inflicted the four-marked bite described here.

As to the blood that came from the girl's mouth it may have been due to a local injury inflicted by her teeth in the fit described, which fit was probably due to fright. I have been unable to find any *valid* evidence to show that Indian viper or krait bite is attended by hæmorrhage from the mouth either in man or animals, though I am of course, familiar with the submucons and subserous hæmorrhage of the alimentary canal and lungs found under these conditions.

As to the rest of her symptoms, I think that we shall not outrage probabilities by ascribing them to fear.

Now as to Dr. Duke's cases. I fear I must differ from that writer in my method of classifying them. As I have already discussed the published cases he refers to, I will not again allude to them, but will confine my attention to his own cases.

They are the most instructive group of cases yet recorded, and had not Dr. Duke been led to place an undue value on the records of other observers, notably on Dr. Banerji's cases, I have no doubt that his own experience would have led him to reject Strychnine for ever.

To begin with, out of seventeen cases, Dr. Duke had nine deaths under the Strychnine treatment. Of the eight recoveries, he admits that it is doubtful whether the snake was poisonous in Cases 1, 2 and 3, while in case 14 the offender was a grass green snake, which produced no serious symptoms. I only know one snake in the plains answering to this description, and that is the very innocent and very common Dryophis Mycterizans. Four cases remain, I have it on Dr. Duke's own authority that in none of these Cases was the snake brought in for identification. Nevertheless Case 6 is unhesitatingly pronounced a Cobra bite. We are told that the symptoms were severe, convulsions being frequent. This is in itself a strange history, and one that excites suspicion, for neither in men or animals does one find convulsions as a symptom of Cobra-bite, till the patient is absolutely moribund. Lastly, I may say that in a letter Dr. Duke wrote me, he candidly owned, that the evidence, on which he attributed the cures in these cases to Strychnine, was his faith in the reputation of the antidote. Science, gentlemen, as I need not remind you knows no such law as faith, and judged on the standard of hard facts. Dr. Duke's cases read to me thus. In eight of them no evidence is forthcoming of Thanatophidial bite and these may therefore be excluded. The remaining nine all died whether from the venom or the remedy or both, it would be hard to say.

To my mind Dr. Duke's cases are the most damning evidence against Strychnine yet to hand, and I think it a high tribute to his integrity of purpose, that in spite of the views he held, these cases were ever put on record. I say 'held'' advisedly, for Dr. Duke has practically owned to me his conversion from the belief, of which he was the quondam champion. I desire to take this opportunity of thanking him for the kindness, openness, and freedom from prejudice, with which he has assisted my enquiries.

Before quitting this subject, allow me to allude to two methods of treatment, which have been recently suggested more or less, as the outcome of the use of Strychnine.

The first of these is a custom against which I would raise a most emphatic and earnest protest. I refer to the neglect of the ligature in the treament of snake bite. Some indeed have not

been content with having left undone the good which they ought to have done, but have gone so far as to undo the good which others had done, I mean that one finds in the records of cases, instances in which observers relying on the efficacy of strychnine have been tempted to remove the ligatures that wiser if less educated hands had applied.

I am aware that much latitude must always be allowed for individual opinion in the treatment of any particular case, and I would be the first to give that latitude to any one who keeps within ordinary bounds. Vicious to the patient as I believe the administration of strychnine to be, I can understand the position of those who do not agree with me now, and who therefore administer it, but nothing to my mind, can defend the practice of depriving a patient of that refuge from his fate which the exclusion of the snake venom from the general circulation affords. The value of the application of the ligature has been proved up to the hilt by experiment; on common physiological grounds its utility is self evident, and as a method of treatment it has been recommeded by names that will live to all time in the history of snake poison research, names such as those of Fayrer, Wall and Richards, nay more it has received the approbation of every trustworthy medical officer in this country, who by actions which speak louder than words has hastened to apply the ligature as soon as he has reached his snake-struck patient.

Gentlemen! I fear that this example may prove infectious and that many of our subordinates with the best intentions may be led into the same error. It is urgently necessary that we should speak out clearly against this evil and nip in the bud what may otherwise prove a source of danger to the lives we are bound to protect, and a source of discredit to the practice of Medicine in India.

The other method of treatment alluded to was suggested by Dr. Lauder Brunton. That able writer has proposed washing out the stomach with Condy's fluid in snake bite, on the grounds that the poison is excreted through the mucous membrane of the stomach and that we are by this mode of treatment able to neutralise it and prevent its re-absorption by the mucous membrane.

There are, however, two flaws in this argument. I speak, gentlemen, with the very greatest respect for the man whom the whole world of science esteems and rightly esteems so highly, and whose pupil I had the honour erstwhile to be. Dr. Brunton will be one of the first to yield to facts and two facts face us here.

1st.—If you will turn to Appendix III. you will notice that I found it impossible to poison animals with even large dose of viperine or colubrine poison taken by the mouth on meat. I am aware that Fayrer killed fowls by the administration of snake poison through the mouth, but my experiments which some of you have witnessed have led me to conclusions different from those of that great observer. I may say that Dr. Browning has also independently arrived at the same result by his work on this subject.

2nd.—A reference to the cases in which *Post mortems* were performed will show that the excretion of the poison as evidenced by submucous hæmorrhage does not take place so early or so markedly from the stomach as it does from the lower part of the small gut and from the great gut. Submucous hæmorrhage in these latter portions of the alimentary tube were the rule, while bleedings from the stomach or upper part of the small gut were rare. I am inclined to believe that the excretion takes place through the solitary and agminated patches of adenoid tissue in the bowel.

Obviously, gentlemen, it would be useless to wash out the stomach under these conditions, while it would be a needless source of irritation to the patient who needs above all things to have his strength husbanded that he may be able to fight out his battle for life unhampered.

The sense of my many obligations again comes over me, and I feel my powerlessness to rightly express my gratitude to the many, who have so freely and generously given me their help in my work.

In Madras the Surgeon-General, Surg.-Lt.-Col. Allison, Surg.-Captain Thomson, Mr. Jones and others have doubled the debt I owe them, while as to Surg.-Captain Giffard, I can only say, that much of the work, I have put before you, has been his almost as much as my own. Equally generous has been the help I have received from many who are not serving in this Presidency. Of these I would mention Surg.-Lieut.-Col. Cunningham, Surg.-Lieut.-Col. Joshua Duke, Surg.-Captains Buchanan and Bird, and Mr. Kanthack.

Once again, Gentlemen, in closing my second paper on this subject, let me say that I have no wish to make converts by the sword of controversy. Mine it has been to lay facts before you, and then to leave you to judge each one for yourselves, but I would press home on you and on each one, whom this paper may reach, that the subject we are dealing with, is no mere child's play. It is a matter of life and death to hundreds, if not to thousands, and it behoves us to think well, nay more to think our best, and having thought, to throw the whole weight of our influence into the scales on one side or the other.

If Strychnine be the hope of the snake-bitten wretch, fight for it. If it be a spectral delusion, a shadow of death to rob the living of precious life, and such I believe it to be, away with it, and the sooner the better.

Surgeon-Major Browning said, that although he had not been able to see the full text of Surgeon-Captain Elliot's present paper, that he had seen sufficient to enable him to say he concurred, generally, in the views expressed by the author.

Assistant-Surgeon Robertson and himself had conducted some experiments with Echis at Guindy, where the snake is very common, he had furnished Surgeon-Captain Elliot with a brief note of the cases. He had never seen an Echis over 16 inches in length, he thought it just possible that an Echis might kill a child or a very weakly adult, in the same way, as scorpion stings were alleged to destroy life. He had a curiosity at Guindy in the shape of a common house rat that had killed three Echis without suffering in any way. The snakes each time struck at the rat savagely and repeatedly but no trace of blood could be seen on the animal.

With reference to the general question of strychnine as an antidote to snake-bite, he regretted that he had not been present at the former meeting, he cordially endorsed all Surgeon-Captain Elliot had said regarding its uselessness as an antidote. At Guindy they had experimented with the cobra, daboia, and bungarus, using strychnine subsequently, in all cases "the dog it was that died". In January 1894 he had written in, officially, to the Surgeon-General on the subject and amongst other things protested in the very strongest manner possible against the indiscriminate use of strychnine. He had carefully read all the recorded cases of alleged cure and keeping in view the various possibilities of error he had not seen a single case in which, it had not occurred to him that, conclusions were arrived at on insufficient grounds.

Surgeon-Major Browning showed, in connection with Surgeon-Captain Elliot's paper, specimens of Echis and Dipsas Trigonatus, the latter, kindly, identified by Mr. Thurston. Natives of this country he said considered the Dipsas Trigonatus a very dangerous snake, it was however quite harmless. The general colouring of the snakes when alive was not dissimilar, and although he believed that the two were not infrequently confounded, no one who noted the typical **V** mark of the Echis the vertical pupil, and the general viperine type of body could fall into such an error.

Appendix I. A.

Krait Poison and Strychnine.

Experiments on Monkeys.

Reference No. of Experiment.	Weight of Animal.	Nature of Experiment.	Nature of Injection.	Dose of Injection.	Time elapsed since 1st Injection.	Symptoms, etc., noted.	Remarks.	Time elapsed between 1st Injection and Death.
I. 22-12-94.	1 lb. 11 oz.	Krait Control.	Krait Poison.	gr. $\frac{1}{2}$	15 mins.	Drowsy; eyelids droopy, a little unsteady.	Death in cases i to iv was too rapid for intestinal hæmorrhages to take place.	25 mins.
					20 do.	Tremulous, jerky, drunken, eyelids drooping.		
					25 do.	Dead.		
II. 22-12-94.	3 lbs. 5 oz.	Antidotal.	Krait Poison.	gr. $\frac{1}{2}$	20 mins.	Eyelids droopy, lively.	...	39 mins.
			Liq. Strych. B.P.	m $\frac{1}{2}$	24 do.	Made a fuss over injection.		
			Liq. Strych. B.P.	m i	33 do.	Jerky at once. Is jerkiness due to strychnine or Krait poison?		
			Liq. Strych. B.P.	m i	37 do.	Dying.		
					39 do.	Dead.		
					P. M.	The usual œdema with some injection at the site of wound. The same appearances as in cases iii and iv, but the kidneys are congested also.		
III. 22-12-94.	2 lbs. 6 oz.	Krait Control.	Krait Poison.	gr. $\frac{1}{12}$		Well.	...	46 mins.
					29 mins.	Drowsy, eyelids droopy.		
					34 do.	Eyelids drooping, drunken, rolling about in pain.		
					39 do.	Twitching.		
					46 do.	Dead.		
					P. M.	At site of injection wound gelatinous œdema. Right side of heart and veins distended. *Liver* full of blood. *Stomach* loaded with food.		

Experiments on Monkeys—(continued).

Reference No. of Experiment.	Weight of Animal.	Nature of Experiment.	Nature of Injection.	Dose of Injection.	Time elapsed since 1st Injection.	Symptoms, etc., noted.	Remarks.	Time elapsed between 1st Injection and Death.
IV. 22-12-94.	2 lbs. 7 oz.	Antidotal.	Krait Poison.	gr. $\frac{1}{10}$				
					26 mins.	Eyelids droopy.		
					31 do.	Eyelids droopy, quiet, ill.		
			Liq. Strych. B. P.	♏ $\frac{1}{2}$	36 do.	Very ill at time of injection.		
			Liq. Strych. B. P.	♏ i	42 do.	Dying.		
					43 do.	Strong tetanic twitches at short intervals.		
					45 do.	All but dead, pupils dilated.		
					48 do.	Dead.		
					P. M.	Gelatinous œdema of wound; right side of heart and large veins loaded with blood. *Liver* ditto. *Bladder* empty in both this and the last case.	...	48 mins.
V. 9-1-95.	4 lbs.	Krait Control.	Krait Poison.	gr. $\frac{1}{16}$				
					35 mins.	Very well		
					55 do.	Eyelids a little droopy, very vicious still, pupils natural.		
					1 hr. 25 do.	Very droopy, still lively.		
					1 do. 40 do.	More quiet, a little drunken, no salivation.		
					1 do. 45 do.	Chewing, seems as if he had something in his mouth that he wants to get rid of. Drooping excessive.		
					2 do. 20 do.	Drunk, meditative.		
					2 do. 45 do.	Stooping drowsily, leaning on a bar, head on hands; when disturbed, movements convulsive, and inco-ordinate.		
					3 hrs.	Weak, inco-ordinate, almost limp; can't stand falls on all fours when lifted.		
					3 hrs. 15 mins.	In *statu quo*		
					4 hrs.	In *statu quo*, but more feeble.		
					4 do. 20 do.	Just alive.		
					4 do. 40 do.	Found dead.	...	4 hrs. 40 mins.
VI. 9-1-95.	4 lbs. 6 oz.	Antidotal.	Krait Poison.	gr. $\frac{1}{16}$				
					40 mins.	Very well.		
					55 do.	Very vicious, no drooping of eyelids, pupils natural.		
					1 hr. 30 do.	Eyelids beginning to droop, very lively.		
			Liq. Strych. B.P.	♏ $\frac{1}{2}$	1 do. 45 do.	More quiet, droopy, no salivation.		
					1 do. 52 do.	Chewing movements.		
					1 do. 57 do.	Jerky to aural stimuli; no lessening of droopiness.		
			Liq. Strych. B.P.	♏ $\frac{1}{4}$	2 hrs. 20 do.	Has got much worse since 1st injection of strychnine was given; is still jumpy, but semi-drunk and less active.		
					2 do. 25 do.	Very poorly jumps to touch.		
			Liq. Strych. B.P.	♏ $\frac{1}{4}$	2 do 50 do.	Stooping drowsily, leaning on a bar, head on hands, jumps to touch, can't stand, convulsive inco-ordinate.		
			Liq. Strych. B.P.	♏ i	3 do. 5 do.	Still twitching to touch, but limp and moribund, can't be roused.		
					3 do. 10 do.	No response to stimulus.		
					3 do. 20 do.	Moribund, jerks to touch.		
					3 do. 35 do.	In *statu quo*.		
					4 do. 5 do.	Just alive, twitches on touch.		
					4 do. 25 do.	Just alive.		
					4 do. 40 do.	Found dead.	...	4 hrs. 40 mins.

Krait Poison and Strychnine. Experiments on Guinea Pigs.

Reference No. of Experiment.	Weight of Animal.	Nature of Experiment	Nature of Injection.	Dose of Injection.	Time elapsed since 1st Injection.	Symptoms, etc., noted.	Remarks.	Time elapsed between 1st Injection and Death.
X. 14-11-94.		Antidotal.	Krait Poison	See experiment ix above.	10 mins.	When lifted a tremor passed over the animal, legs chiefly affected, decidedly ill.		
					13 mins.	A similar tremor.		
			Liq. Strych B.P.	m ½	17 do.			
					19 do	Spontaneous tremor ; jumps when touched or at a sound ; lying semi-prone.		
					25 do.	Well strychnised, lying cheap and prone.		
					29 do.	Dead. No salivation noted throughout.		29 mins.
					P. M.	Noticed a bloody discharge from the vulva, which was not present before innoculation, uterine organs highly congested, bladder full of turbid yellow urine (not bloody), very little extravasation around wound.		

Appendix I. B.

Daboia Poison and Strychnine. Experiments on Monkeys.

Reference No. of Experiment.	Weight of Animal.	Nature of Experiment.	Nature of Injection.	Dose of Injection.	Time elapsed since 1st Injection.	Symptoms, etc., noted.	Remarks.	Time elapsed between 1st Injection and Death.
I. 8-12-94	4 lbs.	Control Daboia.	Daboia poison.	The contents of one gland were divided equally between animals in Experiments I. and II.		Animal healthy ; pupils natural.		
					20 mins.	Eyelids drooping ; Lying down, ill.		
					22 do.	Giddy, seems drunk, marked drooping of eyelids.		
					25 do.	Very drunken, falling about, head on chest, face getting blue.		
					31 do.	Lying down flat, very difficult to rouse, seems paralysed, no salivation.		
					45 do.	Tremulous convulsion, very blue in the face, a little more active.		
					57 do.	Lying on face, paralysed, pupil not dilated, seems dying.		
					2 hrs. 40 do.	Dead.	...	2 hrs. 40 mins.
					Post Mortem.	Liver, spleen and kidneys congested, lungs ecchymosed on surface, stomach full of food, small gut full of bloody chyle in its upper half, submucous ecchymoses abundant at this part, bladder normal.		
II. 8-12-94.	4 lbs.	Antidotal.	Daboia poison.			Very fierce and angry, pupils natural.		
					17 mins.	Becoming ill.		
					22 do.	Giddy, lying down, drunken, eyelids drooping, head falling on chest.		
			Liq. Strych. B.P.	m ii.	26 do.			
					31 do.	More lively but can't raise lids, still seems drunk.		

Daboia Poison and Strychnine. Experiments on Monkeys.

Reference No. of Experiment.	Weight of Animal.	Nature of Experiment.	Nature of Injection.	Dose of Injection.	Time elapsed since 1st Injection.	Symptoms, etc., noted.	Remarks.	Time elapsed between 1st Injection and Death.
II. (continued.)					33 mins.	Worse again, lying flat, dusky.		
					34 do.	Strychnine tremor.		
					36 do.	Tetanic spasms on touch.		
					36½ do.	Severe opisthotonic convulsions.		
					38 do.	Do. do. do.		
			Liq. Strych. B. P.	m i.	42 do.	Strychnisation passed off.		
			Liq. Strych. B. P	m ii.	47 do.	Is practically dead.		
					54 do.	Not yet dead.		
					1 hr. 12 do.	Found dead.	...	1 hr. 12 mins.
					Post Mortem.	Viscera somewhat congested, a few spots of ecchymosis in large gut.		
III. 8-12-94.	2½ lbs.	Control Daboia.	Daboia poison.	The contents of 3 glands were divided between Cases III. and IV.		Well at time of injection.		
					10 mins.	Preliminary drunkenness.		
					11 do.	Stretched out flat with tonic spasms.		
					12 do.	Dusky, eyelids drooping.		
					16 do.	Sitting up, eyes shut, head drooping.		
					19 do.	Lying quiet, eyes shut.		
					20 do.	Prone, can't be roused.		
					1 hr.	When roused, sits up for a few minutes, quickly falls again.		
					3 hrs. 20 do.	Dead.	...	3 hrs. 20 mins.
IV. 8-12-94.	2½ lbs.	Antidotal.	Daboia poison.		9 mins.	Spasms, bad colour, drunken.		
			Liq. Strych. B. P.	m i ss.	10 do.	Head drooping, did not notice injection		
					13 do.	More lively, sitting up, eyes half shut, head drooping.		
					22 do.	Strychnine convulsion.		
					23 do.	Several convulsions.		
					35 do.	Strychnisation passed off, animal weak and dusky.		
			Liq. Strych. B. P.	m 5.	36 do.	Is half dead.		
					55 do.	Dead.	...	55 mins.

Daboia Poison and Strychnine. Experiments on Dogs.

Reference No. of Experiment.	Weight of Animal.	Nature of Experiment.	Nature of Injection.	Dose of Injection.	Time elapsed since 1st Injection.	Symptoms, etc., noted.	Remarks.	Time elapsed between 1st Injection and Death.
V. 1-12-94.	12lbs. ±	Control Daboia.	Daboia poison.	gr. ½		Well, pupils natural.	A bitch.	
					10 mins.	Quiet.		
					30 do.	Very drowsy the last few minutes.		
					50 do.	Quiet, lying down, no salivation, pupils normal.		
					4 hrs.	Still quiet and disinclined to move, but can be roused, pupils not dilated.		
					6 do.	Seems better.		
					8 do.	Seems well, a natural motion.		
					24 do.	Seems very well, eats and is happy.		
					One week.	Has remained perfectly well since last note.	...	Recovered.
VI. 1-12-94.	12lbs.	Antidotal.	Daboia Poison,	gr. ½		Well, pupils natural.	This experiment was done side by side with experiment V.	
					16 mins.	Quiet.		
					1 hr.	Lying very quiet, no salivation, pupils normal.		
					1 do. 45 do.	Defæcated, sleepy, no marked symptoms.		
			Liq. Strych. B. P.	m ii	3 do. 20 do.	Very drowsy, can be roused with difficulty, no salivation or paralysis, did not seem to feel the prick of the needle.	A bitch.	
					3 do. 27 do.	Slightly jumpy.		
					3 do. 37 do.	Has been well under strychnine the last few minutes.		
					3 do. 52 do.	Severely strychnised.		
					3 do. 57 do.	Still severely strychnised, pupils not dilated, salivation.		
			Liq. Strych. B. P.	m ii	6 do. 15 do.	Very ill, retching, trying to vomit, can still walk, did not notice prick.		
					6 do. 45 do.	Strongly strychnised.		
					7 do. 30 do.	Trying to vomit, lying on one side, seems dying, no evidence of strychnisation.		
			Liq. Strych. B. P.	m ii	7 do. 35 do.	Felt the prick, and jumped.		
					7 do. 50 do.	Well strychnised.		

Daboia Poison and Strychnine. Experiments on Dogs.

Reference No. of Experiments.	Weight of Animal.	Nature of Experiment.	Nature of Injection.	Dose of Injection.	Time elapsed since 1st Injection.	Symptoms, etc., noted.	Remarks.	Time elapsed between 1st Injection and Death.
VI. (*continued.*)					7 hrs. 55 mins. *Post Mortem*, (12 hrs. after death.)	Dead. *Stomach.* Patchily congested and containing a melænic semi-fluid mass, about oz. ii. in bulk. *Intestines.* At intervals one finds congested circular patches, over each of these a little blood is extravasated, the blood either adheres to the congested spot or else lies close to it. Beyond these patches, the bowel contains no blood. *Liver.* Marked congestion of lobules. *Kidneys.* Congested, stellate veins, very marked. *Bladder.* Contracted and congested. *Tongue.* Ecchymosed ? *Wound caused by injection.* There is a very extensive extravasation of dark red jelly-like material around the wound, this extravasation stretches up from the thigh along the wall of the abdomen.	...	7 hrs. 55 mins.
VII. 1-12-94.	14 lbs.	Control Daboia.	Daboia Poison.	gr. ½		Very vicious and lively.	A dog.	
					14 mins.	Quiet and drowsy.		
					54 do.	Quiet but not drowsy, walking about.		
					6 hrs.	Bleeding from a wound in the mouth, otherwise fairly well.		
VII. (*continued.*)					7 do. 30 do.	Ill, lying on one side.		
					9 do.	Quite unconscious, was yelping a few minutes ago, has passed copious, offensive, melænic stool, evidently dying, has also been bleeding from the mouth.		
					9 do. 30 do.	Practically dead, pupil reflex still present.		
					11 do. 30 do. *Post Mortem*, (8 hrs. after death.)	Dead. *Tongue.* Ecchymosed, probably from bites. *Stomach.* Healthy, full of food, no blood present. *Duodenum.* Healthy, contains bile. *The lower half of jejunum, the ileum and the large gut* all present circular congested patches, these are more abundant than those found in case VI. As one descends the gut one finds an increase in the amount of blood present; the termination of the large gut being full of melænic fluid. *Kidneys.* Normal. *Bladder.* Normal, contracted. *Liver.* Slight lobular congestion. *Spleen.* Normal.	...	11 hrs. 30 mins.
VIII. 1-12-94.	12 lbs.	Antidotal.	Daboia Poison.	gr. ½		Well at time, pupils natural.		
					6 mins.	Ill, drowsy, salivating, B. O. passed urine.		
			Liq. Strych. B.P.	m ij	12 do.	Standing up, respiration rapid, salivating freely, pupils not dilated.		
					22 do.	Strychnisation commencing, seems as if standing on hot bricks, jumpy to touch.		

Daboia Poison and Strychnine. Experiments on Dogs.

Reference No. of Experiment.	Weight of Animal.	Nature of Experiment.	Nature of Injection.	Dose of Injection.	Time elapsed since 1st Injection.	Symptoms, etc., noted.	Remarks.	Time elapsed between 1st Injection and Death.
VIII. (*continued.*)			Liq. Strych. B. P.	m i	32 mins.	Did not notice prick, seems much the same, salivation has ceased, jumpy.		
					38 do.	Severe opisthotonic convulsion.		
					43 do.	Another convulsion.		
			Liq. Strych. B. P	m i	55 do.	In state of strychnia drowsiness.		
					57 do.	Lying prone, very ill, half dead.		
					1 hr. 2 do.	Dying but still strychnised		
					1 do. 7 do.	Dead.	...	1 hr. 7 mins.
					Post M.rtem.	Some subcutaneous extravasation around wound.		

Daboia Poison and Strychnine. Experiments on Guinea Pigs.

Reference No. of Experiment.	Weight of Animal.	Nature of Experiment.	Nature of Injection.	Dose of Injection.	Time elapsed since 1st Injection.	Symptoms, etc., noted.	Remarks.	Time elapsed between 1st Injection and Death.
IX. Oct. 1894.	...	Control Daboia.	Daboia Poison.	The contents of the glands of one Daboia were evenly divided between animals IX, X, XI and XII.	28 mins.	Very quiet.		
					38 do.	Dusky, ill.		
					54 do.	Lies on one side, occasional convulsion of the limbs, some opisthotonus. breathing laboured, pupils not dilated		
					58 do.	Better, sitting up.		
					1 hr. 5 do.	Convulsions.		
					1 do. 7 do.	Convulsions, sitting half up, but weak behind, gasping slowly, can't stand, at intervals has spasmodic strychnine-like jerks.		
					1 do. 13 do.	Much worse, still spasmodic.		
					1 do. 15 do.	Dying.		
					1 do. 16 do.	Dead.		1 hr. 16 mins.
					Post mortem.	Heart beating long after death, especially its right side, no hæmaturia, no visceral congestion, extensive injection around wound permeating all the layers of the abdomen.		

Reference No. of Experiment.	Weight of Animal.	Nature of Experiment.	Nature of Injection.	Dose of Injection.	Time elapsed since 1st Injection.	Symptoms, etc., noted.	Remarks.	Time elapsed between 1st Injection and Death.
X. Oct. 1894.	...	Antidotal.	Daboia Poison.	See Experiment ix above.	27 mins.	Very quiet.		
					37 do.	Ill and dusky.		
					42 do.	Respiration rapid.		
					52 do.	Very slack, lies almost on its belly.		
			Liq. Strych B. P.	m i	57 do.	Lying on one side, hind limbs weak, breathing slow and laboured.		
					1 hr. 2 do.	Convulsion of arms and legs.		
					1 do. 3 do.	Respiration slow and gasping.		
					1 do. 4 do.	Dying.		
					1 do. 5 do.	Dead.	...	1 hr. 5 mins.
					Post mortem.	Appearances as in previous case, but extravasation less extensive.		
XI. Oct 1894.	...	Antidotal.	Daboia poison.	See experiment IX above.		Well at time of injection.	Very late in first showing symptoms of poisoning. Reason of delay unknown	
					25 mins.	Urinated.		
					30 do.	Very quiet.		
					40 do	Cheap and dusky.		
					1 hr. 38 do.	A Convulsion.		
			Liq. Strych B. P.	m ¼	1 do. 39 do.			
					1 do. 43 do.	Starts occasionally. Has urinated.		
			L'q. Strych B. P.	m ¼	1 do. 48 do.	No further signs of strychnine or snake-poison.		
					1 do. 55 do.	Twitches when touched.		
					2 hrs. 5 do.	Convulsion when touched.		
					2 do. 15 do.	do. do. do.		
			Liq. Strych B. P.	m ½	2 do. 33 do.	Limbs too weak to support body, settling down on its belly.		
					2 do. 35 do.	Twitches when touched.		
					2 do. 40 do.	Twitches violently when touched, no improvement.		
					2 do. 43 do.	Prone. Body and limbs convulsed.		
					2 do. 50 do.	Convulsions.		
					2 do. 51 do.	Twitches when touched.		
			Liq. Strych B. P.	m i	3 do. 8 do.	Practically dead.		
					3 do. 13 do.	Twitches feebly when touched. No improvement.		

Daboia Poison and Strychnine. Experiments on Guinea-pigs.

Reference No. of Experiment.	Weight of Animal.	Nature of Experiment.	Nature of Injection.	Dose of Injection.	Time elapsed since 1st. Injection.	Symptoms, etc., noted	Remarks.	Time elapsed between 1st Injection and Death.
					3 hrs. 45 mins. 3 do. 47 do. *Post mortem.*	Slight convulsion. Twitches on touch. Dead. As in case IX, Infiltration very marked.	...	3 hrs. 47 mins.
XII.		Antidotal.	Daboia poison.	See experiment IX above.	30 mins. 40 do. 45 do.	Well at time of injection. Very quiet. Cheap and dusky. Jerks occasionally as if under strychnine, otherwise very quiet. Respiration rapid, each respiration shakes the whole body and is attended with a little squeak.	Strychnine was given too late and the Experiment was practically a Control Daboia Experiment.	
					55 do. 1 hr. 15 do. 1 do. 25 do.	No increased dilatation of pupils. Breathing more quietly, no noise. Very weak in hind legs. Convulsion.		
			Liq. Strych B.P.	♏ i	1 do. 27½ do. 1 do. 30 do.	On one side. Convulsions continue. Dead.	...	1 hr. 30 mins.

...bite, continued

No. of case.	Reported By	Reported In...	...(B) Recovery or Death.	Result.	Treatment By Strychnine.	Treatment By other means.	Remarks.
48	T. A. Manikam Pillay, C. M. S., Ulunderpet, S. Arcot.	I. M. R... 16th D... ber 18...	...ours.	Recovery.	gr. ½ in 1½ hours.	...	* All accounted for by fear. Male æt. 10.
49	Do.	Do...	...	Recovery.	⅛ gr. in ½ hour.	Ligature above knee.	Male æt. 12. † Symptoms do not point to snake bite. Fear and alcohol are more probably responsible.
50	Do.	D...	...ours.	Recovery.	⅛ gr. in 35 mins.	Native Drugs.	Male æt. 24.
	...						
51	2nd class Hpl. Asst. C. Admanabha Navadoo, Tirupponer, 2nd November 1894.	Commd... Surg... e. Ge... Madr... Surg... H. ... M.B., ... lepat... 24th ... ary 1...	...ours	Death.	·24 gr. in ½ hour of which ·05 was given by mouth and ·19 Subcutaneously.	Nil.	The convulsions are stated by the recorder to have been undoubtedly due to Strychnine. No improvement followed the use of the drug. Classical signs of snake bite were present. The ligature was omitted.

Appendix II.

An Analysis of Recorded cases in which Strychnine has been used as an Antidote for Snake bite, continued from previous paper read before this Branch.

No. of case.	Reported By	Reported In	Identification of the Snake.	Local signs.	Symptoms. Referrible to Snake-bite.	Symptoms. Referrible to Strychnisation.	Symptoms. Referrible to other causes.	Interval between Bite and (A) Commencement of Strychnia treatment.	Interval between Bite and (B) Recovery or death.	Result.	Treatment By Strychnine.	Treatment By other means.	Remarks.
48	T. A. Manikam Pillay, C. M. S., Ulunderpet, S. Arcot.	I. M. Record, 16th December 1894.	Snake seen by three natives.	2 punctures on left great toe.	None.	None.	Body cold and bathed in sweat. Cornea insensitive. Pulse imperceptible at wrist. Heart's action very feeble. Sphincterani relaxed. * Swollen foot 2 days later.	1 hour.	3 hours.	Recovery.	gr. ½ in 1½ hours.	...	* All accounted for by fear. Male æt. 10.
49	Do.	Do.	Snake killed by another person and thrown away.	2 punctures on back of right foot above heel. No bleeding.	None.	Pricking pain in stomach and feeling of tightness there.	Inability to stand† Restlessness. Coldness of body surface. Heaviness of head. Oppression about chest. Incoherence.	1½ hours.	...	Recovery.	½ gr. in ½ hour.	Ligature above knee.	Male æt. 12. † Symptoms do not point to snake bite. Fear and alcohol are more probably responsible.
50	Do. ...	Do.	Snake seen by the patient.	4 punctures on dorsum of left foot. No bleeding.	...	Constriction and pain of the throat. Difficulty of swallowing. Feeling of tightness within the chest. Difficulty of breathing. Sense of rigidity of whole body.	Coma.* Pulselessness. Feeble heart-action.	2 hours.	8 hours.	Recovery.	⅓ gr. in 35 mins.	Native Drugs.	Male æt. 24.
51	2nd class Hpl. Asst. C. Admanabha Navadoo, Tirupponer, 2nd November 1894.	Commd. to Surg.-Genl. c. Govt. of Madras by Surg.-Maj. H. Nailer, M.B., Chingleput, on 24th January 1895.	No snake seen.	Scratch on 2nd toe of right foot.	Pain in foot. Oppression at chest. Drowsiness passing into unconsciousness. Drooping of eyelids Giddiness. Loss of vision. ? Affection of speech Breathing slow.	Convulsions.	Nil.	1 hour.	2 hours	Death.	·24 gr. in ½ hour of which ·05 was given by mouth and ·19 Subcutaneously.	Nil.	The convulsions are stated by the recorder to have been undoubtedly due to Strychnine. No improvement followed the use of the drug. Classical signs of snake bite were present. The ligature was omitted.

No. of Case.	...to ...ces.	Interval between bite and (A) Commencement of Strychnine Treatment.	(B) Recovery or Death.	Result.	Treatment. By Strychnine.	By other means.	REMARKS.
		1½ hours.	8 hrs.	Recovery.	·43 gr. in 5 hours.	Native applications. Ligature Incision cupping.	Adult male. N.B.—(1) Patient a snake charmer. (2) The gland on the same side as the perfect fang was empty. Snake-men sometimes empty the gland before removing the fang. The other fang was hors de combat. (3) Cobra only 3 ft. long and ∴ half grown. (4) Strychnia was given and the patient recovered, but the notes suggest 'post hoc' much more strongly than 'proper hoc."
		1½ days.	1 hour after commencement of strychnine treatment.	Death.	·15 gr.	Native treatment. stimulants.	Probably Echis bite. Strychnine did no good. ? Did it cause death ?
		...	...	Recovery in all three.	(1) $\frac{1}{10}$ gr. (2) $\frac{1}{12}$ gr. (3) $\frac{1}{10}$ gr.	...	...
		...	...	Recovery in all.	(4) $\frac{1}{2}$ gr. (5) $\frac{3}{8}$ gr. (6) $\frac{3}{2}$ gr.	...	* These symptoms suggest strychnisation but not cobra poison.
	admis-	4 hrs.	5 hrs.	Death.	(7) ½ gr.	...	...

No. of Case.	Reported ...on. By	In	Bite ...l Recovery or ...ath.	Result.	Treatment. By Strychnine.	By other means.	REMARKS.
61	Surg.-Lieut.-Col. Joshua Duke.	A paper before I.M.Con... Dec. 1...	...	Death.	*(8) ¼ gr.	Ligature NOT used.	...
62 } 63 }	Do	do	after admission.	Death. Death.	(9) } (10) } ?	...	...
64	Do	do	hr.	Death.	?	Ligature.	Child æt. 5.
65	Do	do	hrs	Death.	(12) 1½ gr.	Ligature & free incision.	A sepoy.
66	Do	do	...	Recovery.	(13) $\frac{1}{10}$ gr.	...	...
67	Do	do	..	...	...	...	§ A cat probably Dryophis mycterisans, a harmless treesnake
68	Do	d	ays.	Death.	(15) $\frac{1}{10}$ gr.	...	Miscarriage and death on 3rd day * Snake probably an Echis.
69	Do	d	hrs.	Death.	(16) $\frac{1}{12}$ gr.	...	...
70	Do	d	days.	Death.	(17) ? dose.	...	Labour set in on 7th day and the woman died.

...ddress before the Indian Medical Congress.

An Analysis of the recorded cases in which Strychnine has been used as an Antidote for **Snake-bite**, continued *from previous paper read before this Branch.*

No. of Cases.	Reported.		Identification of the Snake.	Local signs.	Symptoms.			Interval between bite and		Result.	Treatment.		REMARKS.
	By	In			Referrible to Snake-bite.	Referrible to Strychnisation.	Referrible to other causes.	(A) Commencement of Strychnine Treatment.	(B) Recovery or Death.		By Strychnine.	By other means.	
52	Asst. Surg. Baldeo Singh and Surg.-Capt. G H. Baker, I.M.S., Bandatt, N.W.P.	I. M. G., Dec. 1894.	Cobra properly identified.	Puncture of one fang, one inch from cleft between 1st and 2nd toe of right foot. Tissues around, livid and swollen. Swelling of foot remained for some days.	Giddiness. Inco-ordination. Salivation. Nasal voice. Ptosis of Right eye. Vomiting. Inability to swallow.	Convulsions after ·43 gr. of nitrate of Strychnia in 5 hrs.	Nil.	$1\frac{1}{4}$ hours.	8 hrs.	Recovery.	·43 gr. in 5 hours.	Native applications. Ligature Incision cupping.	Adult male. N.B.—(1) Patient a snake charmer. (2) The gland on the same side as the perfect fang was empty. Snake-men sometimes empty the gland before removing the fang. The other fang was hors de combat. (3) Cobra only 3 ft. long and ∴ half grown. (4) Strychnia was given and the patient recovered, but the notes suggest 'post hoc' much more strongly than 'proper hoc.'
53	Chas. A. Lafrenais, Ag. Civil Surgeon, Tellicherry.	Official letter to Surg.-Genl., c. Govt of Madras, dated 2nd Feb. 1895.	Not identified. Symptoms point to Echis.	Bitten on left heel. Left leg swollen Two punctures on heel.	Face puffy Eyes injected. Collapsed. Bloody urine.	...	...	$1\frac{1}{2}$ days.	1 hour after commencement of strychnine treatment.	Death.	·15 gr.	Native treatment. stimulants.	Probably Echis bite. Strychnine did no good. ? Did it cause death ?
54 55 56	Surg.-Lt.-Col. Joshua Duke.	A paper read before the I.M. Congress Dec. 1894.	(1) (2) (3) Dr. Duke is doubtful whether the Snake was poisonous.	...	...	...	...	...	...	Recovery in all three.	(1) $\frac{1}{10}$ gr. (2) $\frac{1}{25}$ gr. (3) $\frac{1}{15}$ gr.	...	...
57 58 59	Do	do	(4) (5) (6) Snake not identified.	...	...	(6) Symptoms severe Frequent convulsions.*	...	...	...	Recovery in all.	(4) $\frac{1}{2}$ gr. (5) $\frac{3}{4}$ gr. (6) $\frac{2}{3}$ gr.	...	* These symptoms suggest strychnisation but not cobra poison.
60	Do	do	(7) Snake not identified.	...	None cited.	None.	Moribund on admission.	4 hrs.	5 hrs.	Death.	(7) $\frac{1}{2}$ gr.	...	...

An Analysis of the recorded cases in which Strychnine has been used as an Antidote for Snake-bite, continued *from previous paper read before this Branch.*

No. of Case.	Reported By	Reported In	Identification of the Snake.	Local Signs.	Symptoms. Referrible to Snake-bite.	Symptoms. Referrible to Strychnisation.	Symptoms. Referrible to other Causes.	Interval between. (A) Bite and commencement of Strychnia treatment.	Interval between. (B) Bite and Recovery or death.	Result.	Treatment By Strychnine.	Treatment By other means.	REMARKS.
61	Surg.-Lieut.-Col. Joshua Duke.	A paper read before the I.M. Congress Dec. 1894.	8) Snake 'said to be a cobra.'	Bitten on Finger. Finger bleeding.	Drowsiness. Pain in Head? Later unconsciousness.	...	...	...	...	Death.	(8) $\frac{1}{4}$ gr.	Ligature NOT used.	...
62 63	Do	do	(9) { Snake not (10) { seen.	(9) Bitten on ear. (10) " " leg.	Moribund on admission.	...	...	...	(9) 1 hr. (10) 2 hrs. } after admission.	Death. Death.	(9) } (10) } ?	...	...
64	Do	do	(11) Not identified.	...	Moribund on admission. Insensibility, Foaming at mouth.	...	...	$\frac{1}{2}$ hr.	1 hr.	Death.	?	Ligature.	Child æt. 5.
65	Do	do	(12) 'Snake killed a krait.'	(12) Bitten on inner ankle.	...	'No notice of tetanic spasm.'	...	3 hrs. +	31 hrs	Death.	(12) $1\frac{1}{2}$ gr.	Ligature & free incision.	A sepoy.
66	Do	do	(13) Snake not identified.	...	...	...	Convulsed 15 min. after bite.'	...	...	Recovery.	(13) $\frac{3}{10}$ gr.	...	...
67	Do	do	(14) Grass green Snake. §	...	...	...	...	...	...	...	...	...	§ A cat probably Dryophis mycterisans, a harmless treesnake
68	Do	do	(15) "Attributed to the bite of a * Daboia Russelli."	Agonising local pain and swelling of limb.	Never insensible.	...	...	...	3 days.	Death.	(15) $\frac{3}{16}$ gr.	...	Miscarriage and death on 3rd day * Snake probably an Echis.
69	Do	do	(16) Do	Local swelling and excessive pain.	Conscious to nearly the last. Suddenly became insensible and died.	...	...	Few minutes.	16 hrs.	Death.	(16) $\frac{1}{16}$ gr.	...	...
70	Do	do	(17) Do	Bitten on ankle. Local swelling and pain.	...	...	...	...	7 days.	Death.	(17) ? dose.	...	Labour set in on 7th day and the woman died.

N. B.—The figures in brackets [thus (17)] refer to the numbers of these cases in Dr. Duke's original tables appended to his address before the Indian Medical Congress.

continued *from previous paper read before this Branch.*

No. of Cases.	…o to …ses.	Interval between bite and (A) Commencement of Strychnine Treatment.	(B) Recovery or Death.	Result.	Treatment. By Strychnine.	By other means.	Remarks.
		3¼ hrs.	4¾ hrs.	Death.	1·35 grs. in ¾ hr.	Punctures enlarged and Potassium Permanganate rubbed in.	An undoubted case of snake-poisoning in which large doses of strychnine were given, without benefit to the patient.
	…sive fit …er bite, dizzi…ing and sight, respira… slight from …mc m… mouth; face; of both …t lower felt …; dry… …at.	1¼ hrs.	3¾ hrs.	Recovery.	·15 gr. in ½ hr.	Nil.	*(a) The Krait is not a viper, and does not possess viperine teeth; therefore would not inflict the wound described. (b) The snake was only seen by a native woman. (c) All the symptoms exhibited may be safely ascribed to fright. Patient female, æt. 13.
	…irritat… …native	12 hrs.	Less than 13 hrs.	Death.	7½ gr. in 50 minutes.	Patient was bled and dosed by Practitioners.	§ These symptoms might have been produced by the native treatment adopted and are not pathognomonic of snake bite. The recorder believes 'the death of the patient may have been hastened by the Strychnine.'

APPENDIX III.

Experiments on the effect of Snake poison administered by the mouth.

Reference No. of Experiment.	Date.	Remarks.
(1)	January 5th, 1895.	A big Pie-dog ate some meat into which had been injected the contents of one gland of a large healthy Daboia. The poison had been kept about a month, but experiments with the contents of the other gland of the same snake, showed that it was still very deadly when subcutaneously injected. *Later.*—The dog was none the worse for his meal and lived till January 16th, when he was bitten by a Daboia and died within 2 hours of the bite.
(2)	January 9th.	A Pie-bitch was given the contents of one gland of a Daboia on meat, and also the gland itself. Two or three drops of poison had been expressed from the gland, this being fully as much as another Daboia injected through a leaf in a vigorous bite. The poison was soaked up on the meat. The dog ate both meat and gland. At first she was evidently suspicious and preferred fresh pieces of meat, but greed and persuasion prevailed in the end and the poisonous matter was fairly swallowed. *Later.*—The animal is still alive on January 18th, and has never showed any signs of ill-effects from the dose.
(3)	January 16th.	The poison was extracted from the glands of 2 large Daboias by some snakemen in my presence. They obtained some poison by making one snake bite over a leaf into a glass section-dish. The remainder they squeezed out with their thumbs into the mouths of the reptiles and then soaked the poison up on pieces of meat. The poison thus extracted was given on meat to a large pie-dog which ate it up greedily, and has never seemed in any way the worse for the dose.
	January 18th.	The dog is as well as ever it was.
(4)	December 1st, 1894.	About ¾ grain of dried cobra poison was given to a white pariah dog at 2 P.M. The poison was dissolved in a little water and soaked up with meat, which the dog ate. The dog showed no signs of poisoning, remaining as vigorous as ever. It made so much noise, on account of the unaccustomed restraint that it was let loose at 7 P.M., 5 hours after taking the poison. It immediately ran off as vigorous and we as possible.

An Analysis of the recorded cases, in which Strychnine has been used as an Antidote for Snake-bite, continued *from previous paper read before this Branch.*

No. of Cases.	Reported.		Identification of the Snake.	Local signs.	Symptoms.			Interval between bite and		Result.	Treatment.		REMARKS.
	By	In			Referrible to Snake-bite.	Referrible to Strychnisation.	Referrible to other causes.	(A) Commencement of Strychnine Treatment.	(B) Recovery or Death		By Strychnine.	By other means.	
71	O. W. Jones, M.D., Civil Surgeon, Wun District.	I.M. Gazette, November 1894.	Cobra, identified by patient, a snake charmer.	Two punctures on right thumb.	Salivation, ptosis; indistinctness of speech. Staggering gait; dimness of vision; drowsiness passing into complete insensibility.	...	...	$3\frac{1}{2}$ hrs.	$4\frac{1}{4}$ hrs.	Death.	1·35 grs. in $\frac{3}{4}$ hr.	Punctures enlarged and Potassium Permanganate rubbed in.	An undoubted case of snake-poisoning in which large doses of strychnine were given, without benefit to the patient.
72	Do	Do	* Snake not caught, said to have been seen by native woman, attributed to Bungarus Cæruleus, and described as Viper bite.	4 minute indistinct punctured wounds on right little toe.	Nil	Nil.	Slight convulsive fit 15mins. after bite, followed by dizziness, vomiting and dimness of sight, profuse perspiration of body slight bleeding from mucous membrane of mouth; puffiness of face; congestion of both eyes; "right lower extremity *felt* paralysed"; dryness of throat.	$1\frac{1}{2}$ hrs.	$3\frac{3}{4}$ hrs.	Recovery.	·15 gr. in $\frac{1}{2}$ hr.	Nil.	*(a) The Krait is not a viper, and does not possess viperine teeth; therefore would not inflict the wound described. (b) The snake was only seen by a native woman. (c) All the symptoms exhibited may be safely ascribed to fright. Patient female, æt. 13.
73	Surg.-Lt.-Col. H. Hyde of Cuddalore, case was treated by Civil Apothy. P. Muthusawmy.	Communicated officially to the Surg.-Genl. c. Govt. of Madras.	Seen by the Apothecary and described as Panaya Viryan.	2 small punctures on left ear, covered with blood.	Drowsiness § Loss of power over the extremities. Respiration slow and sobbing. Pulse feeble. Pupils slightly dilated.	Twitches due to Strychnine.	Conjunctivæ irritated by native medicine.	12 hrs.	Less than 13 hrs.	Death.	$\frac{2}{3}$ gr. in 50 minutes.	Patient was bled and dosed by Practitioners.	§ These symptoms might have been produced by the native treatment adopted and are not pathognomonic of snake bite. The recorder believes 'the death of the patient may have been hastened by the Strychnine.'

Experiments on the effect of Snake poison administered by the mouth.

Reference No. of Experiment.	Date.	Remarks.
(5)	February 2nd, 4 P.M.	A Daboia, 3 feet 9 inches long, was brought in by a native freshly killed. Its glands were dissected out and found to contain an unusually large amount of poison. They were emptied and the poison was sopped up on meat and bread and given to a strong Pie-dog. The animal ate the food and afterwards the glands which were sandwiched inside a piece of bread.
	9-30 P.M.	Dog has remained well.
	February 9th.	Dog has remained well throughout.
(6)	February 9th 3 P.M.	Same dog as in last experiment, ate 10 drops of cobra poison on meat and bread. The poison was extracted from a freshly-killed cobra, 3 feet 9 inches long, the glands being also given. The dog therefore ate about one grain of fresh cobra poison, enough in fact to kill 10 dogs if it had been subcutaneously injected.
	12th	From beginning to end the dog had never a symptom of cobra poisoning.
(7)	February 12th.	Six drops of cobra poison which had been extracted from a large cobra on February 11th were given on meat to a Pie-bitch. She ate the meat greedily.
	14th.	Bitch has in no way suffered from her meal of poison.
(8)	February 27th, 1895, 7-50 A.M.	10 drops of cobra poison removed from a vigorous cobra on 11th February 1895, were dissolved in water and stirred up thoroughly with some meal which was then given to two ducks. The ducks greedily cleaned the tin, but suffered in no way from their meal. The cobra poison would have weighed over a grain.
(9)	February 27th, 8 A.M.	The contents of the left gland of a large cobra were dissolved in water and thoroughly mixed with a handful of rice which was then greedly eaten by two fowls. The poison had been removed from the snake on 16th February 1895, and measured sixteen drops (about gr. ii). The fowls were none the worse for their meal.
(10)	February 27th, 11 A.M.	Twenty-one (21) drops of poison were removed from the right gland of a large cobra on 16th February 1895, and were to-day dissolved in water and mixed with some leaves from a hedge.
	8 P.M.	A goat ate nearly all these leaves to-day, and is none the worse for his meal.
	28th, 12 noon.	The rest of the leaves have been eaten by the animal.

Experiments on the effect of Snake poison administered by the mouth.

Reference No. of Experiment.	Date.	Remarks.
(11)	February 28th, 8-15 A.M.	The same goat as in last experiment has just eaten some leaves which have been wet with a solution of Daboia poison. The poison when extracted on 16th February 1895 measured 11 drops. The animal disliked the poison-covered leaves and had to be made forcibly to eat them, but the whole of the poison was eventually got down.
	11-15 A.M.	Goat none the worse for the poison.
	March 6th.	Goat alive and well.
(12)	March 28th, 1895 4-45 P.M.	The glands were extracted from a freshly killed Daboia 41 inches long. Eight drops of poison were expressed from the two glands, this was at once soaked up on bread, and both poison and glands were then eaten by a goat (the same animal as in experiment 11).
	March 21st, 1895.	The goat has been in no way ill from its meal.
(13)	March 20th, 1895 3-15 P.M.	The poison glands were removed from a freshly killed Krait (Bungarus cœruleus measuring 37 inches in length. 9 drops of poison were expressed from the two glands and immediately sopped up on pieces of meat and bread. Both the glands and the poison were eaten by a pie bitch.
	March 21st, 1895	Dog has been perfectly well, and has shown no symptom of poisoning.

APPENDIX IV.

Some records of cases in which animals were bitten experimentally by snakes.

CASE I. (*Recovery*).

Jany 8th ... ...A large pie-dog was bitten in the fold of the hind leg by a vigorous Daboia, 3 feet 8 inches in length.

1-25 P.M. ...The dog walked over the snake in search of some food that had been thrown near the reptile's head. The Daboia seized the dog and shook it, nor did it let go till the dog had bolted several yards squealing loudly. Teeth marks seen.

2- 0 P.M. ...Licks bite occasionally, otherwise well.

2-20 P.M. ...Has been uneasy the last 10 minutes. Licks wound often.

2-50 P.M. ...Dog is cheap but stands. Part hot and tender.

3-45 P.M. ...Seems fairly well.

5- 5 P.M. ...Seems well; there is marked staining at the seat of the bite which is tender.

Jany. 9th, ...10-0 A.M.. Alive and well; two teeth marks are seen as white marks which look as if the spots had been touched with chloride of zinc stick; around these marks there is a purple stained area obviously the result of subcutaneous extravasation.

13th ... ...The staining has gradually faded and is now greenish yellow in colour and becoming indistinct, there is but little tenderness left now. Animal quite well.

The dog was seen by Surg.-Lieut.-Col. Browne and Surg.-Captains Williams and Giffard.

CASE II. (*Death*).

Jany. 16th ...11-30 A.M...The same dog as in the previous experiment was fairly bitten by a vicious Daboia, about 3 feet 4 inches long. The dog had nearly walked over the snake in search of food. The bite was so quickly given that one could hardly see what had happened. The dog rushed off yelling furiously with blood flowing from the right foreleg just above the foot, and lay down in a corner.

11-37 A.M...Looks very ill; pupils large; defæcating, quiet, breathing heavily.

11-40 A.M...Comatose.

11-43 A.M...Violent heavings of abdomen followed by semifluid motion in which there was no blood.

11-45 A.M...Pupils contracted to half the diameter they were at first.

12-15 ...No convulsions up to date. In *statu quo*.

12-30 ...A semifluid motion, streaked with blood, forcibly ejected.

12-55 ...Still breathing but practically dead.

1-10 ...Breathing fast and laboured. Pupils dilated. Eyes turned downwards.

1-15 ...Gasping. Just passed about ℥ss of dark blood per rectum. A little blood-tinged fluid has also escaped from the mouth.

1-20 ...Per rectum about ℥ii of frothy melænic fluid.

1-30 ... Do do do do do

1-33 ... Do do do do do

2-0 ...Conjunctive insensitive. Respiration shallow and less frequent.

2-15 ...Dead 2¾ hours after the bite.

No *Post Mortem* was made.

Remarks. Of the two bites which this dog received the first seemed the more efficient and the local staining showed poison was injected. The glands of the snake which inflicted the first bite were dissected. Left gland nearly empty but contained some poison. Right gland contained several drops of poison. The fangs of both sides were seen working during life.

CASE III. (*Recovery.*)

Jany. 10th ... 1895. 3-30 ...Pie bitch was bitten on the face and nose by an Echis about 15 inches long which struck three times and drew blood.

3-40 ...Nose swollen. Dog lying down.

3-55 ...Dog very poorly. Pupils moderate

4-20 ...Swelling of face and head severe. Submaxillary and cervical glands enlarged. No evidence of frontal headache. Pupils natural. Dog can stand, but lies down at once when lifted on to its feet.

4-30 ...Retching.

4-35 ...Tremulous movements affecting trunk and limbs. Bitch very ill.

5-25 ...Face, head and neck hugely swollen. Can't stand, hind legs very weak.

6-30 ...Swelling of head and neck enormous. Pupils large. Very ill. Won't stand.

9-15 ...More lively. Eating with pleasure. Swelling as before.

9-45 ...Seems much better. Pupils natural now.

Jany. 11th .. 7 A.M ...Swelling less. Cheery, walking about, wagging tail, eating well, and easily.

Jany. 12th ... Swelling subsiding. Dog fairly lively.

Jany. 13th ... ... Do do do do do. No tenderness.

Jany. 14th ... ...Swelling nearly disappeared.

CASE IV (*Recovery.*)

Jany. 14th ... 11-30 A.M...Same Dog as in case III bitten by a vigorous Echis, 13 inches long on both hind legs. Blood came. Dog did not howl

2 P.M ...Seems well but can't stands as both hind legs are much swollen and she will not trust them. No glandular enlargement. Pupils natural.

9 P.M ...Has remained much as in last note. Ate food well.

Jany. 15th ... ...Face is a little more swollen. Both legs swollen. The wounds on her face and legs caused by the bites have formed shallow ulcers. She prefers to lie down and is evidently not well.

Jany. 16th ... ...Still cheap. Legs and face still a little swollen.

Jany. 17th ... ...Swelling subsiding. Better all round.

Jany. 18th ... Well as ever. No swelling.

Jany. 19th ... ...Quite well.

CASE V. (*Recovery*).

Jany. 19th ... 3 P.M ...Same dog as in cases III and IV bitten by an Echis on the left hind foot.

4-45 P.M...Slight swelling of left hind leg. Dog rather cheap.

Jany. 20th ... ...Swelling slight. Dog well.

Jany. 22nd ... ...No signs, local or general. Dog quite well.

CASE VI. (*Recovery*).

Jany. 14th ... 11-30 A.M...Pie bitch severely bitten by an Echis Carinata 13 inches long on the left hind foot. Bitch howled and licked foot.

11-40 A.M...Leg much swollen. Animal cheap.

2-0 P.M ...Leg greatly swollen up to the hip. Dog won't trust it and stands on 3 legs. Pupils natural. Tenderness not excessive even at the seat of wound.

4-0 P.M ...No marked change.

7-0 P.M ...Do do do Pretty fit.

9 0 P.M ...Do do do do do. Eats well.

Jany. 15th ... ...Seems well. Appetite good, Won't trust leg fully. Great swelling of whole leg. Glands not much enlarged. Two superficial sores over region of the bite. These do not seem painful.

Jany. 16th ... Very fit. But leg still swollen and untrustworthy.

Jany. 17th ... Very fit. Swelling subsiding. Leg only slightly tender.

Jany. 19th ... Well as ever. Swelling disappeared. Ulcers nearly healed.

CASE VII. (*Recovery*).

Jany. 19th ... 3 P.M ...Same bitch as in last case bitten on nose and left forefoot by Echis, drawing blood in the nose.

4-45 P.M...Some swelling of left foreleg. Dog fit.

Jany. 20th ... Very little swelling. Animal quite fit.

Jany. 22nd ... No signs (local or general) of disease.

CASE VIII (*Recovery*)

Jany. 19th 3 P.M ...A large well grown Pie dog bitten by an Echis on left foreleg over 1st joint.

3-5 P.M .. Local swelling commencing.

4-45 P.M...A good deal of swelling of the whole leg. Dog quite fit.

Jany. 20th ... ...Swelling well marked. Dog is not well.

Jany. 22nd ... ...Still slight swelling locally. No tenderness. Dog well.

CASE IX (*Death*)

Jany. 16th ... 12-30 P.M...A large strong Pie dog was bitten on the belly and on all four feet by 4 Echises. Two of the snakes not merely struck but held on making the dog yelp.

1 P.M ...Right fore foot swollen.

Jany. 17th ... 9 A.M ...The dog died.

Post Mortem. Extensive subcutaneous red currant-jelly like extravasation over lower surface of the abdomen, over surface of right fore and hind legs, in retroperitoneal space and in anterior and posterior mediastinal spaces. Both pleura contained bloody fluid.

Lungs.—Show large congested patches.

Alimentary Canal.—Stomach natural full of blood.

Small gut.—Upper part natural, bile-stained.

Lower half of small gut and the large gut show numerous submucous extravasations and contain within them a certain amount of bloody matter.

Liver.—Slightly congested.

Kidneys } Natural.
Spleen }

APPENDIX IV B.

Kindly communicated by Surg.-Major W. Browning, I. M. S.

I.

Healthy bitch weighing 30lbs. bitten on the upper and lower lips by a freshly caught Echis 12 inches in length.

Symptoms.—Salivation, hurried respiration, rigors, refused food and water, swelling of lips and down the neck and had a general appearance of illness, recovered.

II

Bitch in poor condition weighing 26lbs. bitten by two freshly caught Echis, respectively 15½ and 10 inches, on the nose, lips, hind leg and toes.

Symptoms.—Salivation, hurried respiration, hair on back standing erect, parts around bites much swollen, animal will not place affected leg on the ground, refuses food and water general appearance of being very ill. This animal had had a litter a month previously and on the morning following the experiment, that was a bloody discharge from the vagina. Recovered.

III.

Healthy dog, weighing 35½lbs. bitten by the larger of the two Echis used in Experiment II, about 10 minutes had elapsed between the two experiments, with the exception of slight swelling, no ill effects were noted in this case.

Summary.—The chief symptoms were considerable swelling and a general appearance of being ill, the symptoms came on within three minutes and with the exception of the swelling all passed off within 12 hours.

APPENDIX V.

A case kindly communicated by Surgeon-Major W. Browning, I.M.S.

At 2-15 P.M. on 8th October 1894 a strong young grass-cutter woman æt about 25 years was bitten on the palmar surface of the last phalanx of the left thumb while in the act of cutting grass. A companion at the time killed the snake and applied some moistened chunam from her betel bag over the wounded part. The patient came to the Dispensary about 10 minutes after the occurrence. Her companion who had accompanied her was sent to fetch the snake.

Observing two fang marks which had previously bled, these were at once freely laid open and bleeding encouraged by keeping the whole thumb immersed in very hot and strong carbolic lotion which was frequently renewed.

About two hours after her arrival at the Dispensary, the patient complained of a slight pain in the shoulder of the affected side and a dull frontal headache. At 8 P.M. a sharp attack of hæmorrhage occurred from the bitten part, which was controlled with considerable difficulty. At 1 A.M. another slight attack of hæmorrhage came on.

Besides these trivial symptoms no others of an alarming nature shewed themselves. All symptoms of shock were completely absent.

No internal remedies whatever were used.

The snake which bit the woman was an Echis, 10 inches in length.

Fearing that the patient would fall into the hands of quacks she was detained at the dispensary till the morning.

Except for a swollen condition of the thumb the patient left the dispensary perfectly well.

THE

BRIGHTON LIFE TABLE

(Based on the Mortality of the Ten Years, 1881–90).

BY

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1893.

PREFACE.

A Life Table furnishes the most trustworthy measure of the vital conditions of a community. There are, however, serious difficulties in its application to comparatively small localities, and these account for a large share of the delay in the issue of the present Life Table.

In the first place, the difficulty arises of obtaining the requisite data. The census population of Brighton, distributed according to age and sex, has not yet been published: and had it not been for the courtesy of Dr. Ogle Superintendent of Statistics in the General Register Office, Somerset House, the Brighton Life Table could not have been hitherto commenced. I take this opportunity of expressing my cordial acknowledgment of the kindness received from Dr. Ogle and his assistants.

When the necessary data as to population and deaths were secured, a further difficulty arose. The more carefully the data as to deaths were examined, the more evident it became that they embraced a number of deaths not properly belonging to the Municipal Borough of Brighton. Had these deaths been excluded from the Life Table an initial suspicion would have attached thereto. The alternative plan was adopted of embracing within the Life Table the population and deaths of Hove, and including also the deaths of inhabitants of Brighton and Hove, which occurred in public institutions without their borders. Hence this Life Table refers to the Parliamentary Borough of Brighton.

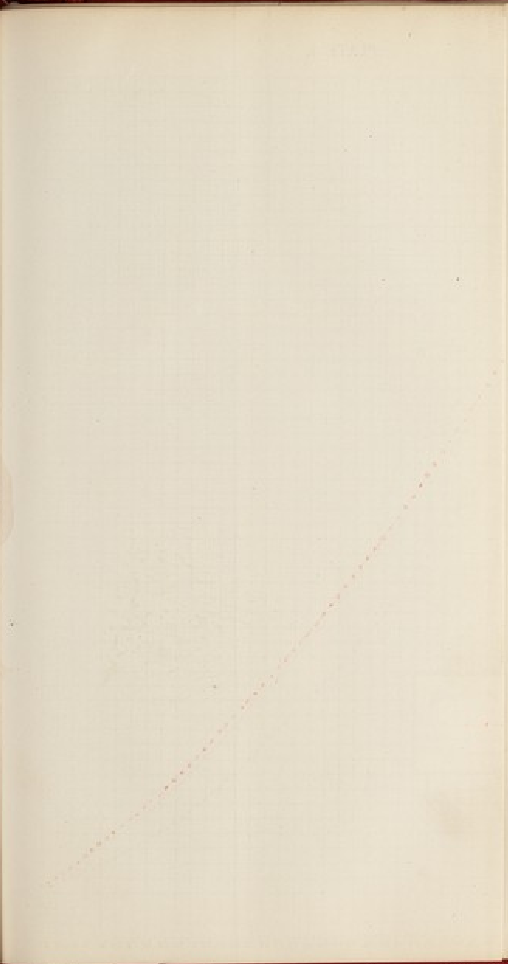
The method adopted in the construction of the Brighton Life Table is not the analytical method usually employed, but the graphic method, which, as shewn by Mr. Geo. King, the Hon. Sec. of the Institute of Actuaries, was the method employed by Milne in the construction of his famous Carlisle Table.

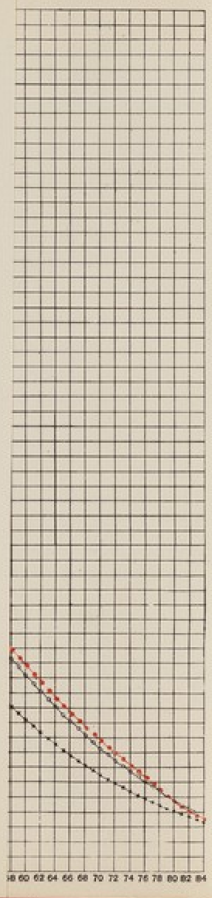
Mr. King has criticised the curves given in pages 12-13, and I am greatly indebted to him for valuable guidance and help. Mr. Frankland, F.I.A., has also kindly given help in several points of difficulty. I am, however, alone responsible for the accuracy of the Life Table.

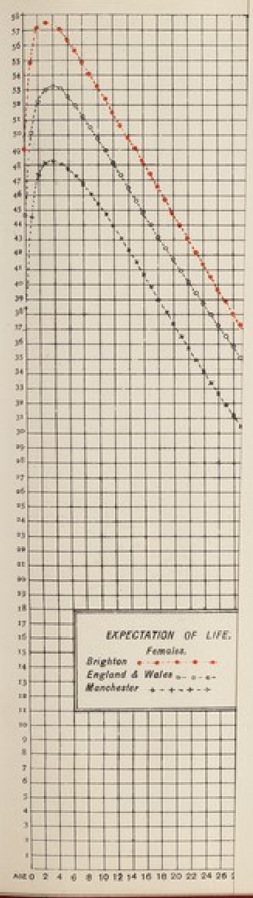
The adaptation of the graphic method of constructing a Life Table to public health purposes, represents, I think, an important improvement. For not-only is the method very accurate when properly applied, but it is also simple in application. The graphic method brings the construction of a Life Table within the reach of every medical officer of health, and thus supplies him with an instrument of increased accuracy for calculating the exact vital conditions of the community whose health he is appointed to guard.

ARTHUR NEWSHOLME.

Town Hall, Brighton,
May 10th, 1893.






EXPECTATION OF LIFE.
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Brighton
England & Wales
Manchester

PLATE I.

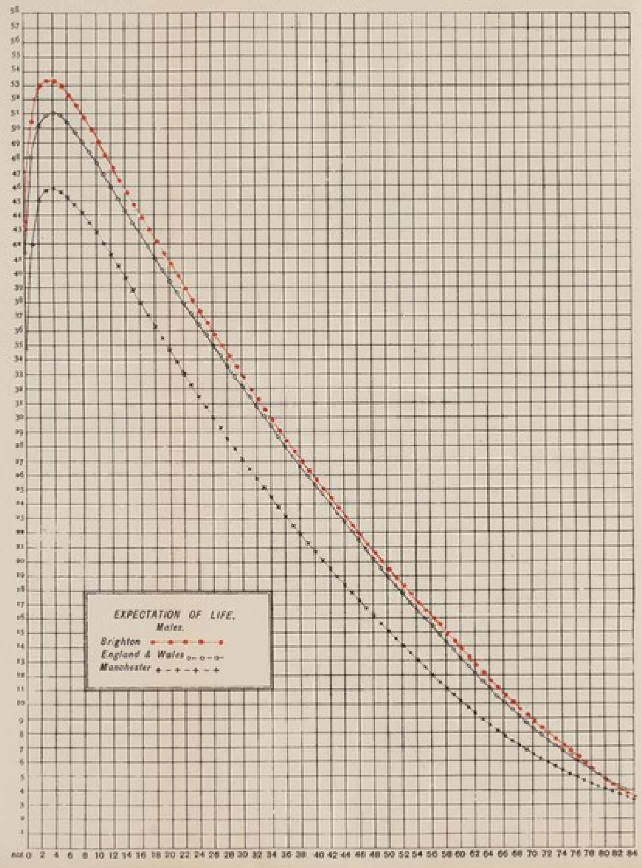
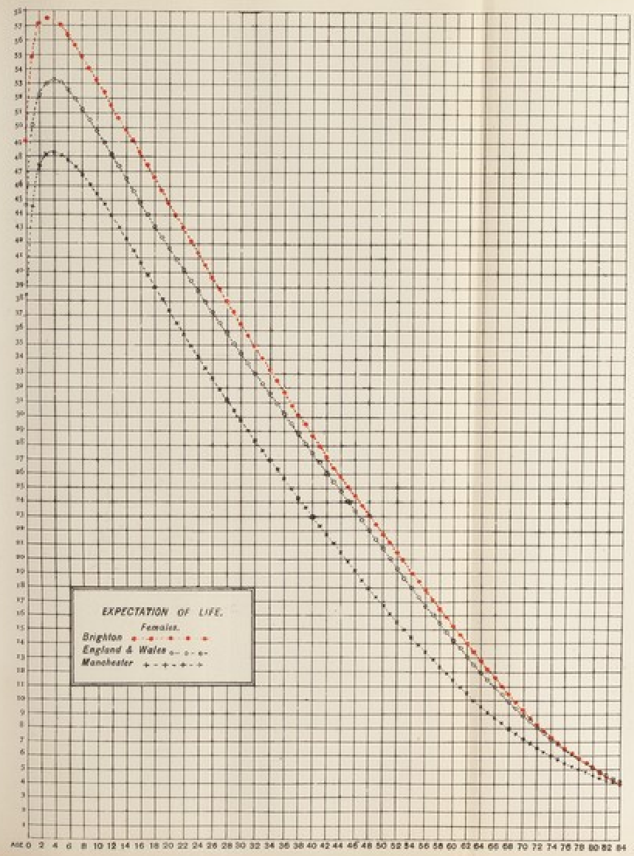


PLATE II.



THE BRIGHTON LIFE TABLE.

A.—Data.

Local death-rates are always interesting to those having at heart the welfare of the locality concerned. It has, however, been repeatedly shewn that these local death-rates are not absolutely accurate, as they do not take into account the varying constitution of populations as to the proportion of the two sexes and of persons at ages of greater or less mortality; and in many cases they do not include the deaths of inhabitants of the given locality who die in public institutions outside its borders.

Although the effect of varying age and sex constitution is confined within somewhat narrow limits, in an accurate statement of rates of mortality it must be eliminated, and this can be accomplished most perfectly by means of a Life Table. By means of such a Life Table for Brighton, we can completely eliminate the disturbing influence arising from the excessive number of old people who are stated on the one hand to unduly raise its death-rate; as also the opposite effect caused by an excessive proportion of females, especially at the ages of lowest mortality, and by a proportion of children under five below the average of that for the great towns.

A further advantage of a Life Table formed like the present from the figures as to life and death in Brighton during a period of ten years, is that the variations in mortality necessarily occurring in single years are counter-balanced, and a correct determination of the true chances of life is obtained, assuming that the vital conditions of the decade 1881-90 continue to hold good.

The results of a Life Table being such that they may be stated in the form of the "expectation of life," *i.e.*, the number of years which persons of a given age taken one with another will continue to live, their significance is greater and more easily understood than that of a mere statement of the number dying in a year out of a thousand persons of varying ages.

Data for a Life Table.—The data on which a Life Table is formed are the number and ages of the living and the number and ages of the dying. The ideal life table represents "a generation of individuals passing through time," and measures the probabilities of life and death of this generation at birth, and of the survivors at each successive age until the whole generation becomes extinct. Hence Dr. Farr calls a Life Table a *biometer*, and speaks of it as of equal importance, in all enquiries connected with human life or sanitary improvements, with the barometer or thermometer and similar instruments employed in physical research.

(a). In such an ideal life table, supposing 100,000 children to be born at the same moment, this number and the number surviving at each successive age would be entered in a column which is headed by the symbol l_x; where l_x represents the number who reach the precise age x.

In a second column, the number out of the 100,000 children starting life together who die before the completion of each year of life would be entered. Thus the number who die before reaching the first anniversary are placed opposite the age 0 in the table, and so on. In this way we obtain the column headed d_x; where d_x represents the number out of l_x persons attaining the precise age x, who die before reaching the age $x + 1$.

In practice it is not possible to observe a number of children through the different stages of life until the last has died, in the precise manner above indicated; and even were it practicable, the results obtained, although they would possess a historic value, would not give a trustworthy indication of the probabilities of life at the present time.

(b). It is not necessary, however, to assume as in the preceding case, that all the persons observed have been born at the same time. If we could trace any 100,000 children throughout life, however various might be the dates of their births, a Life Table might be similarly constructed, if the numbers living and dying during each year of life were known.

(c). We may go a step further, and state that it is not necessary for the construction of a trustworthy Life Table to trace the history of individual children. If we know the population at each year of age living in a district at the commencement of any year, and the number of deaths for each year of age during the whole of the corresponding year,—it being assumed that with the exception of those who die during the year, each member of the population lives throughout the entire year within the district under observation,—we have an example of a population at various ages from birth to the most advanced age, suffering from the mortality incident to these various ages during an actuarial unit of time, *i.e.*, a year; and this may be taken as comparable to the generation of persons traced through life, and subjected at each successive year to the mortality incident to that age until the whole generation became extinct.

The results founded on a single year's mortality experience, would as already indicated possess one great advantage over the results derived from

the observation of "a generation of individuals passing through time." They would be up to date and would therefore give a more accurate estimate of the present probabilities of life and death than the latter. They would, however, be open to objection because of paucity of data, and because they might represent an extreme value in a series of years of varying mortality. For this reason, in the present Life Table the results of ten years have been taken as the basis on which the probabilities of life and death have been calculated.

The population of the Parliamentary Borough of Brighton at the census of 1881 was 128,350; at the census of 1891 it was 141,970. The deaths occurring from January 1st, 1881, to December 31st, 1890, numbered 23,768, making the mean annual death-rate 17·65 per 1,000. Out of these data, which are set forth in detail in Table II., the Brighton Life Table has been constructed.

Degree of Trustworthiness of Data.—The migratory character of a large proportion of its population appears at first sight to throw doubt on the trustworthiness of the data forming the basis for a Life Table for Brighton. Assuming, however, that the age, sex and condition of health of 12,000 persons living in Brighton for a single month are identical with that of 1,000 persons living in Brighton for twelve months, the effect of the two groups of persons upon the death-rate, and therefore upon the probabilities of life as ascertained by a Life Table, would be identical. It is impossible to say that the migratory portion of the population of Brighton fulfils conditions which exactly balance in the manner just indicated. After a careful consideration of the problem founded on local knowledge and investigation, the conclusion at which I have arrived is that in the figures hereafter used for a Life Table, Brighton is handicapped by a considerable under-statement of population and a slight over-statement of the deaths occurring during the decade 1881-90. Let me explain these statements in further detail.

(a). Under-statement of Population. The census enumerations in 1881 and 1891 were early in the month of April. The population for each intervening year and the total population for the whole decade (see p. 12) are based on these enumerations. Now in April the population of Brighton is probably at its lowest or nearly its lowest ebb; its hotels and lodging-houses are comparatively empty; and the population of that month if accepted as the basis for calculation (as in this investigation) is so accepted in order to avoid any possible cavil under the next head.

(b). Over-statement of Deaths. The deaths of inhabitants of Brighton in outlying institutions, such as the Shoreham Workhouse and Hangleton Fever Hospital have been properly included in the death-returns for the decennium; but it has not been thought necessary to make an addition to the population equal (were it known) to the portion of the Brighton population living in these external institutions.

During the summer and autumn, Brighton has a much larger number of visitors than in the first four months of the year. Of these visitors a certain proportion die in the town; and in so far as these deaths occur among a larger population of visitors than is present in Brighton in the month of April, the death rate (which is based on an estimate of the population calculated from the April enumerations) is over-stated. The deaths of visitors ought to be included in the total number of deaths in Brighton; but if the population does not include an equally full proportionate number of visitors, the death-rate must to a corresponding extent be over-stated.

In addition to the deaths of visitors in excess of the enumerated population of visitors, it must be remembered that Brighton contains the Sussex County Hospital and the Alexandra Hospital for Children, which draw patients from the entire county, thus swelling the general death-rate.*

It has also been urged that Brighton being a health resort, the persons who visit and settle here are to a larger extent invalids with a poorer prospect of life than average persons of the same age. This probably operates among the poor to a greater extent than is commonly supposed; a large number of needy phthisical patients who die here have arrived within six or twelve months of their deaths. Among the rich, the effect of invalid immigration is to a large extent counteracted by the healthy servants and others who come with the invalids.†

(c). Possible under-statement of Deaths. A glance at Plate III., page 12 will shew how large an excess of females, especially at the ages 15-35, there is in the Brighton population, due to the large number of female servants, shop-assistants, &c., at these ages. Do the figures as to deaths among females at these ages give the total number of deaths occurring in the corresponding population? The majority of domestic servants are drawn from rural districts, and it is well-known that when servants fall ill, they are usually, if the illness is acute in character, sent into hospital, and if it is chronic to their homes. Thus the death-rate of rural districts at these ages is apt to be over-stated, and that of towns to be under-stated.

The comparison between Brighton and the whole of England in Table I. seems to shew traces of such disturbance. There is no reason to suppose that such transfer of moribund females occurs at the ages 5-10 and 10-15; but it is probable that at the ages 15-20, 20-25 and 25-35, a certain

* The extent to which the County Hospital receives patients from outside Brighton may be gathered from the figures for the three years 1890-92. In these three years 340 patients died in the County Hospital, of whom 61 came from rural districts and 8 from London, equal to 20·3 per cent. of the total deaths in this Institution.

† During 1892, systematic inquiries into the history of all patients dying of phthisis in Brighton were commenced. The returns for the first year are not complete; but they shew that at least 10 per cent. of the total deaths from phthisis were imported cases.

proportion (say 10 or 20 per cent.) of the percentage deficiency of the Brighton death-rate as compared with that of the whole country may be caused by this transfer of fragile lives aged 15-35 to rural districts. It is impracticable to introduce any correction for this possible error of data; but it is probable that the under-statement of population and the over-statement of deaths shewn to exist in other directions will counterbalance any possible error arising under the present head.

The objection has, however, considerable weight, and for this reason in drawing conclusions from the Brighton Life Table (page 17 *et seq.*) the male life table has been chiefly employed.

TABLE I.

Age.	Males.			Females.		
	Death-rate per 1000 Males in each group.		Excess or deficiency of Death-rate of Brighton over England per cent.	Death-rate per 1000 Females in each group.		Excess or deficiency of Death-rate of Brighton over England per cent.
	Brighton, 1881-90.	England, 1881-85.		Brighton, 1881-90.	England, 1881-85.	
0—	64·01	59·6	+ 7·4	52·59	50·5	+ 4·1
5—	4·83	5·8	—16·7	4·45	5·6	—20·5
10—	2·30	3·2	—28·1	2·53	3·3	—23·3
15—	4·13	4·6	—10·2	2·92	4·7	—37·8
20—	5·05	6·0	—15·8	3·44	5·9	—41·7
25—	7·72	8·2	— 5·8	5·42	7·9	—31·4
35—	12·94	12·7	+ 1·9	9·01	10·9	—17·3
45—	21·17	19·4	+ 9·1	14·44	15·2	— 5·0
55—	32·76	33·6	— 2·5	24·36	27·8	—12·3
65—	64·36	68·8	— 6·4	50·93	59·5	—14·4
75—	132·29	144·6	— 8·5	121·92	129·4	— 5·8
85 and upwards	293·80	296·4	— 1·1	266·40	267·8	— 0·7

B.—Method of Construction of a Life Table.

Method of ascertaining Population and Deaths for each Year of Age.—In the construction of a Life Table it is necessary to ascertain the death rate holding good for each year of life in the two sexes. For this purpose we must have an accurate statement of

(1) The population for each year of age; and

(2) The number of deaths occurring during the corresponding year.

These data are not supplied in full for each year either for population or deaths, and we must now discuss the means for interpolating the correct figures for each year of life from the figures furnished in Table II.

TABLE II.

Age.	Population of the Parliamentary Borough of Brighton. Census, 1881. Males.	Census, 1881. Females.	Census, 1891. Males.	Census, 1891. Females.	Deaths in the Parliamentary Borough of Brighton. 1881-90. Males.	1881-90. Females.	Age.
0—	7233	7374	7046	7051	4569	3800	0—
5—	6653	6435	7137	7169	333	301	5—
10—	6158	6473	6829	7300	149	174	10—
15—	5258	8069	5882	8600	229	243	15—
20—	5158	8023	4967	9038	256	292	20—
25—	8471	12291	9142	13894	678	709	25—
35—	6260	8889	7308	10411	872	866	35—
45—	4557	6698	5335	7755	1040	1034	45—
55—	3174	4819	3574	5443	1104	1243	55—
65—	1645	2807	2254	3451	1235	1577	65—
75—	663	1041	778	1291	945	1416	75—
85—	76	118	85	221	261	413	85—
95—	3	4	4	5	7	22	95—
Total All Ages	55309	73041	60341	81629	11678	12090	Total All ages
	128350		141970				

(*a*) *To ascertain the total number of lives at risk at each group of ages during the decade 1881-90.*—We must first ascertain the central population in each group by adjusting the figures in Table II. to June 30th.

The formula is $Q = P\ R^{\frac{1}{4}}$ where Q = central population required; P = census population; and R = population resulting per unit per annum. R is first found from the formula $Q = P\ R^{10}$ *

*Value of R for each Age Period.

Age.	Males.	Value of R for each age period.	Females.	Value of R for each age period.	Age.
0–	$7{,}046 = 7{,}233\ R^{10}$	·99738	$7{,}051 = 7{,}374\ R^{10}$	·99553	0–
5–	$7{,}137 = 6{,}653\ R^{10}$	1·00705	$7{,}169 = 6{,}435\ R^{10}$	1·0109	5–
10–	$6{,}829 = 6{,}158\ R^{10}$	1·01040	$7{,}300 = 6{,}473\ R^{10}$	1·0121	10–
15–	$5{,}882 = 5{,}258\ R^{10}$	1·01128	$8{,}600 = 8{,}069\ R^{10}$	1·0064	15–
20–	$4{,}967 = 5{,}158\ R^{10}$	·99623	$9{,}038 = 8{,}023\ R^{10}$	1·0120	20–
25–	$9{,}142 = 8{,}471\ R^{10}$	1·00765	$13{,}894 = 12{,}291\ R^{10}$	1·0123	25–
35–	$7{,}308 = 6{,}260\ R^{10}$	1·01560	$10{,}411 = 8{,}889\ R^{10}$	1·0159	35–
45–	$5{,}335 = 4{,}557\ R^{10}$	1·01590	$7{,}755 = 6{,}698\ R^{10}$	1·0148	45–
55–	$3{,}574 = 3{,}174\ R^{10}$	1·12600	$5{,}443 = 4{,}819\ R^{10}$	1·0123	55–
65–	$2{,}254 = 1{,}645\ R^{10}$	1·03200	$3{,}451 = 2{,}807\ R^{10}$	1·0209	65–
75–	$778 = 663\ R^{10}$	1·01610	$1{,}291 = 1{,}041\ R^{10}$	1·0217	75–
85–	$89 = 79\ R^{10}$	1·01200	$226 = 122\ R^{10}$	1·0636	85–

Next we find Q the central population from $Q = P\ R^{\frac{1}{4}}$ where P is the census population and R is given in the table in the footnote on page 10. Thus:

$$Q = 7233\ (\cdot 99738)^{\frac{1}{4}}$$
$$\log.\ 7233 = 3\cdot 859318$$
$$\tfrac{1}{4}\log.\ \cdot 99738 = \bar{1}\cdot 999716$$
$$\log.\ Q = 3\cdot 859034$$
$$\therefore Q = 7228 = \text{central male population, 1881, aged 0-5.}$$

The central populations for each census year thus obtained are as follows:—

TABLE III.

Age.	1881. Males.	1881. Females.	1891. Males.	1891. Females.	Age.
0—	7228	7366	7041	7043	0—
5—	6665	6452	7150	7188	5—
10—	6174	6492	6847	7322	10—
15—	5273	8082	5898	8613	15—
20—	5153	8047	4962	9065	20—
25—	8487	12328	9159	13936	25—
35—	6284	8924	7336	10452	35—
45—	4575	6724	5356	7783	45—
55—	3184	4834	3585	5459	55—
65—	1658	2822	2272	3469	65—
75—	666	1046	781	1298	75—
85—	79	124	89	229	85—

Having now ascertained the central population for the two census years 1881 and 1891, we proceed to ascertain the total population for the ten years 1881-90, *i.e.*, the total number of lives subjected to a year's risk of death during this period.

The method by which the value of R has been calculated for each age period is sufficiently indicated in the table (footnote, page 10). In calculating the total population for the years 1881-90, the following method has been adopted. Employing the notation already explained, the population for each year of the decade would be denoted by P, PR, PR^2, &c. . . . . PR^9. These amounts give the terms of a geometric series, of which the first term is P and common ratio is R. Hence the total population for the decade is the sum of this series, $P + PR + PR^2 + \&c. + PR^9$, the usual formula for which gives a sum to ten terms $= P\,\frac{R^{10}-1}{R-1} = \frac{PR^{10}-P}{R-1} = \frac{\text{Population, 1891} - \text{population, 1881}}{\text{annual increase per unit}}$

The tables already given supply us with the central population for each census year. Thus in the third age period the male population for 1891 = 6847, and for 1881 it is 6174. The difference is 673. Also for that period R = 1·0104.

Therefore total population $= \frac{673}{\cdot 0104} = 64712$. A similar calculation gives us the results contained in Table IV. for the other age periods.

It is plain that when R is less than unity, the population for 1891 will be less than that for 1881, so that numerator and denominator of the above fraction will always have the same sign.

TABLE IV.

TOTAL NUMBER OF LIVES AT RISK IN THE TEN YEARS 1881–90, AND TOTAL NUMBER OF DEATHS DURING THE SAME PERIOD.

Age.	Number of Lives at Risk.		Deaths.		Mean Annual Death-Rate for each life at risk.	
	Male.	Female.	Male.	Female.	Male.	Female.
0 –	71,374	72,259	4,569	3,800	·06401	·05259
5 –	69,236	67,524	333	301	·00483	·00445
10 –	64,712	68,595	149	174	·00230	·00253
15 –	55,408	82,969	229	243	·00413	·00292
20 –	50,663	84,833	256	292	·00505	·00344
25 –	87,843	130,732	678	709	·00772	·00542
35 –	67,436	96,101	872	866	·01294	·00901
45 –	49,119	71,568	1,040	1,034	·02117	·01444
55 –	33,698	51,020	1,104	1,243	·03276	·02436
65 –	19,187	30,957	1,235	1,577	·06436	·05093
75 –	7,143	11,613	945	1,416	·13229	·12192
85 –	878	1,589	261	413	·29726	·25991
95 –	34	44	7	22	·20588	·50000
Total	576,731	769,803	11,678	12,090	·02024	·01575

NOTE.—The ages are read thus: 0 and under 5, 5 and under 10, 10 and under 15, &c.

(*b*) Having now obtained a statement of the *total number of lives at risk* in quinquennial and decennial groups of ages, the process by which the corresponding numbers *for individual years of life* have been obtained, must be examined. This has been done by an adaptation of the graphic method,

PLATE III. POPULATION—MALES.

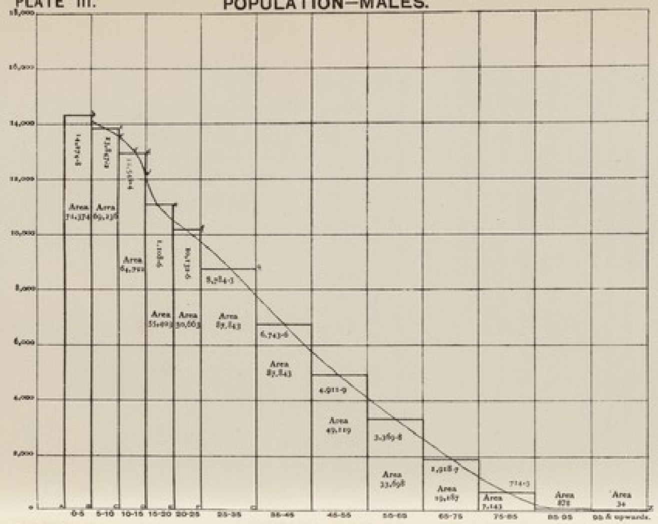
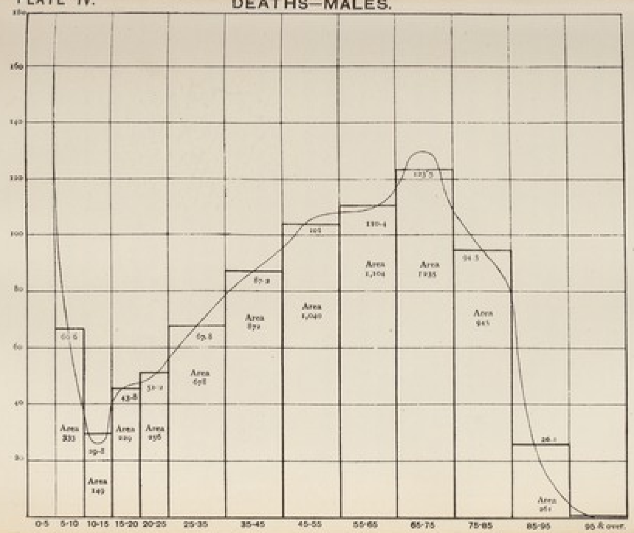


PLATE IV. DEATHS—MALES.



as described in a paper by Mr. George King, F.I.A., in the Journal of the Institute of Actuaries, No. cxxxi. (Oct., 1883), "On the Method used by Milne in the Construction of the Carlisle Table of Mortality." In this paper Mr. King cleared up the mystery which had hung over the method pursued by Milne in the construction of the Carlisle Life Table, and shewed that the method pursued was a graphical one identical with that here adopted for Brighton.

The method may be briefly described as follows: Along the abscissa line AZ (Plate III.) mark off five equal portions, each to represent five years, for the first five quinquennial intervals of age; and let eight other equal portions, each of double length to represent ten years, succeed them for the subsequent decennial intervals of age.*

At each of the points, A and B, erect perpendiculars to AZ, and make the perpendicular lines of such a height, in accordance with the marginal scale previously decided upon, that the parallelogram A*b* shall equal in dimensions the population living aged 0-5. Thus in the diagram, B*b* = 14274·8, and this when multiplied by 5, the number of years included between A and B, = 71374. Similarly C*c* = 13847·2, and this when multiplied by 5, gives 69236 as the area of B*c*. In the later groups, 10 years are taken. Thus G*g* = 8784·3, the area of F*g* being 87843. Having thus plotted out the populations living at various groups of ages, the number living at each single year of life is obtained as follows:—

A curved line is described through the parallelograms already drawn, sweeping as easily as possible through the upper part of these parallelograms from *A* to *Z*. This curved line (1) must be as little curved as other conditions will admit of. (2) It must never change its direction abruptly so as to form an angle in its path. (3) The curved line thus described must so cut each of the parallelograms that the area included between the base line below, the corresponding portion of the two ordinates laterally, and the portion of the curved line above, shall equal the area of the parallelogram erected on the same base. Thus the area of the parallelogram C*d* = the area of C*c'd'e'*D. In other words the area cut off is exactly equal to the area added.

If now the distances AB, BC, CD, DE, &c., along the abscissa line be divided into equal portions representing one year each, then vertical lines drawn *from the centre of each of these spaces* will give the central population for each year of age.

* Plates III.-VI. have been reduced from the original diagrams, which were constructed on Layton's actuarial paper. This is sub-divided into accurately ruled small squares, thus enabling correct measurement to be made of the perpendiculars representing the number living or the number of deaths at the centre of each year.

The accuracy of the curve is confirmed by ascertaining that the sum of the ordinates drawn from the base line within each space to the curved line bounding the space above is equal to the area of the parallelogram drawn on the same base. Thus in Plate III., $Cd = 64712 =$ the sum of the five ordinates, $13420 + 13220 + 13000 + 12710 + 12372$.*

The accuracy of this method has been demonstrated and illustrated by Mr. George King in the paper already mentioned and in a more recent communication to the Institute of Actuaries on Family Annuities (Journal of the Institute of Actuaries, Vol. XXX., p. 291). The tracing of the curves being effected by a purely graphical process, different draughtsmen may arrive at slightly divergent results. It is, however, impossible that any material discrepancy can thus arise if due care is exercised and if the rules set forth above are rigidly adhered to.

Having described in full the method by which the central population for each year of age is ascertained, it is not necessary to describe the same process for the deaths occurring at groups of ages. A study of Plates III.-VI. and of the description already given will render the method easily intelligible.

The results obtained are set forth in detail in Tables 1 and 2 in the appendix.

Population aged 0-5. The graphic method just described gives accurate results for the greater part of life. The first five years of life, however, give special difficulty whatever method of calculating the central population of each of these years is adopted. This is inseparable from the defective character of the data for these years, the ages of young children being often inaccurately stated in the census returns. Hence, although the number of children at each year of age under 5 can be ascertained from the census returns, these numbers are untrustworthy. The total number aged 0-5 may be accepted as accurate, but the distribution of this total at each age under 5 must be found by an independent method.

The method adopted is based on the births during the decennium. The population under one year of age in any year may be taken as equal to the births from July 1st to December 31st of the preceding year *plus* the births from January 1st to June 30th in the same year, and *minus* the deaths under one year of age during the same year. Similarly the population under one year of age for the ten years 1881-90 may be taken to be equal to the total births 1880½–1889½, *i.e.*, from July 1st, 1880, to June 30th, 1890, *minus* the number of deaths under one year of age in the ten years, 1881-90.

* It is not essential that in every case the sum of the ordinates shall exactly equal the area of the corresponding parallelogram. Occasionally it may be necessary to compensate for excess or deficiency in the neighbouring part of the curve. This is only exceptionally required in order to obtain a good curve.

PLATE III. POPULATION—MALES.

PLATE V. POPULATION—FEMALES.

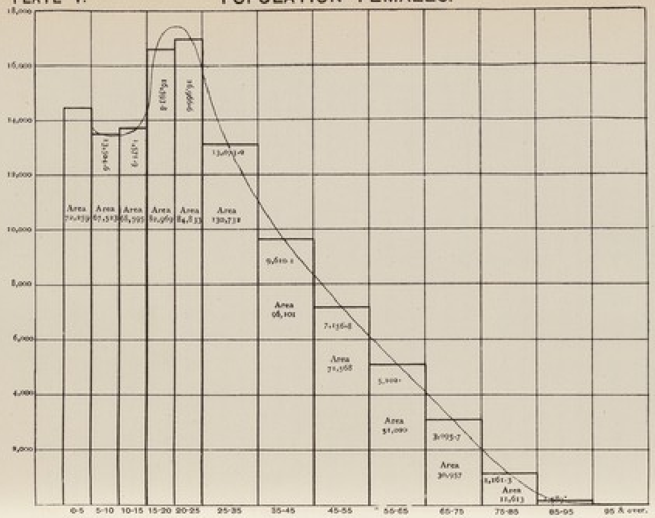
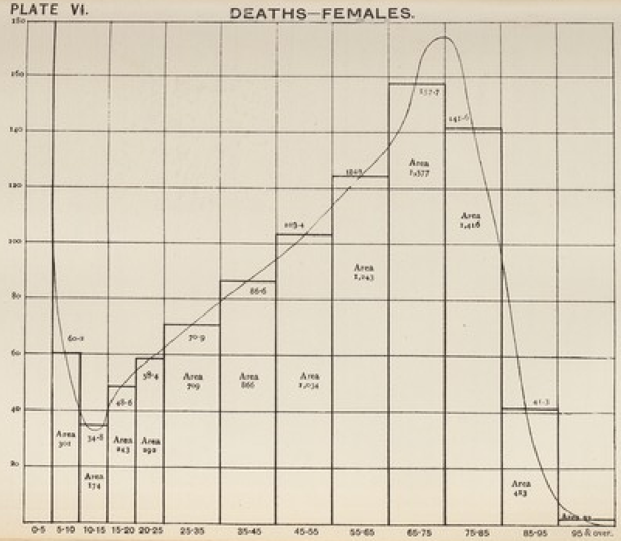


PLATE VI. DEATHS—FEMALES.



Thus having ascertained the total male births from July 1st, 1880, to June 30th, 1890, and subtracting from the result the total number of deaths of males under one year of age in the ten years 1881-90, we obtain the population out of which the deaths at the age 1-2 occur during the same period. Subtracting the deaths at the age 1-2 we obtain the number out of which the deaths at the age 2-3 occur; subtracting these we obtain the population out of which the deaths at the age 3-4 occur; and subtracting these we obtain the population out of which the deaths 4-5 occur.

The sum of the five amounts thus obtained gives 76627, which is the aggregate population at the commencement of the first five years of life. But when estimated from the census returns it is 71424, the difference being accounted for by migration. Hence these five amounts must each be reduced in the proportion of $\frac{71424}{76627}$.

Having obtained by this means the corrected population at the beginning of each of the first five years of life, we next proceed to obtain the *mean population*, which for each of these years except the first may be taken as the geometrical mean between the population at the beginning of the year (l_x) and at its end (l_{x+1}). In other words the logarithms of the population at the beginning and end of the year are in arithmetical progression. The mean populations thus ascertained are given in Table 1 (Appendix).

The sum of the mean populations for the four years 1-5 is 54,121, and this subtracted from 71,374 gives 17,253 as the mean population of the first year of life.

Construction of the Life Table.—The number of lives at risk at the centre of each year of life and the number of deaths in the corresponding years of life being now known, we obtain by division m_x = the rate of mortality per unit of population, better known to actuaries as the *central death-rate*, because it represents the rate at which people are dying in the *centre* of a given year.

From the m_x column, the probability that a person at each age will survive one full year (p_x) can be obtained.

The probability of living through one year $= \frac{\text{number of survivors at end of year}}{\text{number living at beginning of year}}$;

and by a simple algebraical method it can be shewn (page 227, *Elements of Vital Statistics*), that

$$p_x = \frac{2 - m_x}{2 + m_x}$$

The p_x column calculated from m_x for each age is given in Table 5 (Appendix) separately for the two sexes.

We can now build up the Life Table step by step. It is usual to start with 100,000 children at birth. In Brighton during the ten years 1881-90, the births of male and female children were in the proportion of 51,195 to 48,805, making 100,000 of both sexes. The numbers 51,195 and 48,805 are, therefore, taken as the number at age 0 in the l_x column of Tables 3 and 4 (Appendix).

Starting with 51,195 male infants at birth, the number living at the end of one year is obtained by multiplying this number by the probability of surviving to the end of the first year.

$$\text{Thus } 51{,}195 \times {\cdot}84608 = 43{,}315$$
$$43{,}315 \times {\cdot}93392 = 40{,}452, \text{ and so on.}$$

In order to obtain the mean expectation of life for each individual it will evidently be necessary to ascertain the total number of years lived by the individuals under consideration and divide the sum by the number of individuals living this total number of years. The l_x column in Tables 3 and 4, gives the necessary data for this calculation.

Thus the 43,315 males surviving to the end of the first year of life out of 51,195 born will have each lived a complete year in the first year, or among them 43,315 years. Similarly 40,452 males will live another complete year each in the second year, or among them a further 40,452 complete years; similarly 39,456 complete years of life will be lived in the third year; 38,723 in the fourth year, and so on, until the males started with become extinct at the age of 105.

It is evident, therefore, that the total number of complete years lived by the 51,195 males started with at birth will be 43,315 + 40,452 + 39,456 + 38,723 + ... 1 = 2,206,174 years. As this number of years is lived by 51,195 males, the number of complete years lived by each male $= \frac{2{,}206{,}174}{51{,}195} = 43{\cdot}09$ years.

This result is known as the *curtate expectation of life.*

We have, in the above remarks, confined our attention to the complete years of life, and have not taken into account that portion of lifetime lived by each person in the year of his death. In some instances this may only be a few days, in others nearly an entire year; but it may be assumed with a fair degree of accuracy, taking one person with another, that the duration of life in the year of death will be half-a-year.

If we add this half-year to the curtate expectation of life, the *Complete Expectation of Life* is obtained.

Thus, the Complete Expectation for males at birth $= 43{\cdot}09 + {\cdot}5 = 43{\cdot}59$ years; at the age of 10 years $= 48{\cdot}62 + {\cdot}5 = 49{\cdot}12$ years.

In Tables 3 and 4 (Appendix) only the complete expectation of life is printed.

We may note here that the term *mean duration of life* is sometimes used as synonymous with expectation of life (or mean after-lifetime), instead of signifying, as it strictly should, the present age in years *plus* the expectation of life. At birth the two terms are necessarily synonymous. At the age of 40, the expectation of life for males is 25·60 years; the mean duration of life for males of this age $= 40 + 25{\cdot}60 = 65{\cdot}60$ years.

Table 5 (Appendix) is added, in order to enable a comparison to be made of the number of survivors out of 100,000 infants born of each sex at each subsequent age. It has been calculated from the l_x column in Tables 3 and 4 (Appendix).

C.—Deductions from the Brighton Life Table.

Having stated the data on which the Brighton Life Table is based and described the method of its construction, we are in a position to study the life-history of the persons living in Brighton during the decennium 1881-90, on the assumption which the Life Table makes, that they were subjected throughout the whole of their lives to the conditions existing during those ten years.

The three essential points required for such a study will be found in the tables in the appendix, and in the curves which express the same numerical results in a graphic and more easily apprehended manner.

These three points are:

(a) The *mortality per unit of population* (m_x) *or the probability of living one year* (p_x) for each year of life in the two sexes separately. These two functions are closely connected by the formula $p_x = \frac{2 - m_x}{2 + m_x}$ and it has therefore only been considered necessary to print the p_x column in Table 5 (Appendix), with its corresponding curves for the two sexes at each year of age (Plate VII. and VIII.).

Thus at birth the probability of a male child living one year is $\frac{84608}{100{,}000}$ (the certainty of surviving to the end of the first year of life being taken as unity), and therefore the probability of his dying during the year is $\frac{100{,}000 - 84608}{100{,}000} = \frac{15392}{100{,}000}$. At 25 the probability of a male living one year is $\frac{99403}{100{,}000}$, and the probability of his dying during the year $\frac{597}{100{,}000}$ and so on.

(b) The *number of survivors out of 100,000 children born* of each sex, at each succeeding year of life, until the whole number becomes extinct by death.

Table 5 (Appendix) starts with 100,000 boys and 100,000 girls assumed to be born at the same time, and shews how many survivors there would be at the end of each successive year of life, with the death-rates of 1881-90. Thus of 100,000 males born 66979 are still alive at the end of 30 years from birth; and of 100,000 females born 71750 survive to the same age.

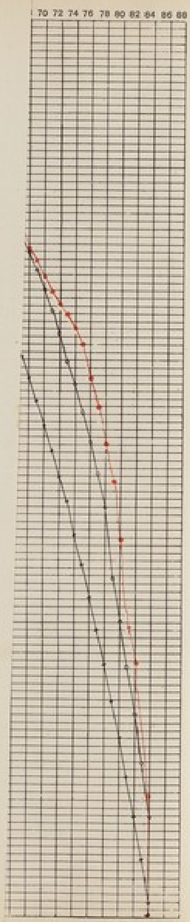
(c) The mean after-lifetime, or expectation of life, of males and females at the end of each year of life.

In the last column of Tables 3 and 4 (Appendix) is given the mean expectation of life of males and females at the end of each year of life. Thus for males having just completed their 25th year the mean after-lifetime is 36·51 years, for females of the same age it is 40·48 years.

For any one year of life the first of these *(a)* offers the best test of vitality. The two last—*(b)* and *(c)*—are dependent to some extent on events during preceding and subsequent years of life. Thus in Brighton the number of male survivors out of 100,000 born is greater at each year of age than in England and Wales and still greater than in Manchester. This might, however, be possibly caused by conditions peculiarly favourable to the life of children, which carried over an excess of survivors to older ages, more than sufficient to counterbalance the tendency of any suppositious injurious influences acting upon adults. We know, however, that in fact no such peculiarly favourable or unfavourable forces operate in Brighton. The curves in Plate IX. run smoothly throughout; but the possibility of the operation of such a disturbing element has to be remembered.

Similarly the expectation of life at any age, being determined by the total number of years of life lived by the persons surviving beyond the given age, might be raised by an exceptionally low mortality at one group of ages, sufficient to more than counterbalance a high mortality at another group of ages. It is evident therefore that although the number of survivors at any given age and the expectation of life at that age are most valuable tests of vitality, they are influenced by the vital conditions of other years of life, unlike the death-rate or the probability of life for a single year. The best plan is to take all three tests into account in instituting comparisons.

No previous Life Table having been constructed for Brighton, it is impossible to contrast the local vital conditions of 1881-90 with those of any preceding decennium. The value of the present Life Table will be greatly enhanced when ten years hence it becomes practicable by constructing another Life Table to ascertain, by the only strictly accurate method, the probabilities and mean duration of life of the population of Brighton during another decennium and contrast them with those of 1881-90. By this means an


70 72 74 76 78 80 82 84 86 88


AGE
2 4 6 8 10 12 14 16
PRO
Brigh
Engl
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PLATE VII.

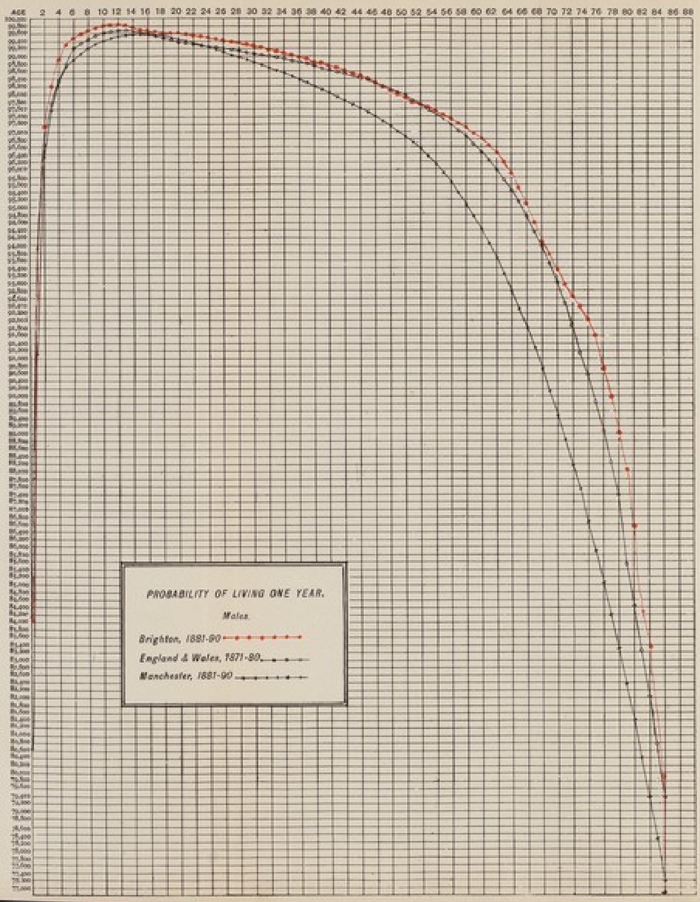
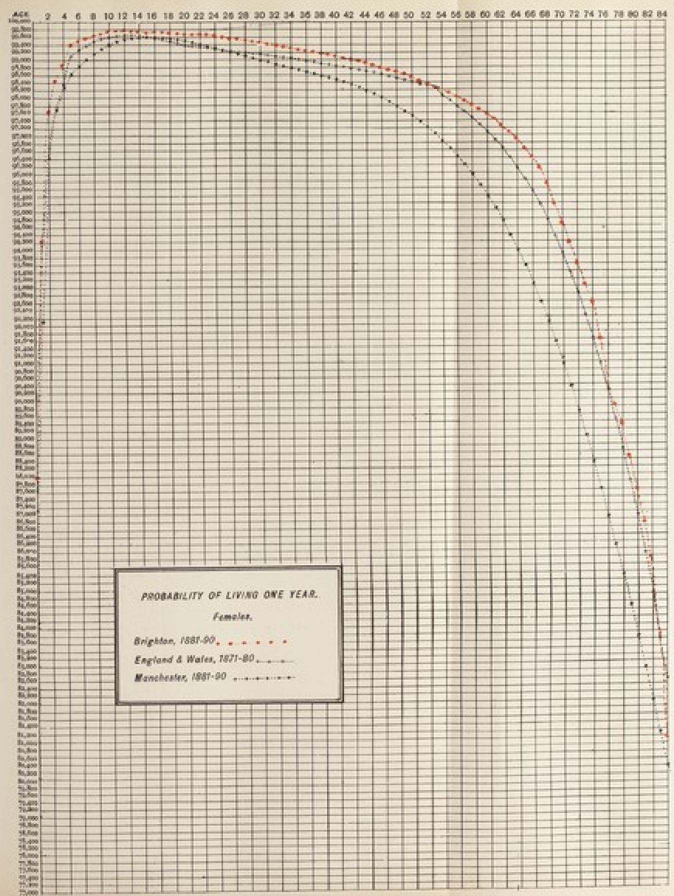


PLATE VIII.



exact gauge of the years of life saved by sanitary and other improvements will be obtained.

Such a comparison being at present impossible, we must fall back upon a comparison between the Brighton and other Life Tables. The most recent Life Table for the whole of England and Wales is that for the decennium 1871-80, prepared by Dr. Ogle, the corresponding Life Table for 1881-90 not being yet published. Dr. Ogle's Life Table is therefore used here for comparison with Brighton. Fortunately there is also available for comparison a local Life Table for 1881-90. This is for the City of Manchester, having been prepared by Dr. Tatham, the Medical Officer of Health of that city. Free use is made of this Life Table for purposes of comparison; and the comparison is interesting as shewing the immense difference in the expectation of life in a large and crowded manufacturing centre and in a seaside health resort.*

Comparison of Probability of Life at each Age.—Plate VII. shews that the probabilities of life among males are at most ages greater in Brighton than in England and Wales, the ages 44–53 forming an exception to this rule. Among females the result, as shewn in Plate VIII., is somewhat similar, the probability of life being higher in Brighton than in England and Wales at all ages except 52–54.

Comparison of Number of Survivors at each Year of Age.—It will be seen from Table 5 (Appendix), and graphically in Plate IX., that the number of both male and female survivors out of 100,000 born is greater in Brighton than in England and Wales, and still greater than in Manchester, for practically every year of age until the whole number becomes extinct. The number of survivors among females is greater at each age than among males; but the number of female survivors in Manchester is smaller than the corresponding number of male survivors in England and Wales, and still smaller than the corresponding number of male survivors in Brighton.

The results of the tables in the appendix are summarised in the following tables. It will be seen that in Brighton out of 100,000 male children born, 9,628 more survive to the end of their twenty-fifth year than in Manchester, and 3,565 more than in England and Wales. The period from 25 to 65 years of age embraces the years in which the largest proportion of the work of life is done; it is interesting to note, therefore, that in Brighton

* Dr. Tatham's valuable Life Table is constructed (like the English Life Table) by the analytical method; the Brighton Life Table by the graphic method. This does not however, invalidate the comparison between them.

out of 100,000 males born, 14,388 more reach the age of 65 than in Manchester and 2,739 more than in England and Wales. This larger number of survivors to the higher ages out of a given number born implies a corresponding increase in the number of years of working life, and forms a sufficient answer to those who assert that the main decrease of mortality in recent years having been in the early years of life, is of doubtful good to the community.

Table V.

Excess of Survivors in Brighton at each Age out of 100,000 Born as Compared with Manchester and with England and Wales.

Age.	Excess of Survivors out of 100,000 Male Children Born, as compared with		Excess of Survivors out of 100,000 Female Children Born as compared with	
	Manchester, 1881-90.	England and Wales, 1871-80.	Manchester, 1881-90.	England and Wales, 1871-80.
5	7,229	1,718	6,754	2,284
15	9,425	2,859	9,225	3,343
25	9,628	3,565	10,170	4,984
45	12,511	3,938	14,283	7,458
65	14,388	2,739	18,704	7,114
85	2,826	552	4,817	1,706

This table may be read as follows: Out of 100,000 male children born, 7229 or 7·23 per cent. more reach the age of 5 years than in Manchester, and 1718 or 1·72 per cent. more than in England and Wales. Similarly 12·51 per cent. more male children reach the age of 45 years than in Manchester, and 3·94 per cent. more than in England and Wales.

Comparison of Expectations of Life at each Year of Age.—The following tabular statement giving the expectation of life at the end of each five years of life, and Plates I. and II. page 5, giving the expectation of life for each single year of life, shew that in Brighton the expectation of life at birth for males was 43·59 years as compared with 34·71 years in Manchester and 41·35 years in England and Wales. In other words it was 20·4 per cent. higher than in Manchester and 5·1 per cent. higher than in England and Wales. Similarly for females the expectation of life at birth in Brighton was 49·00 years as compared with 38·44 years in Manchester, and 44·62 years in England and Wales, an excess in favour of Brighton of 21·5 and 8·9 per cent. respectively.

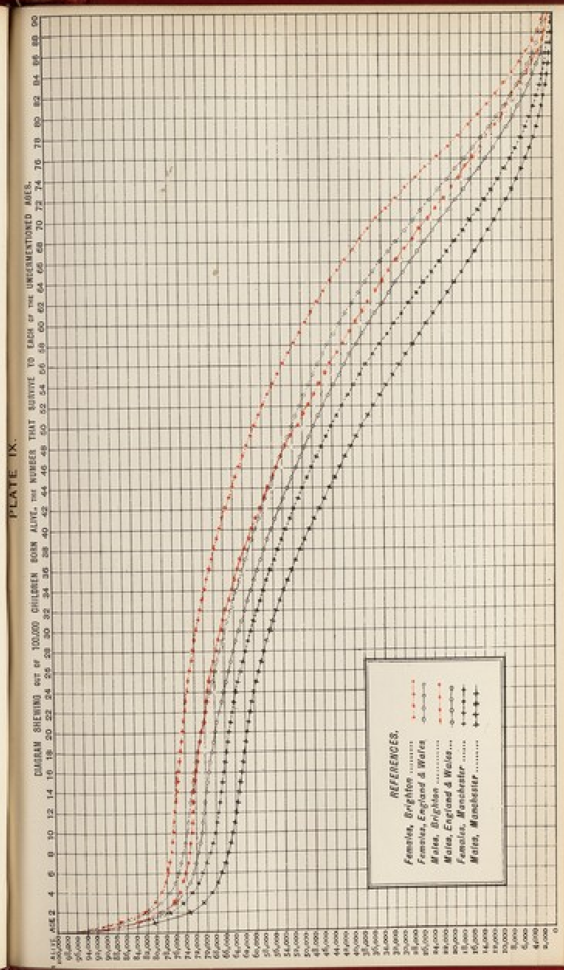


TABLE VI.

Expectation of Life at Various Ages.

Ages.	Males.			Females.		
	Brighton, 1881-90.	Manchester, 1881-90.	England and Wales, 1871-80.	Brighton, 1881-90.	Manchester, 1881-90.	England and Wales, 1871-80.
0	43·59	34·71	41·35	49·00	38·44	44·62
5	52·87	45·59	50·87	56·92	48·06	53·08
10	49·12	42·75	47·60	53·15	45·43	49·76
15	44·67	38·78	43·41	49·07	41·50	45·63
20	40·55	34·62	39·40	44·76	37·33	41·66
25	36·51	30·69	35·68	40·48	33·38	37·98
30	32·67	27·08	32·10	36·39	29·73	34·41
35	29·02	23·76	28·64	32·48	26·30	30·90
40	25·60	20·68	25·30	28·71	22·99	27·46
45	22·36	17·80	22·07	25·07	19·79	24·06
50	19·33	15·06	18·93	21·79	16·74	20·68
55	16·48	12·49	15·95	18·48	13·91	17·33
60	13·67	10·16	13·14	15·26	11·35	14·24
65	10·96	8·15	10·55	12·19	9·11	11·42
70	8·69	6·48	8·27	9·32	7·25	8·95
75	6·64	5·11	6·34	6·97	5·76	6·87
85	3·33	3·16	3·56	3·72	3·76	3·88

We prefer, however, more particularly to compare the expectation of life at the ages of five and upwards, as the data on which the expectation of life at birth and from birth to the age of five years are calculated are not so trustworthy as those for later years. This point has been already discussed (page 14), and it is sufficient to add here that the population data for the first five years of life (owing largely to confusion in the statement of age) are not very trustworthy; that the same causes operate in a minor degree in the registration of deaths under five years of age; and that, although the figures as to the total number living and the total number dying under five years of age may be considered accurate, the exact distribution of these is somewhat dubious.

After the fifth year of age there is greater accuracy in the statement of ages; and the figures, at least for males, may be accepted as approximately correct. The expectation of life being based on the *subsequent* years of life will not be affected by possible inaccuracies preceding the age under consideration.

Table VI. and Plate I. shew that among males the expectation of life is considerably greater at all ages in Brighton than in Manchester. At the age of 5 the excess is $7\frac{1}{4}$ years, at the age of ten it is nearly $6\frac{1}{2}$ years, at the age of 20 it remains about 6 years, while at 40 it is 5 years, and at 60 between 3 and 4 years. Compared with England and Wales, the expectation of life among males is just two years greater in Brighton at the age of 5, at the age of 10 about 1½ years, at the age of 20 over one year, at the age of 40 over one-third of a year, and at the age of 60 half a year greater in Brighton.

These satisfactory results may be expressed in another way, as in Table VII.

TABLE VII.

The Proportion of the Expectation of Life at various Age Periods in Brighton to that of Manchester and of England and Wales.

Mean After-lifetime (Expectation of Life) in Manchester (1881-90) and England and Wales (1871-80), Brighton (1881-90) being taken as 100.

Age.	Manchester, 1881-90.		England and Wales, 1871-80.	
	Males.	Females.	Males.	Females.
0	79	78	95	91
5	86	84	96	93
15	87	85	97	93
25	84	82	98	94
45	79	79	98	96
65	74	75	96	94
85	95	101	107	104

Taking the expectation of life in Brighton as 100, then among males at birth it is 79 in Manchester and 95 in England. At the age of 5, it is 100 in Brighton, 86 in Manchester, 96 in England and so on. The male expectation of life remains higher in Brighton than in England, until the age of 77 is reached, when the two are identical, as may be seen by glancing at Plate I.

Share of each Age Period in the Gain of Life.—It has been already shewn that the improved prospects of survivorship at the earlier ages of life imply for the community an increase of the number of years of life during the working period of life. This point must now be more exactly established. Mr. Noel Humphreys* classifying the years of life lived, into those lived 0 – 20, 20 – 60, and 60 and upwards, shewed that by far the larger proportion of the increased duration of life is lived at useful ages (20-60), and not at the dependent ages of childhood or old age. Dr. Tatham in the Manchester Life Table has

* Journal of the Royal Statistical Society. June, 1883.

extended this inquiry, and his classification of age-groups is adopted in Tables VIII. and IX., with a slight modification.

Table VIII. shews the number of years out of the total number of complete years of life, lived during each age-period.

TABLE VIII.

Years Lived out of the Total Mean Lifetime during each Age-period.

Age.	Males.			Females.		
	Brighton.	England and Wales.		Brighton.	England and Wales.	
	1881-90.	1838-54.	1871-80.	1881-90.	1838-54.	1871-80.
0–15	11·21	10·72	10·96	11·62	11·12	11·38
15–25	7·05	6·48	6·76	7·48	6·70	7·02
25–45	12·60	11·18	11·36	13·78	11·51	11·89
45–65	8·85	7·99	8·50	10·61	8·45	9·51
65 & upwards	3·38	3·04	3·27	5·01	3·57	4·32
All Ages	43·09	39·41	40·85	48·50	41·35	44·12

It may be noted in passing that, for the sake of convenience, the curtate expectation of life (less than the complete expectation by half-a-year) is the total lifetime given in the last line of the preceding table; and the number of years in each of the age-periods is the share of this lifetime lived during that age-period. Thus (see Table 3 Appendix) the years of life lived on the average by each male between the ages of 25 and 45 $= \frac{1,271,083 - 625,961}{51,195} = 12{\cdot}60$ years, and so on.

The table may also be read thus: According to the Brighton experience 100 males live in the aggregate 4,309 complete years of life, of which 1,121 years are lived at ages under 15, 705 at ages 15–25, 1,260 at ages 25–45, 885 at ages 45–65, and 338 at ages 65 and over; and so on.

It is evident, therefore, that 100 males will live in the aggregate 228 more years in Brighton at ages 25–65 according to the experience of 1881–90, than during the same period of life according to the experience of England in 1838–54, and 159 more years than during the same period of life according to the experience of England in 1871–80.

The years lived in each age-period may be stated as a percentage of the total expectation of life, as in the following table. It will be noted, however, that this method will not indicate the fact that the total expectation of life on which the percentage is formed is greater in Brighton than in the others.

TABLE IX.

PERCENTAGE OF TOTAL LIFETIME LIVED IN EACH AGE PERIOD.

Age.	Males.			
	Brighton.	Manchester.	England and Wales.	
	1881-90.	1881-90.	1838-54.	1871-80.
0–15	26·0	29·5	27·2	26·9
15–25	16·4	17·7	16·5	16·5
25–65	49·7	48·6	48·6	48·6
65 and upwards	7·9	4·2	7·7	8·0
	100·0	100·0	100·0	100·0

This table clearly shews that a larger proportion of the total average lifetime is now lived at the years of usefulness, 25–65, than in England and Wales in the past. Hence inasmuch as the total duration of life has been considerably increased, it follows that the number of years lived during the useful period of life has also increased.

A glance at Plates I. and II. will shew that the expectation of life at the higher ages gradually loses its superiority over that for England and Wales ten years earlier, the two curves steadily approximating as age advances.

It is evident therefore that although, owing to the large number of lives saved during the early years of life, the number surviving to the higher ages has increased, thus securing a great gain to the *community*, this is not incompatible with a stationary or even dimished prospect of life for each *individual* over a certain age. In England the death-rate for males was higher in 1871-80 for all age groups above the 25-35 period, and for females was higher in 1871-80 for all age-groups above the 35-45 period than in preceding decennia. The mean expectation of life for males in England was less in 1871-80 for all ages after the 19th year than in 1838-54 (Dr. Farr's English Life Table, No. 3); and for females was less for all ages after the 45th year. At the same time it is true that the number of male survivors was greater in 1871-80 than in 1838-54 up to the end of the 67th year; and the number of female survivors are greater in 1871-80 than in 1838-54 up to the 93rd year.

In Brighton there are indications of a similar state of things, Tables V.-IX. and Plates I., II. and VII.-IX., shewing that the superiority of Brighton over England and Wales becomes much less at the higher ages.

It becomes then interesting and important to enquire, why has the improvement in probabilities of life at the earlier ages not been participated in throughout life?

Why has not the expectation of life improved for ages beyond 20 in males and 45 in females according to the experience of England and Wales (1871-80), an experience which Brighton probably shared to some extent with the rest of the country?

(1). An initial doubt is thrown by some on the accuracy of the data which shew such a result. It is suggested that with advance of time, the age returns at the census enumerations and in death certificates have become increasingly accurate, and that the increased mortality and diminished expectation of life at the higher ages is the result of this increased accuracy of statement, and, therefore, only apparent. That there is occasional exaggeration in the statement of age at advanced years, and that among females between 20 and 50 there is a not infrequent understatement of age is well known. It cannot, however, be supposed with an appearance of reason that any alteration in the operation of these or like causes will explain the diminished expectation of life at the higher ages in England in 1871-80 as compared with 1838-54.

(2). A favourite explanation of the diminished expectation of life in adult years is that, owing to the saving of life in the earlier years of life—a saving which has been especially in zymotic diseases and phthisis and other tubercular diseases—there has been a larger number of weakly survivors, who would under the former *régime* have been carried off by these diseases. In other words, the operation of the law of the survival of the fittest has been impeded, with results unfavourable to the health and vigour of adult life. This argument assumes that weakly children are more prone to attack by infectious diseases than robust children, an assumption which experience does not confirm. These diseases appear to attack the majority of children, weakly or robust, who are exposed to their infection. It might be reasonably expected, therefore, that with a decrease in the total deaths from infectious diseases, there would have been at least a corresponding decrease in the number of those who are left maimed by an attack of one of these diseases to survive to adult life. We personally think that the weeding out of weakly lives, caused by the greater mortality among weakly children suffering from an infectious disease, is almost entirely counterbalanced by the greater number of children made weakly in former times by non-fatal attacks of an infectious disease.

The case for deterioration of the race by survival of patients who would formerly have died in early life from phthisis and other tubercular diseases, appears to be a stronger one. It is probable that a larger proportion of phthisical patients are cured than formerly. It is probable also that many more children with a strong tendency to phthisis, or even suffering from its early symptoms are prevented by the improved medical treatment and the improved social conditions of recent years, from developing the disease. These now may survive to adult life and become the parents of children with a strong tubercular tendency.

Such a fact need not, however, cause any serious apprehension for two reasons. In the first place, hereditary tendencies to phthisis only act under favourable predisposing conditions, such as damp and overcrowded houses, sedentary occupation in a cramped position, &c.; and in presence of the active exciting agent, the specific bacillus to which phthisis and other tubercular diseases are due. The exciting cause of tuberculosis is the introduction *ab extra* of the specific infection by inhalation or by means of food.

In the second place, assuming that more phthisical patients survive than formerly, is it not equally true that fewer persons *become* phthisical than formerly? With a diminution of the active cases of phthisis, the number of centres for phthisical sputum, which as dust, is the chief cause of subsequent infection, must have diminished to a corresponding extent. Of the fact that the predisposing causes of phthisis,—damp and overcrowded houses, ill-ventilated workshops, &c.—are steadily diminishing, there is evidence on every hand. It is, therefore, reasonable to suppose that much at least of the deteriorating effect of survival of tubercular persons is counterbalanced by the large number of persons who are *prevented by improved sanitary and social conditions from becoming tubercular*.

It is premature at present to attempt by statistical means to determine how far the counteracting influences which are at work, balance each other, or failing a balance on which side is the preponderating effect.

(3) The increased stress of modern life is supposed by many to explain the increased death-rate among adults. It is doubtful if such increased strain exists in the community as a whole. Each adult as he becomes year by year more deeply involved in the battle of life, comes to the conclusion that the general strain of life in the community is increasing, forgetting that the same causes operated as life advanced in previous generations. There is reason for thinking with Dr. Pye-Smith that much of the evil ascribed to "over-pressure" is really due to over-feeding and drinking.

Assuming, however, that over-pressure exists in certain stations of life, *e.g.*, among city merchants, medical men, &c., it cannot be said to exist generally among professional men. Clergymen, lawyers and civil-servants are as classes long-lived.

Even assuming that over-pressure exists throughout the whole of the professional and mercantile classes, these do not form the mass of the community. *The majority of the population of England and Wales belong to the wage-earning classes*, and the conditions of these classes will therefore necessarily have the greatest influence on the total result. What are the facts as regards these classes? They may be gathered from an important address by Mr. Giffen.* He shews that the wages of the agricultural labourer have increased, while his hours have decreased. In the textile, engineering and house-building trades, he shews that the workman gets from 50 to 100 per cent. more money than 50 years previously for 20 per cent less work. He sums up in the following general statement: "While the workman's wages have advanced, most articles he consumes have rather diminished in price, the change in wheat being especially remarkable, and significant of a complete revolution in the condition of the masses. The increased price in the case of one or two articles—particularly meat and house-rent—is insufficient to neutralise the general advantages which the workman has gained."

The conditions of housing of a large proportion of the wage-earning classes are still unsatisfactory, and leave ample scope for improvement, though they have immensely improved as compared with fifty years ago. It must also be admitted that there is a considerable (though probably a diminishing) residuum who are not included in the general improvement described by Mr. Giffen.

There are two other circumstances affecting the life of the community which must be considered in this connection. These are the effects of increasing "urbanization" and the associated increase of manufacturing (and largely indoor) occupations as contrasted with agricultural and outdoor occupations.

At the census of 1861, 37·7 per cent. of the total population of England and Wales was rural; at the census of 1881, this proportion had decreased to 33·4 per cent., and at the census of 1891 to 28·3 per cent. The urban death-rates are generally higher than the rural, though the former have shewn a greater reduction in recent years than the latter. It is impossible to deny *in toto* that the conditions which go to form the sum-total of urban life are less favourable to a healthy adult existence than those of rural life, though no attempt can be made at present to estimate the share of the increased number of the urban population in say 1871-80 as compared with 1838-54, in producing the higher adult death-rate at the more recent period.

* The Progress of the Working Classes in the last Half-Century, by R. Giffen, F.R.S. (Inaugural Address, Statistical Society, Session 1883-84).

(4) Another consideration requires to be borne in mind. We are at present in a transition period. The Public Health Acts of 1871 and 1875 heralded immense improvements in sanitation, the fruits of which have not even yet been fully reaped. There has been, more especially since 1875, steady and increasing improvement in the conditions under which people live. Men now 40 years of age were born in the pre-sanitary period; and the first 20 years of their life were spent under more unhygienic conditions than those now holding good. This fact would go far towards explaining a stationary death-rate at the higher ages. It does not, however, explain an increased death-rate at those ages.

The explanation of this increased death-rate at the higher ages will probably be evident, when at the end of another 20 or 30 years the improved conditions of life have endured sufficiently long to enable their full force and value to be determined. We must be content in the meantime to have stated the more important factors which appear to be at work, leaving the complete solution of the problem to a time when the statistical experience of our country is more mature.

BRIGHTON LIFE TABLE

(Based on the Mortality of the Ten Years, 1881-90).

TABLE I.

TOTAL NUMBER OF LIVES AT RISK AND DEATHS FOR EACH YEAR OF AGE.

MALES.

Age.	Population.		Deaths.	
	In Original Groups.	Distributed.	In Original Groups.	Distributed.
0		17,253		2,877
1		14,001		957
2		13,405		334
3	71,374	13,135	4,569	246
4		13,580		155
5		14,040		100
6		13,970		78
7	69,236	13,870	333	62
8		13,740		51·5
9		13,616		41·5
10		13,420		32·2
11		13,220		27·2
12	64,712	13,000	149	26·2
13		12,710		27·4
14		12,362		36·0
15		11,730		42·3
16		11,300		44·5
17	55,408	11,000	229	46·
18		10,778		47·
19		10,600		49·2
20		10,430		48·2
21		10,300		49·3
22	50,663	10,140	256	50·7
23		9,980		52·8
24		9,813		55·
25		9,620		57·7
26		9,450		60·
27		9,270		62·3
28		9,100		64·7
29		8,903		67·
30	87,843	8,700	678	69·
31		8,500		71·1
32		8,300		73·2
33		8,100		75·5
34		7,900		77·5
35		7,680		80·
36		7,480		81·6
37		7,270		83·2
38		7,050		85·
39	67,436	6,830	872	86·5
40		6,636		88·
41		6,430		89·6
42		6,220		91·1
43		6,020		92·8
44		5,820		94·2
45		5,680		96·5
46		5,500		98·5
47		5,330		101·
48		5,140		103·2
49	49,119	4,990	1,040	105·

TABLE I.

TOTAL NUMBER OF LIVES AT RISK AND DEATHS FOR EACH YEAR OF AGE.

MALES—*Continued.*

Age.	Population.		Deaths.	
	In Original Groups.	Distributed.	In Original Groups.	Distributed.
50		4,820		106·
51		4,670		107·
52		4,490		107·2
53		4,320		107·6
54		4,179		108·
55		4,050		108·2
56		3,900		108·4
57		3,730		108·5
58		3,600		108·8
59		3,430		109·3
60	33,698	3,300	1,104	109·7
61		3,138		110·5
62		2,990		111·5
63		2,840		113·3
64		2,720		115·8
65		2,520		118·5
66		2,400		123·
67		2,250		127·5
68		2,110		129·
69	19,187	1,980	1,235	129·5
70		1,850		129·2
71		1,700		128·
72		1,580		124·
73		1,470		116·
74		1,327		110·3
75		1,200		106·5
76		1,060		104·
77		950		101·2
78		840		98·5
79	7,143	750	945	96·0
80		640		93·2
81		530		91·
82		483		88·2
83		380		85·2
84		310		81·2
85		210		70·
86		180		49·
87		130		37·5
88	894	110	261	28·5
89		90		22·
90		70		17·
91		50		13·5
92		30		10·5
93		15		7·5
94		9		5·5
95		9		3·
96	18	5	7	2
97		2		1
98		1		1
99		1		

TABLE 2.

TOTAL NUMBER OF LIVES AT RISK AND DEATHS FOR EACH YEAR OF AGE.

FEMALES.

Age.	Population.		Deaths.	
	In Original Groups.	Distributed.	In Original Groups.	Distributed.
0		17,233		2264
1		14,271		846
2	72,259	13,716	3,800	327
3		13,462		207
4		13,577		156
5		13,700		81·
6		13,513		69·2
7	67,523	13,480	301	58·
8		13,410		49·5
9		13,420		43·3
10		13,500		37·2
11		13,560		33·8
12	68,595	13,630	174	33·0
13		13,760		33·5
14		14,145		36·5
15		14,869		43·2
16		16,400		46·4
17	82,969	17,000	243	49·
18		17,300		51·2
19		17,400		53·2
20		17,400		55·3
21		17,340		57·
22	84,833	17,090	292	58·3
23		16,850		59·9
24		16,153		61·5
25		15,450		63·5
26		14,682		65·2
27		14,100		66·8
28		13,700		68·5
29		13,200		70·0
30	130,732	12,700	709	71·6
31		12,300		73·2
32		11,900		75·
33		11,500		76·7
34		11,200		78·5
35		10,900		79·8
36		10,520		81·2
37		10,330		83·
38		9,980		84·2
39	96,101	9,711	866	86·
40		9,400		87·2
41		9,180		89·
42		8,930		90·3
43		8,700		92·0
44		8,450		93·3
45		8,280		95·2
46		7,960		97·0
47		7,750		98·8
48		7,500		100·2
49	71,568	7,300	1,034	101·8
50		7,000		104·
51		6,800		106·

TABLE 2.

TOTAL NUMBER OF LIVES AT RISK AND DEATHS FOR EACH YEAR OF AGE.

FEMALES—*continued.*

Age.	Population.		Deaths.	
	In Original Groups.	Distributed.	In Original Groups.	Distributed.
52		6,570		107·5
53		6,308		110·5
54		6,100		113·0
55		6,000		115·2
56		5,820		117·2
57		5,600		119·2
58	51,020	5,400	1,243	121·3
59		5,200		123·3
60		5,010		125·3
61		4,820		127·3
62		4,570		129·3
63		4,400		131·4
64		4,200		133·5
65		3,950		137·
66		3,800		139·5
67		3,617		143·
68		3,370		148·
69	30,957	3,160	1,577	156·
70		3,000		164·
71		2,800		169·
72		2,600		172·
73		2,400		174·
74		2,260		174·5
75		1,900		174·2
76		1,720		172·5
77		1,570		168·
78		1,400		158·
79	11,613	1,210	1,416	148·
80		1,053		139·
81		900		128·
82		760		118·5
83		620		109·8
84		480		101·
85		380		88·
86		300		76·5
87		240		64·
88		180		50·
89	1,589	150	413	40·
90		109		31·
91		90		23·
92		70		18·
93		40		13·
94		30		9·5
95		15		7·
96		8		5·
97	44	6	22	3·8
98		5		2·6
99		4		1·6
100		3		1·
101		2		·6
102		1		·3
103				·1

TABLE 3.
BRIGHTON LIFE TABLE.
(BASED ON THE MORTALITY OF THE TEN YEARS, 1881-90.)

MALES.

Age.	Dying in each Year of Age, 0-1, 1-2, &c.	Born, and Surviving at each Age.	Sum of the Number Living, or Years of Life lived at each Age $x+1$ and upwards to the last Age in the Table.	Mean After Life Time (Expectation of Life) at each Age.
x	d_x	l_x	Σl_{x+1}	$\mathring{e}_x$
0	7,880	51,195	2,206,174	43·59
1	2,863	43,315	2,162,859	50·43
2	996	40,452	2,122,407	52·96
3	733	39,456	2,082,951	53·29
4	440	38,723	2,044,228	53·29
5	272	38,283	2,005,945	52·87
6	211	38,011	1,967,934	52·27
7	169	37,800	1,930,134	51·56
8	141	37,631	1,892,503	50·78
9	114	37,490	1,855,013	49·98
10	90	37,376	1,817,637	49·12
11	77	37,286	1,780,351	48·14
12	75	37,209	1,743,142	47·35
13	80	37,134	1,706,008	46·44
14	108	37,054	1,668,954	45·54
15	131	36,946	1,632,008	44·67
16	145	36,815	1,595,193	43·81
17	153	36,670	1,558,523	43·00
18	159	36,517	1,522,006	42·18
19	169	36,358	1,485,648	41·36
20	167	36,189	1,449,459	40·55
21	156	36,022	1,413,437	39·74
22	178	35,866	1,377,571	38·91
23	189	35,688	1,341,883	38·10
24	198	35,499	1,306,384	37·30
25	211	35,301	1,271,083	36·51
26	221	35,090	1,235,993	35·72
27	234	34,869	1,201,123	34·95
28	243	34,635	1,166,488	34·18
29	259	34,392	1,132,096	33·41
30	265	34,133	1,097,963	32·67
31	279	33,868	1,064,095	31·92
32	298	33,589	1,030,506	31·18
33	309	33,291	997,215	30·45
34	322	32,982	964,233	29·73
35	338	32,660	931,573	29·02
36	351	32,322	899,251	28·32
37	364	31,971	867,280	27·63
38	397	31,607	835,673	26·94
39	393	31,210	804,463	26·28
40	407	30,817	773,646	25·60
41	421	30,410	743,236	24·94
42	437	29,989	713,247	24·28
43	451	29,552	683,695	23·63
44	468	29,101	654,594	22·99
45	484	28,633	625,961	22·36
46	499	28,149	597,812	21·74
47	519	27,650	570,162	21·12
48	540	27,130	543,032	20·52
49	554	26,591	516,441	19·92
50	567	26,037	490,404	19·33
51	590	25,470	464,934	18·75
52	587	24,880	440,054	18·27

TABLE 3.
BRIGHTON LIFE TABLE.
(BASED ON THE MORTALITY OF THE TEN YEARS, 1881-90.)

MALES.—(*Continued*).

Age.	Dying in each Year of Age, 0-1, 1-2, &c.	Born, and Surviving at each Age.	Sum of the Number Living, or Years of Life lived at each Age $x+1$ and upwards to the last Age in the Table.	Mean After Life Time (Expectation of Life) at each Age.
x	d_x	l_x	Σl_{x+1}	$\mathring{e}_x$
53	596	24,293	415,761	17·61
54	605	23,697	392,064	17·04
55	608	23,092	368,972	16·48
56	615	22,484	346,488	15·39
57	627	21,869	324,619	14·78
58	633	21,242	303,377	14·22
59	647	20,609	282,768	14·22
60	652	19,962	262,806	13·67
61	668	19,310	243,496	13·11
62	682	18,642	224,854	12·56
63	697	17,960	206,894	12·02
64	720	17,263	189,631	11·46
65	760	16,543	173,088	10·96
66	789	15,783	157,305	10·46
67	826	14,994	142,311	9·99
68	828	14,168	128,143	9·54
69	845	13,340	114,803	9·11
70	842	12,495	102,308	8·69
71	846	11,653	90,655	8·28
72	817	10,807	79,848	7·89
73	758	9,990	69,858	7·49
74	737	9,232	60,626	7·16
75	722	8,495	52,131	6·64
76	727	7,773	44,358	6·21
77	713	7,046	37,312	5·79
78	702	6,333	30,979	5·39
79	677	5,631	25,348	5·00
80	673	4,954	20,394	4·62
81	676	4,281	16,113	4·27
82	590	3,605	12,508	3·97
83	608	3,015	9,493	3·65
84	657	2,407	7,086	3·44
85	529	1,850	5,236	3·33
86	316	1,321	3,915	3·40
87	254	1,005	2,910	3·39
88	168	751	2,159	3·37
89	127	583	1,576	3·20
90	99	456	1,120	2·95
91	85	357	763	2·64
92	81	272	491	2·31
93	76	191	300	2·07
94	46	115	185	2·11
95	25	69	116	1·68
96	15	44	72	1·64
97	12	29	43	1·48
98	7	17	26	1·53
99	4	10	16	1·60
100	2	6	10	1·66
101	1	4	6	1·50
102	1	3	3	1·00
103	1	2	1	·50
104	0	1	0	
105		0		

TABLE 4.
BRIGHTON LIFE TABLE.
(Based on the Mortality in the Ten Years 1881-90.)
FEMALES.

Age.	Dying in each Year of Age, 0-1, 1-2, &c.	Born and Surviving at each Age.	Sum of the Number living or Years of Life lived at each age $x+1$ and upwards to the last age in the table.	Mean After-Lifetime (Expectation of Life) at each Age.
x	d_x	l_x	Σl_{x+1}	$\mathring{e}_x$
0	6,017	48,805	2,362,354	49·00
1	2,464	42,788	2,319,566	54·71
2	946	40,324	2,279,242	57·03
3	600	39,378	2,239,864	57·38
4	444	38,778	2,201,086	57·26
5	228	38,334	2,162,752	56·92
6	195	38,106	2,124,646	56·25
7	164	37,911	2,086,735	55·54
8	139	37,747	2,048,988	54·78
9	121	37,608	2,011,380	53·98
10	103	37,487	1,973,893	53·15
11	93	37,384	1,936,509	52·30
12	91	37,291	1,899,218	51·43
13	91	37,200	1,862,018	50·55
14	96	37,109	1,824,909	49·68
15	108	37,013	1,797,896	49·07
16	105	36,905	1,760,991	48·22
17	106	36,800	1,724,191	47·35
18	109	36,694	1,687,497	46·48
19	112	36,585	1,650,912	45·62
20	116	36,473	1,614,439	44·76
21	120	36,357	1,578,082	43·90
22	114	36,237	1,541,845	43·04
23	129	36,123	1,505,722	42·18
24	137	35,994	1,469,728	41·33
25	148	35,857	1,433,871	40·48
26	159	35,709	1,398,162	39·65
27	168	35,550	1,362,612	38·83
28	177	35,382	1,327,230	38·01
29	188	35,205	1,292,025	37·20
30	197	35,017	1,257,008	36·39
31	207	34,820	1,222,188	35·60
32	219	34,613	1,187,575	34·81
33	229	34,394	1,153,181	34·03
34	239	34,165	1,119,016	33·25
35	248	33,926	1,085,090	32·48
36	259	33,678	1,051,412	31·72
37	268	33,419	1,017,993	30·66
38	279	33,151	984,842	30·19
39	289	32,872	951,970	29·46
40	291	32,583	919,387	28·71
41	312	32,292	887,095	27·97
42	322	31,980	855,115	27·24
43	333	31,658	823,457	26·44
44	344	31,325	792,132	25·79
45	354	30,981	761,151	25·07
46	375	30,627	730,524	24·35
47	383	30,252	707,272	23·88
48	397	29,869	677,403	23·18
49	408	29,472	647,931	22·48
50	429	29,064	618,867	21·79
51	457	28,635	590,232	21·18
52	458	28,178	562,054	20·44

TABLE 4.
BRIGHTON LIFE TABLE.
(Based on the Mortality in the Ten Years 1881-90.)
FEMALES.—*(Continued)*.

Age.	Dying in each Year of Age, 0-1, 1-2, &c.	Born and Surviving at each Age.	Sum of the Number living or years of Life lived at each age $x+1$ and upwards to the last age in the table.	Mean After-Lifetime (Expectation of Life) at each Age.
x	d_x	l_x	Σl_{x+1}	$\mathring{e}_x$
53	483	27,720	534,334	19·78
54	500	27,237	507,097	19·15
55	509	26,737	480,360	18·48
56	523	26,228	454,132	17·81
57	542	25,705	428,427	17·16
58	559	25,163	403,264	16·52
59	576	24,604	378,660	15·89
60	594	24,028	354,632	15·26
61	612	23,434	331,198	14·63
62	639	22,822	308,376	14·01
63	653	22,183	286,193	13·40
64	673	21,530	264,663	12·79
65	733	20,857	243,806	12·19
66	726	20,124	223,682	11·61
67	752	19,398	204,284	11·03
68	706	18,646	185,638	10·45
69	864	17,940	167,698	9·84
70	909	17,076	150,622	9·32
71	937	16,167	134,455	8·81
72	976	15,230	119,225	8·32
73	998	14,254	104,971	7·86
74	986	13,256	91,715	7·42
75	1,076	12,270	79,445	6·97
76	1,069	11,194	68,251	6·59
77	1,029	10,125	58,126	6·24
78	972	9,096	49,030	5·89
79	937	8,124	40,906	5·54
80	890	7,187	33,719	5·19
81	835	6,297	27,422	4·85
82	790	5,462	21,960	4·52
83	760	4,672	17,288	4·20
84	745	3,912	13,376	3·92
85	658	3,167	10,209	3·72
86	568	2,509	7,700	3·57
87	457	1,941	5,759	3·46
88	352	1,484	4,275	3·38
89	267	1,132	3,143	3·27
90	216	865	2,278	3·12
91	147	649	1,629	3·00
92	115	502	1,127	2·74
93	109	387	740	2·41
94	80	278	462	2·16
95	74	198	264	1·83
96	60	124	140	1·63
97	32	64	76	1·69
98	15	32	44	1·87
99	6	17	27	2·08
100	4	11	16	1·95
101	2	7	9	1·79
102	2	5	4	1·30
103	2	3	1	·83
104	1	1	0	
105	0	0		

TABLE 5.

PROBABILITY OF LIFE AT EACH AGE, AND NUMBER OF SURVIVORS OUT OF A GIVEN NUMBER BORN.

Age.	The Probability of Living One Year. p_x		Number of Survivors at each Year of Age out of 100,000 at Birth.	
	Males.	Females.	Males.	Females.
0	·84608	·87672	100,000	100,000
1	·93392	·94242	84,999	87,672
2	·97538	·97654	79,380	82,623
3	·98144	·98478	77,425	80,685
4	·98863	·98857	75,987	79,457
5	·99290	·99405	75,125	78,546
6	·99445	·99489	74,590	78,079
7	·99554	·99569	74,176	77,680
8	·99626	·99632	73,845	77,343
9	·99696	·99678	73,569	77,059
10	·99761	·99726	73,344	76,811
11	·99795	·99751	73,168	76,601
12	·99799	·99758	73,017	76,409
13	·99785	·99756	72,869	76,222
14	·99709	·99743	72,713	76,037
15	·99646	·99710	72,501	75,839
16	·99607	·99718	72,242	75,619
17	·99583	·99712	71,958	75,404
18	·99564	·99704	71,659	75,187
19	·99537	·99694	71,346	74,962
20	·99539	·99683	71,015	74,733
21	·99523	·99672	70,687	74,496
22	·99501	·99659	70,380	74,249
23	·99472	·99645	70,031	74,015
24	·99442	·99620	69,661	73,752
25	·99403	·99589	69,273	73,470
26	·99368	·99557	68,858	73,168
27	·99330	·99528	68,425	72,740
28	·99296	·99501	67,966	72,497
29	·99249	·99468	67,489	72,134
30	·99222	·99438	66,979	71,750
31	·99177	·99406	66,460	71,340
32	·99112	·99373	65,913	70,916
33	·99072	·99335	65,328	70,466
34	·99023	·99302	64,722	69,976
35	·98964	·99271	64,090	69,508
36	·98915	·99231	63,426	69,000
37	·98862	·99200	62,724	68,469
38	·98745	·99160	62,009	67,921
39	·98743	·99123	61,230	67,349
40	·98682	·99108	60,459	66,756
41	·98616	·99035	59,661	66,159
42	·98545	·98993	58,834	65,521
43	·98477	·98943	57,978	64,861
44	·98394	·98902	57,093	64,179
45	·98311	·98857	56,175	63,475
46	·98229	·98776	55,224	62,748
47	·98123	·98734	54,246	61,980
48	·98012	·98670	53,291	61,195
49	·97917	·98615	52,168	60,383
50	·97825	·98525	51,081	59,547
51	·97685	·98404	49,969	58,668
52	·97641	·98377	48,811	57,731

TABLE 5.—*continued.*

Age.	The Probability of Living One Year. p_x		Number of Survivors at each Year of Age out of 100,000 at Birth.	
	Males.	Females.	Males.	Females.
53	·97546	·98258	47,660	56,792
54	·97448	·98164	46,490	55,803
55	·97369	·98098	45,303	54,779
56	·97264	·98007	44,110	53,735
57	·97133	·97894	42,904	52,663
58	·97023	·97780	41,674	51,552
59	·96863	·97659	40,432	50,403
60	·96733	·97529	39,163	49,228
61	·96541	·97393	37,884	48,011
62	·96342	·97202	36,573	46,736
63	·96123	·97057	35,236	45,448
64	·95831	·96876	33,868	44,109
65	·95406	·96487	32,455	42,731
66	·95003	·96395	30,964	41,229
67	·94490	·96123	29,417	39,651
68	·94019	·95703	27,796	38,114
69	·93667	·95183	26,172	36,670
70	·93260	·94679	24,514	34,904
71	·92739	·94141	22,862	33,046
72	·92437	·93596	21,202	31,131
73	·92415	·93003	19,599	29,136
74	·92014	·92566	18,112	27,095
75	·91501	·91233	16,666	25,080
76	·90642	·90449	15,250	22,881
77	·89888	·89843	13,823	20,696
78	·88922	·89317	12,425	18,595
79	·87971	·88473	11,048	16,588
80	·86426	·87617	9,720	14,675
81	·84192	·86722	8,399	12,861
82	·83269	·85535	7,073	11,156
83	·79842	·83731	5,915	9,543
84	·76841	·80961	4,723	7,991
85	·71428	·79245	3,630	6,469
86	·76039	·77383	2,592	5,126
87	·74790	·76470	1,972	3,966
88	·77602	·76274	1,473	3,001
89	·78218	·76470	1,144	2,289
90	·78340	·75100	895	1,749
91	·76211	·77379	701	1,324
92	·70213	·77215	534	1,024
93	·60000	·72043	375	789
94	·60000	·71366	226	567
95	·63636	·62162	135	404
96	·66666	·52380	86	253
97	·60000	·51898	57	131
98	·60000	·54076	34	65
99	·60000	·66666	20	35
100			12	23
101			8	14
102			6	10
103			4	6
104			2	2
105			0	0

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REPORT

ON A

MISSION TO PARIS

IN OCTOBER, 1889, TO ATTEND THE 4TH SESSION OF THE FRENCH SURGICAL CONGRESS, TOGETHER WITH OBSERVATIONS ON THE MILITARY MEDICAL SCHOOLS OF FRANCE.

BY

SURGEON-GENERAL SIR T. LONGMORE, R.P., C.B.,
Professor of Military Surgery at the Army Medical School, Netley.

(*Mem.*—The Observations on the French Military Medical Schools are brought down to the present date, February, 1890.)

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REPORT.

PART I.—THE CONGRESS.

General Remarks.

In compliance with orders from the Director-General, Medical Staff, conveyed to me by letter No. $\dfrac{\overset{4800}{7}}{1318}$, and dated 4th October, 1889, to attend the French Surgical Congress appointed to commence on the 7th of October, I left London on the 6th of October and arrived at Paris on the evening of the same day. I reported myself early on the following morning to the President of the Congress, Baron Larrey. I had previously called upon the Secretary-General, Dr. Pozzi, who very kindly at once placed me *au courant* with the arrangements of the Session, and afforded me every facility for taking part in the proceedings that were to follow. I remained at Paris in attendance on the meetings until their conclusion on the afternoon of Saturday, the 12th of October, and on Monday, the 14th, travelled back to London, reporting my return on the following morning.

History and Objects of the Congress.

The French Surgical Congress is an institution of recent date, the one which I attended having been the fourth only of the annual Sessions of the Society which have taken place. A Report on the transactions of the third Congress, which was attended by Brigade Surgeon Godwin, was printed in the volume of Army Medical Reports for the year 1887 (London, 1889). The purpose of the Congress seems to have been extended in scope during the last year or two, for whereas at the beginning its main object appeared to be to establish friendly and scientific relations between the surgeons of Paris and the provincial surgeons of France, it now seeks not only to establish scientific intercourse between the French surgeons of the metropolis and provinces, but also between them and the surgeons of other countries—to give the Congress an international rather than solely a national character. The prevailing desire to extend the usefulness of the Congress by combining the experience of foreign surgeons with the results of the practice of surgery by members of the profession resident in France was referred to in the opening address of Baron Larrey, the President for the year, and in the Report of the General Secretary, Professor Pozzi.

Its international character.

The Honorary Presidents.

It was also, no doubt, in accordance with the general desire to give the Congress an international rather than a more restricted national character that, out of eleven Honorary Presidents elected by the Congress, six of the number were not natives of France: one being from Holland, one from Belgium, one from Roumania, one from Switzerland, one from Denmark, and myself from England. The remaining five were distinguished surgeons from the leading provincial cities of France. It was probably intended to be complimentary to England that at one of the sittings, on the 11th of October, the honour was conferred on me of being requested to take the Chair and to preside at the meeting.

Proceedings of the Congress.

The sittings took place both in the mornings and in the afternoons of the days of meeting. The hours fixed were from 9 to 12 o'clock in the morning, and from 3 to 6 o'clock in the afternoon, but in consequence of the large number of papers placed on the lists the afternoon sittings were arranged to commence an hour earlier on the last two days of the Congress. As many as eighty papers were set down to be read at the Congress, but a few were omitted. On an average fifteen minutes were allowed for each paper, but the time was prolonged in some instances with the consent of the meeting. Occasionally patients were brought into the theatre in illustration of the effects of operative proceedings described in the papers read or for other purposes of demonstration. No discussion as a rule followed the papers, as is customary at similar meetings in England, although exceptionally from time to time observations were made, or questions asked, by the President or some of the members present. The only language used at the Congress was French.

There was no sitting on the morning of the 9th of October, the time being devoted to visits of individual members to the principal hospitals of Paris; and again, on the afternoon of Thursday, the 10th of October, no papers were read, but the members of the Congress visited certain institutions of interest. The places visited were the buildings, which are on a vast scale and installed with the most perfect arrangements, for the new practical school attached to the Faculty of Medicine, the Morgue, and the Pasteur Institute. On the morning of Friday, the 11th of October, also, instead of the usual meeting at the Amphitheatre, the members visited the Exhibition grounds for the purpose of inspecting the collections of surgical instruments and examining the hospital materials and appliances, together with the Sick Transport conveyances, exhibited by the Ministry of War and the various Societies for aid to sick and wounded.

Place of Meeting.

The great semicircular amphitheatre of the Faculty of Medicine, said to be capable of seating 1,400 persons, was placed at the disposal of the Congress for its meetings, and here the Session was opened on Monday, the 7th of October, in presence of a large gathering of members, about 150 in number, as well as of a considerable assemblance of other persons, the upper row of seats of the amphitheatre being open to the public.

The meeting also took place in this theatre on the following morning, but about noon, just before the time for closing the meeting, while M. le Dentu, of Paris, was engaged in communicating the results of his experience on operations practised for local tuberculous disease, smoke appeared about the platform on which the President and Vice-President were sitting. The occurrence was at first regarded as a matter of trifling importance, but it was soon followed by an outburst of flame, showing its serious character, and the meeting was hastily broken up. The means of exit being close by, and the passages sufficiently numerous and free, no difficulty was experienced in quitting the theatre and reaching the large rectangular court outside. This court forms the principal means of access to the buildings of the Faculty of Medicine. The lodge of the Concierge is on one side of the court, near the entrance gates, and, in its construction, a fire alarm bell had been attached to it as a measure of precaution. This was at once rung, and in a very short time firemen with the necessary appliances were on the spot, but it was only after exertions which lasted an hour that the fire was extinguished.

Fire at the Faculty of Medicine.

Amphitheatre burnt.

Paintings of professional interest destroyed.

A considerable portion of the amphitheatre was completely burnt, but the objects of chief interest destroyed were three large paintings by a French artist of the name of Matout. The one most highly prized represented Ambroise Paré introducing the use of the ligature for stopping the flow of blood after an amputation, in place of the hot iron which at the time was in general use for arresting hæmorrhage. This painting, which was of very large size, 9 × 5 metres, was entirely destroyed. One of the two other paintings burnt represented a surgical operation in early days at the Hôtel-Dieu, and the other, the first lecture given in Paris on anatomy, the place being the Chapel of St. Julien-le-Pauvre, one of the oldest chapels in Paris. Although these two paintings were not so completely destroyed as the large one connected with Ambroise Paré's introduction of the ligature, they were said to be damaged beyond the possibility of restoration. Some marble busts were also much injured; one of Hippocrates which was placed above the platform fell to the ground and was broken into fragments. The fire was caused by overheating the warming apparatus, the mouth of which was stated to be close beneath the tribune, or platform, of the amphitheatre, and insufficiently guarded.

Place of Meeting changed.

In consequence of the destruction of the amphitheatre at the Faculty of Medicine the sittings of the Congress subsequently took place in the still larger amphitheatre of the new School of Medicine, which is on the opposite side of the same street where the entrance to the Faculty of Medicine is placed. All the parts of the new School were not yet fully completed, but the amphitheatre was sufficiently finished to be used for the meetings. The School itself occupies a very large extent of ground, and the laboratories, anatomical rooms, apartments designed for scientific collections, and others, are on a very costly and magnificent scale. They are constructed and arranged not simply with attention to the bare necessities of teaching purposes, but with the addition of every modern appliance that could be thought of for facilitating the labours both of those who teach and of those who are under instruction.

Subjects discussed.

Three special subjects had been previously fixed for consideration at the Congress, and upwards of thirty members brought forward their experience and expressed their views regarding them. These questions were—(1), the immediate and remote results of operations practised for local tuberculous disorders; (2), the surgical treatment of peritonitis, and (3), the treatment of aneurysms of the extremities. In addition to the papers and observations on these special questions, numerous other papers were read, the subjects of which may be said to have embraced the whole region of surgical pathology and operative interference in patients of both sexes. These papers were seventy-one in number.

It is not possible in a report like the present one to give a digest of such a number of papers that would either do justice to the papers themselves or that would be likely to serve any useful purpose. The omission of an attempt to give an abstract account of them is of the less moment, inasmuch as they will be printed in *extenso*, revised by their authors, in the transactions of the Congress which will be published under the direction of the Secretary General and Committee of Management. A copy of the volume of transactions will be furnished to each member of the Congress.

Remarkable surgical operation.

I may, however, refer briefly to the cases of two of the patients who were presented to the Congress as they had both been the subjects of surgical operations of remarkable interest. In the first of the two patients I allude to, the whole of the right ilium, pubes, and a portion of the ischium had been extirpated two years previously for osteosarcoma. The tumour, which was of enormous volume, overlapped the ilium in all directions. The operation was commenced by two incisions, a vertical anterior one near the symphysis, and a second one of immense extent inclosing within its boundary the whole outline of the ilium. The ilium was then separated from all its muscular connexions and extirpated. A portion of the ischium was alone preserved for the sake of the muscular insertions belonging to it. The head of the femur was sawn across obliquely. There was no serious hæmorrhage. Six large drainage tubes were inserted in the wound, and reunion was obtained by first intention. Notwithstanding the formidable extent of the operation, which lasted more than three hours owing to the difficulty of separating the bone from its connexions with the muscular tissues and adjoining bones, and certain special difficulties met with in the removal of part of the ischium and head of the femur in consequence of the manner in which these parts were invaded by the tumour, the patient bore the operation on the whole fairly well. He was able to leave his bed in two months from the date of its per-

formance and up to the time of his appearance at the Congress there had not been any sign of a return of the disease at the seat of operation or elsewhere. He was able to walk satisfactorily with the aid of crutches, and had considerable power of flexing the thigh toward the abdomen and executing other movements of the limb. His general health was good. This formidable and extensive operation had certainly saved the patient from a very painful and speedy death. The operator, who himself presented the patient to the Congress and gave the history of the case, was M. Roux, of Lausanne.

The second case to which I just now alluded was brought forward by M. Demons, of Bordeaux, and is that of a patient in whom the whole of the larynx had been extirpated two years and four months previously for epithelioma. The disease had its origin in the cavity of the organ and was limited to it. The man was in excellent health but could only make himself understood by signs and movements of the lips. None of the structures in the neighbourhood of the situation from which the larynx had been removed presented the least trace of a return of the disease. The history of the case, with a description of the operation and the patient's progress, had been read at one of the previous annual meetings of the Congress. Surgical attention having been so much attracted to questions regarding this operation and its effects in consequence of the case of the late greatly lamented Emperor of Germany, the operation in this instance, and the condition of the patient, formed subjects of particular interest.

Successful case of complete removal of the larynx.

I will now close this part of my report, but it would, however, be ungracious to do so without an acknowledgment of the remarkable courtesy and kindness shown to the foreign visitors by the eminent President of the Congress, its staff, and indeed by all the French members present at the meetings. The Officers of the Congress devoted themselves to making the visit of the foreign members as agreeable and as instructive as time at disposal and other circumstances would allow; while all the principal institutions of Paris likely to afford interest to members of the medical profession were freely opened to them.

Concluding remarks.

PART II.—THE MILITARY MEDICAL SCHOOLS OF FRANCE.

I took the opportunity while at Paris of visiting the Military Hospital of the Val-de-Grâce, and the buildings attached to it for the use of its celebrated Military Medical School. The courses of lectures and practical exercises had terminated before the time of my visit, but through the kind attention of Médecin Principal Dr. Chauvel, one of the Professors of the School, I was enabled to see the establishment very thoroughly. I was aware that several changes had been made in the School, especially in the

Visit to the Val-de-Grâce.

programme of study, since I visited it in the year 1878, and I was desirous of ascertaining the nature and extent of these changes. As the constitution and internal economy of the School at the Val-de-Grâce differ in many particulars from those of the Army Medical School at Netley, it has appeared to me that a description of the French School, of the regulations under which it is governed, and of its principal educational features, will be useful and interesting for purposes of comparison with corresponding points in the Netley School. At the same time that I collected particulars regarding the School of advanced studies at the Val-de-Grâce, I made myself acquainted with the modifications which have been introduced in the preliminary education of the Army Medical Officers through the recent law creating a new military medical school at Lyons. I propose to devote the remainder of this report to a description of the results of my inquires on these topics.

School of Applied Medicine at the Val-de-Grâce.

I had been under the impression that the existing Military School of Applied Medicine and Pharmacy at the Val-de-Grâce (*École d'Application de Médecine et de Pharmacie Militaires*) was a very old institution at the time the Army Medical School was founded in England in the year 1860. I think this belief was a very general one among those who were interested in the establishment of the English School, and it seems to be one not confined to this country. In the elaborate official report on the "Education of Medical Officers for the Public Service in England," by Medical Inspector R. C. Dean, United States' Navy, which includes a detailed description of the results of his visit to Netley in March 1876, the following remarks occur:—"It has been my object to give in this report a complete and detailed account of the systems of education for medical officers of the army and navy adopted by France and England, two great and enlightened nations. Occupying as they do a foremost place among the mighty powers of Europe, and ever vying with each other in the improvement of their formidable naval and military forces, it is fair to assume that whatever they have done in this direction has been the result of the lessons of experience and of a well-grounded conviction of its utility. . . . . Both these nations have sought through their schools, naval and military, to mitigate, as much as possible, the evils which war and disease bring on their people, and to keep their forces efficient and promptly available by land and sea. The two systems, having the same object, yet differ from each other as widely as the character of the two nations, and it may be to our advantage to view them in comparison. That of France is much older and longer established, having been organized considerably more than a hundred years ago; while that of England was inaugurated as recently as 1860. The former is, therefore, naturally more extended and complete; there being in France the three Naval Medical Schools of Brest, Rochefort, and Toulon and the Army Medical School at the Val-de-Grâce in addition; whereas in England there is but one

Remarks by Med. Inspr. Dr. Dean, U. S. Navy.

school in common for the medical corps of the army, navy, and Indian services."*

Institution of the existing School at the Val-de-Grâce.

The foregoing statement is correct as regards the three Naval Medical Schools of France at Rochefort, Toulon, and Brest, which were respectively instituted in the years 1722, 1725 and 1731, but is not applicable to the existing Special School at the Val-de-Grâce, for it was only decreed ten years before, and inaugurated only eight years before, the Practical Army Medical School in England. The decree authorizing the institution of the French School of Application at the Val-de-Grâce was dated 9th August, 1850, but the decree determining its organisation was not issued until the 13th of November, 1852. The mistake has arisen in consequence of the distinction not having been recognized between the School of Applied Medical Science now at the Val-de-Grâce, and the Schools which formerly existed at certain military hospitals set apart for general and clinical instruction with the view of preparing pupils for the medical service of the Army. The hospital of the Val-de-Grâce was one of these "Hospitals of Instruction" long before the existing School of Application at the Val-de-Grâce was instituted.

Mode of recruiting the Sanitary Corps of the Army in France.

It will be instructive to glance at the successive modifications which the plans adopted for recruiting the ranks of the Sanitary Corps of the French army have undergone at various intervals during comparatively recent years as well as at the changes which have been made from time to time in the arrangements of the preparatory schools where pupils destined for the medical service have received their early medical education and military training under the direction and at the cost of the French Government.

Elementary Mil. Med. Schools in 1836.

In the year 1836 the French Government instituted three elementary schools for the preparation of students to fit them for the medical service of the army. They formed a constituted part of the chief garrison hospitals at the three cities of Lille, Metz, and Strasburg. The schools were designated "*Écoles de Médecine Militaires*," and the hospitals "*Hôpitaux Militaires d'Instruction*." The pupils (*élèves*) passed their first two years of study in medicine and surgery at one or other of these schools, and having completed this probationary period, they spent another year of study at the more advanced school (*École de Perfectionnement*) of the military hospital of the Val-de-Grâce† in Paris. This hospital was then distinguished as the "*Hôpital*

Advanced Mil. Med. School in Paris.

* See pp. 91–92 of the U. S. Navy Department Report on "The Naval Medical Schools of France and England, &c., by Richard C. Dean, Medical Inspector, U. S. Navy," Washington, Government Printing Office, 1876. 1st Part: On the Naval Medical Schools of France; 2nd Part: Education of Medical Officers for the Public Service in England. The Medical Department, R.N., took part in the Practical Medical School at Netley, at the time of Inspector Dean's visit in 1876.

Origin of the Mil. Hospital of the Val-de-Grâce.

† Records show that the *Maison du Val-de-Grâce* was suppressed, like other religious houses, in the early period of the French Revolution, and that the building was appropriated as a *General Military Hospital*, by decree, dated 31st July, 1793. It soon gained great importance from its size and position, and thus offered a specially advantageous field for military medical observation and

Militaire de Perfectionnement." The pupils acquired at these schools a general knowledge of medicine and surgery with their allied sciences, at the same time that they were educated in habits of subordination and discipline. When the pupils left the Val-de-Grâce they were sent to various military hospitals, either in France or Colonial stations, as Sub-Assistant Surgeons (*Sous-Aides*), and in this capacity were employed in subordinate professional duties. After a few years, generally from 7 to 8 years, they returned for another year to one of the hospitals of instruction at Metz, Strasburg, or Lille, and subsequently for a second year at the hospital of the Val-de-Grâce. During this period they had to pass the necessary examinations for the degree of doctor at a Faculty of Medicine, and when this degree had been obtained, the grade of Aide-Major in the Army Medical Service was conferred on them.

Hospitals of Instruction suppressed in 1850.

In 1850 the Military Hospitals of Instruction were suppressed. In March, 1852, a degree was promulgated by the terms of which no candidates were to be received for military service but such as had already completed their studies in medicine at civil schools and obtained their doctor's degree. Those doctors who were successful at an open competition for appointments were then to pass, with the grade of Aide-Major, for one year's special study of the military bearings of their profession at the Val-de-Grâce.

Creation of a Mil. Med. School at Strasburg, 1856.

This plan did not prove successful. It was found that a sufficient number of candidates for military service could not be obtained from among members of the medical profession who had obtained the doctorate at their own, or their family's cost. The Government felt itself compelled, therefore, to revert to the plan of engaging pupils from the commencement of their studies, and training them at schools under government direction. In the year 1856, in consequence of the pressure due to the great losses by death among the medical officers of the French army in the Crimea, to resignations, and to other circumstances, the necessity for a change in the mode of recruiting the medical service of the army became so urgent that in June of that year a decree was issued for the creation of a new military medical school at Strasburg. Shortly afterwards, a large number of young students destined for military service (les élèves du service de santé militaire) were collected at Strasburg, and were quartered in a large barrack near the Faculty of Medicine of that city. They went through military exercises and training while they pursued their professional studies at the Strasburg Faculty at the cost of the government until they had passed all the usual examinations, and had obtained the University Diploma of Doctor in Medicine. As soon as they had acquired this degree, they entered by right the Practical School of Applied Medicine,

instruction. Notwithstanding that great improvements have been made in some particulars, this hospital is by no means free from grave defects of construction, which are traceable to the purpose for which the building was originally designed, and are unfortunately irremediable. No measure, short of a complete reconstruction of the building, could place it on a level with modern ideas of hospital requirements.

which was now in operation at the Val-de-Grâce, subject only to an entrance examination of fitness, and at this school they went through the courses of instruction in the applications of their professional knowledge to the special conditions of military service.

Changes after the war of 1870-71.

After the war of 1870-71, and the loss by France of Strasburg, the system of education just described was subjected to some modifications. Partly in consequence of the great expenses which the Strasburg school had entailed, and partly owing to difficulties due to insufficient means of instruction in certain branches of tuition at the Faculty of Medicine for so large a number of pupils—the military pupils amounting at one time to 350, and the civil pupils being at least equal in number—a resolution was come to that the system of collecting all the military medical pupils in a single locality should not again be adopted. Before making fresh arrangements, however, in this direction, another trial was instituted, but still unsuccessfully, to obtain candidates for army practice from qualified doctors of medicine in civil life.

It is recorded by M. Léon Le Fort in his work, entitled "La Chirurgie Militaire et Les Sociétés de Secours en France et à l'étranger" (Paris, 1872, p. 45), that not long after the loss of Strasburg and its school, the French Government tried to fill up some of the vacancies in the ranks of the Medical Corps by reverting to the mode of recruiting adopted in the decree of 1852, that is, by offering the vacant appointments to those who had obtained their doctor's degree by their private resources. The 5th of January, 1872, was fixed for the competition, and 50 appointments were offered, but only two doctors in medicine appeared as candidates for them. Various reasons are assigned by M. Le Fort for this failure to attract competitors among this class of French qualified medical practitioners.

Decrees of 1879, 1880.

The attempt to enlist medical recruits for the army by these means having proved unsuccessful, and a resolution having been formed, as before mentioned, not to re-establish a single military medical school like the one which had been at Strasburg, a fresh system was adopted. It was ordained that military medical pupils should be accepted as before, but that they should be distributed between 11 of the chief cities of France, each of which contained a Faculty of Medicine and a sufficiently large garrison hospital. The decrees ordering these arrangements were promulgated in the years 1879 and 1880. Paris was included among the 11 cities named in the decrees. It was left to the pupils to select, according to their convenience or choice, the place of study they preferred.

Mil. Med. Schools at Nancy and Bordeaux, 1883.

This system was only maintained for about three years, when, for various reasons, a change was introduced in October, 1883, and a plan embracing a more limited distribution of the pupils was adopted in its stead. Two special preparatory military medical schools were instituted, one at Nancy, and one at Bordeaux. These provincial towns, though remote from one another, were said to offer certain facilities of access to students from different parts of France. More complete arrangements were made for inducting the pupils into the routine of duties at the military hospitals, and in training them in the ways of military life and discipline, at the same time that they followed, as their predecessors had done elsewhere, the regular courses of medical and surgical studies at the respective Faculties of Medicine of the two towns. As soon as the pupils had completed their studies and obtained their doctorate at the Faculties of Medicine, they were moved to the Val-de-Grâce, and subjected to an examination as to fitness for military service. If this were passed successfully, they now entered the institution with the designation of "*Médecins Stagiaires*,"* and after completing a "*Stage*" of at least eight months at the school, they underwent another examination, the exit examination (*Examen de sortie*). This being passed successfully, the Stagiaire left the Val-de-Grâce with the grade of Aide-Major, 2nd class. This continued to be the system in force until the recent passage of a law establishing a new military medical school at Lyons.

"Médecins Stagiaires" at the Val-de-Grâce.

Law of 1888, creating the New Mil. Med. School at Lyons.

The law just alluded to, by which an entirely new school at Lyons has been created, having passed the Chamber of Deputies and Senate, was promulgated by the President of the Republic on the 14th December, 1888. It seems destined to exert a considerable influence on the training and education of the medical officers of the French army. The experience previously gained on these subjects was so fully considered, the provisions of the new law so amply discussed, during the passage of the bill through the French Parliament, while the outlay expended in the establishment of the school has been so considerable, that it may reasonably be expected the institution will endure longer than any of its predecessors without any fundamental change in its organisation.

Existing modes of recruiting the French Army Med. Corps.

The new law makes provision for the following modes of recruiting the regular medical service of the French active army:—

Mil. Med. Pupils.

(1) Medical students will be accepted between 17 and 22 years of age, provided they are found physically fit for military service, that they possess a diploma of Batchelor of Arts and Batchelor of Science, and that they succeed in passing an examination at a public competition which will be held annually under conditions determined by the Minister of War. Having complied with these requirements, they will be classed according to the results of the competitive examination, and will then receive letters of nomination to the School of Military Medical Service at Lyons. On admission to the school they will receive a gratuity for outfit, the amount of which is determined each year by the Minister of War; they will draw an allowance of 1,000 francs a year, which will be supplemented by further grants if it be shown that the resources of their family are

Explanation of the designation "Stagiaires."

* The period of time during which a barrister in France is obliged to attend the Bar before he can be inscribed on the Register of Barristers is called a "*Stage*," and the barrister during this probationary period is spoken of as an "*Avocat Stagiaire*." The term is probably closely related to the word *étage*, as applied to each successive story of a house. It was, no doubt, in imitation of the legal applica-

insufficient to assist in their maintenance at the school;* the books and instruments necessary for their studies will be supplied by the government; and the educational fees at the Faculty of Medicine are also defrayed by the government. In consideration of these advantages the pupils enter into an engagement to remain five years at study, or the period necessary for obtaining the diploma of Doctor in Medicine, and they sign a contract to serve at least six years in the Medical Corps of the active army, commencing from the date of their promotion to the grade of Médecin Aide-Major, 2nd Class, after leaving the Val-de-Grâce. The new school is strictly a military institution. All the pupils are quartered at the school, and they take their meals together at it. They wear a special uniform, and are in every respect under the same obligations of military discipline as the pupils at the other military schools in France.

Corporals and Privates from the ranks.

(2) In addition to the young students just named, corporals and soldiers of the army are allowed, under certain conditions, to compete for admission to the Military Medical School at Lyons. The conditions are that they must be above 22 years of age, and must have completed six months of real and effective service on the 1st of July of the year in which the competition takes place, but they must not be above 25 years of age at that date. They must be robust, and free from any disorder or infirmity likely to render them unfit for service; must have the diploma of Batchelor in Letters and of Batchelor in Science, and must have passed such a probationary period at a medical school as may satisfy the Minister of War. Medical students drawn as Conscripts would come within this class.

Civilian Doctors in Medicine.

(3) In addition to the pupils educated at Lyons, civilians who have obtained the diploma of Doctor in Medicine without having passed through any military school, are to be admitted in a certain proportion, which will be determined by the Minister of War, to compete for appointments in the medical service, provided they do not exceed the limits of age fixed by the regulations. If they are successful in passing the competitive examination, and the inspection as to physical fitness for military service, they will be admitted to the Special Military Medical School at the Val-de-Grâce and be enrolled as Stagiares, like the military élèves. Like them, also, they have

tion of the term, that the name "Médecins Stagiaires" was given to the Doctors in Medicine during their period of instruction and probation at the School at the Val-de-Grâce. The term is only applied to them during the interval between the time when they cease to be *élèves*—pupils—and when they enter the "Corps des Médecins Militaires" as Aides-Majors of the 2nd Class. The "Stagiaire," in French phraseology, corresponds with the designation "Surgeon on Probation" at the British Army Medical School, but while the stage of the former has a duration of nearly a year, the corresponding stage of the latter lasts only four months. The surgeons going through the courses of special study at the Val-de-Grâce are commonly spoken of, in brief, as "the Stagiaires," the word Médecins being omitted, excepting when employed to distinguish them from the "*Pharmaciens Stagiaires*."

* A list of the pupils to whom gratuities, complete or partial, are accorded after proof of the insufficiency of the fortune of their relatives to supply their needs, is published officially. The names of fifty-five pupils were published in lists of this nature, subsequently, to the competitive examination of the year 1889.

to enter into an engagement to serve at least six years in the medical corps of the active army, starting from the date of their acquiring the grade of Médecin Aide-Major, 2nd class. It is thought that the more honourable conditions of service which are now in force in the medical department of the French army will induce young medical men holding University degrees to join the corps in future who would have declined to do so under former arrangements.

Strength of the Corps of Military Surgeons in France.

The army medical recruits enlisted for service by the means just enumerated, are required to maintain the Corps of Military Surgeons of the active army (*Corps des Médecins Militaires*) at its proper strength. The strength of the corps, all grades included, was fixed by law in 1882 at 1,300, and this was the regulated number of the corps in 1889. In case of mobilisation, the cadre of the Corps of Military Surgeons would be completed by the surgeons of the reserve, and by those of the territorial army, who are under other and special regulations.

The Special Military Medical School at the Val-de-Grâce.

The special Military Medical School at the Val-de-Grâce has yet to be described. This school differs essentially, in its purpose and organisation, from the military medical schools which have just been referred to. They were schools at which the pupils resided, or to which they were attached, while they were acquiring the amount of knowledge which would enable them to pass the successive tests which were obligatory before they could obtain the diploma of a Doctor in Medicine. While they remained at these schools they studied their profession under conditions similar to those under which medical students acquire a knowledge of the medical sciences in England, as they are still doing at Lyons, with the sole exception, that they have been all the time under military control and discipline, and that the expenses of their education have been more or less completely defrayed by the Government under certain conditions of contract. The school at the Val-de-Grâce is a school for the special application of the general professional knowledge which has been thus gained, and is therefore analogous, in its general principles and purpose, to the Army Medical School at Netley.

Its institution in 1850.

The existing school at the Val-de-Grâce was instituted by a decree in the year 1850, and in it was designated the Practical School of Military Medicine (*École d'application de la Médecine Militaire*), and was described as being established for the purpose of causing Doctors in Medicine admitted for service in the army to pass at it one year's "stage." In a decree of 1852, by which the organisation of the school was determined, it was described as the Special School of Military Medicine and Pharmacy (*École speciale de Médecine et de Pharmacie Militaires*),*

* There are two classes of Stagiaires at the School:—"*Les Médecins Stagiaires*," Medical Candidates for Appointments, and "*Les Pharmaciens Stagiaires*," Candidates for appointments as Pharmaciens. These latter in the French Service more nearly agree with the English Apothecaries of former days, than with the Dispensers in the British Medical Service of the present time. In the remarks in the text the Medical Stagiaires only, as a rule, are mentioned or referred to.

and its purpose was referred to as being to complete the practical instruction of young doctors of the Faculties of Medicine seeking entrance into the Corps of Army Medical Officers (*Corps des Officiers de Santé Militaire*). In a subsequent decree, dated June, 1856, at the close of the Crimean War, when the establishment of the school was increased, and its organisation improved, its objects were described to be the initiation of the "Médecins Stagiaires" into the specialities of the exercise of their art in the army, to complete their practical instruction, to make them acquainted with the special maladies which have a predominance, or tendency to predominance, in armies, with the means of their prevention, and to give them a thorough knowledge of the regulations, laws, and decrees which govern the medical service in its relations with the army at large. Successive improvements in details of the school have been made since those dates, and it is maintained by those best acquainted with the establishment, that this progressive evolution has been attended by very favourable results.

Objects of the School.

Its correspondence in purpose with that of the Army Medical School at Netley.

Although the purposes of the two principal Military Medical Schools in France, and in England, are identical, viz., to secure for the public service thoroughly capable medical officers trained in the special duties of the branch of the military service in which they are destined to act, and well prepared to meet the varied emergencies that may possibly occur in the course of their service, yet it will be seen that the systems by which these objects are sought to be attained in the two countries, differ in some essential particulars. By the French system, the majority of the candidates for military appointments are relieved of the expense of obtaining their professional education. The Government gives the pupils (*élèves de santé militaire*), gratuitously, the whole of their medical instruction, from the first rudiments taught in the Medical Schools which they attend, to the advanced examination at a Faculty or University by which they obtain their Doctor's Degree; and, subsequently, after the Doctorat is acquired, the State continues to supplement, free of cost, the general education now possessed, by a special training in the particular duties of the branch of the public service in which, in the future, he will be occupied. For all this expenditure, the Government requires an engagement of service for a fixed period, and, in default of the engagement being kept, requires the money expended on education to be repaid to the State. According to the British system, a candidate for a Medical Commission must get his education, and his licenses to practice medicine and surgery at his own expense, and only gives him, at the cost of the State, that supplementary education which is essentially requisite to fit him to perform, intelligently, the special work he is called upon to do in the public service. The French system of undertaking the cost of the education, from first to last, necessarily entails heavy demands on the public purse, and it is questionable whether the State secures for itself as many advantages in return, as the British

Important differences in the systems of educating Military Medical Officers in France, and in England.

Government does by its less expensive plan. I had a conversation on the subject with a very experienced officer at the Val-de-Grâce, who has been concerned, for a long time, with military medical education in France, and he told me he was inclined to believe the English system to be the most advantageous, irrespective of questions of cost. He thought that, if the preliminary medical education were obtained by the *élèves* at civil schools, wholly under civil direction, they would be more thoroughly grounded in professional knowledge; and that, as regards military discipline, the habit of which is one of the chief alleged advantages of the existing system, his impression was that those who have come to the Val-de-Grâce, as Civil Doctors in Medicine, have been quite as amenable to military rules, as those who had received their medical education under military supervision and restraint.

I will now proceed to give an account of the plan of organisation and particular arrangements for carrying on the studies at the French Army Medical School.

Organisation of the Military Medical School at the Val-de-Grâce.

No pupil can be received at the School without the presentation of his diploma, proving that he has got the degree of Doctor in Medicine, or of Pharmacien of the 1st Class, or without fulfilling all the other conditions required by the regulations. On arrival, he is medically examined by one of the Staff of the School told off for the purpose, who has to be satisfied that the candidate is physically fit for military service. If the examining officer discovers the apparent existence of a disorder, or infirmity, such as might lead to an officer being placed on half-pay, it is his duty to propose the presentation of the candidate before the Special Military Invaliding Committee, if the candidate is already under engagement, or proposes that his admission should be postponed if the candidate is not engaged. If the disorder should be a curable one, but likely to occupy a long time in the treatment, the admission of the pupil is adjourned. Every case of the kind has to be fully reported to the Minister of War.

Personal Staff of the School.

The Personnel of the School is divided into two Sections:—(A) the Staff of the School for Administration and Discipline, and (B) the Teaching Staff.

Administrative Staff.

The former Section (A) consists of—

1 Médecin-Inspecteur, Director.
1 Médecin-Principal, 1st Class, Assistant-Director.
1 Médecin-Major, 1st Class, Librarian and Conservator of the Collections.
1 Médecin-Major, 1st Class, Major, for Discipline.
3 Médecins-Aide-Majors, 1st Class, Superintendents for Discipline.
1 Purveyor, 1st Class, in charge of Matériel and Paymaster.

The latter Section (B) consists of—

Teaching Staff.

6 Professors.
8 Assistant-Professors (*Professeurs-Agrégés*).

The Subordinate Staff of the School (*Le petit état-major*) is composed of—

Subordinate Staff.

1 Purveyor's Assistant.
1 Serjeant Hospital Attendant (*infirmier de visite*).
5 Serjeants of the Hospital Corps as Clerks for Records and Correspondence.
1 Serjeant-Instructor in Fencing (*Maître d'Armes*).
7 Corporals of the Hospital Corps, to assist as Clerks for Records and Correspondence.
12 Privates of the Hospital Corps, 1st and 2nd Class.

The Subordinate Civil Agents are—

1 Laboratory Assistant.
1 Doorkeeper at the Office of Direction.

System of Administration.

The general administration of the School is placed in the hands of a Director (*Le Directeur de l'École*), who is appointed by Presidential Decree on the proposal of the Minister of War. He is vested with much the same powers as those which are embodied in the Senate of the British Army Medical School. The present Director is Médecin-Inspecteur Gaujot. In his capacity of Director, he exercises authority over the personal Staff of the School, and over all parts of the school service, including the departments of administration, instruction, and discipline. He is in the same position as regards responsibility, authority, pay, and emoluments, &c., as the Directors of the Schools of the other Services of the Army. All orders, whether affecting the School generally, or special branches of it, emanate from him, and he makes all requisite arrangements that special circumstances not provided for in the School Regulations may need. Immediately under him is an Assistant-Director (*Sous-Directeur*), through whom, under ordinary circumstances, he receives the reports of the different members of the School Staff. In case of urgency, he receives the reports direct. He has the power of granting leave of absence within certain limits to the personnel of the School, and all proposals for advancement, or rewards, among them, whether military or civil, must be initiated by him. He appoints, suspends, or dismisses, such employés and subordinates as are not appointed by the Minister of War direct. In fact, on the spot, he represents the Minister of War, with whom he corresponds direct, and to whom he addresses, after each stage, observations on the conduct, studies, and health of the Stagiaires, and general working of the School. An official residence is provided for the Director within the precincts of the Val-de-Grâce.

The Director of the School and his functions.

The Sub-Director of the School.

The Assistant Director of the School—at present Médecin Principal 1st Cl., A. Badour—is at the same time the Principal Medical Officer of the Military Hospital of the Val-de-Grâce.

He, like the remainder of the officers of the school, is nominated by the Minister of War. He is not only the medium of communication, as before mentioned, between the Director and all parts of the service of the school, but he is in direct administrative charge of the discipline and maintenance of order in the school. The personnel of the school is under his immediate supervision and orders. In the absence of the Director he takes his place. He is not charged with any part of the teaching, but he is Director of Studies (*Directeur des Etudes*), and in this capacity exercises a general supervision and control over all that concerns the teaching and practical instruction at the school. One of his special functions is to watch that all the resources of the hospital, as regards the patients in it, are turned to account for the clinical instruction of the Stagiaires, and to this effect he arranges for the Stagiaires being present at all surgical operations, and all clinical expositions in the lecture theatre (*conférences cliniques magistrales*). He settles the days and times of these *Conférences* according to reports which he receives from the medical officers treating the cases, and from the professors and assistant professors of the school. If the assistant director is absent, the Médecin Principal highest in grade, or the senior officer present, acts in his stead.

The Major and Superintendents.

The Major and Superintendents are in direct executive charge of the discipline and good order of the Stagiaires, and watch over them in the discharge of their routine duties. These officers, as well as the purveyor and librarian act in conformity with the rules which govern all military schools in France, modified only by the special regulations affecting the interior economy of the Medical School in which they hold their appointments.

Three Special School Councils.

A particular feature of the School of Application at the Val-de-Grâce is the existence of three Committees or Councils, which form part of its constitution. These Councils are concerned in the management of the school, and meet at occasional intervals for the transaction of business. The Director of the School presides over each of them. They are (1) the Council of Improvement (*Conseil de Perfectionnement*); (2) the Council of Adminstration (*Conseil d'Administration*); and (3) the Council of Discipline (*Conseil de Discipline*). Each Council has its particular composition. (1). The Council of Improvement meets at least twice a year, but can be convoked at any time that the Director thinks fit. It is composed of the Director himself, President; of the Assistant Director and the Professors of the School; together with an Assistant Professor who is designated each year by the Director to act as secretary. This Council gives its opinion, at the same time stating the grounds upon which the opinion is formed, on all topics connected with the studies pursued at the school, and on any extraneous educational matters that may be submitted for its consideration by the President or one of its members. If its deliberations lead to a proposal for modifying the programme of work, or for a re-arrangement of the employment of the time at disposal for

Council for Improvement.

study, the minutes of the meeting are annexed to a request conformable with the proposal, and the whole is submitted by the Director of the School to the Minister of War. (2). The Council of Administration is composed of the Director of the School, President; of the Assistant Director; of the Major, who is charged with the duty of formulating the matters which the Council has to consider (*rapporteur*); the Purveyor and Paymaster; the Senior Professor and one other Professor. This Committee acts under the general regulations for the administration of army schools, so far as concerns the charge of equipment and property, and the disbursement of money. (3). The Council of Discipline is composed of the Director, President; the Sub-Director; one Professor, designated for the year by the Director; and of two Médecins Principaux or Majors from the garrison of Paris nominated by the Minister of War. This Council is charged with the task of promoting all measures which are necessary for the maintenance of order. Any Stagiaire who has committed a fault grave enough to justify his dismissal from the school must be brought before the Council of Discipline, and should the dismissal of the offender be proposed, the proposition is submitted together with particulars of the case to the Minister of War, who decides on the proposal. In the event, however, of any serious disorder or ot collective manifestation or fault, the Minister of War on the report of the Director of the School, without the intervention of the Council of Discipline, takes such measures as he may judge proper in the interest of discipline.

Administrative Council.

Disciplinary Council.

The influence of these Councils in effecting improvements in the organisation and working arrangements of the school will be better understood on mentioning that the Director of the School, Médecin-Inspecteur Gaujot, also holds a seat in the Special Technical Committee of the direction of the Army Medical Service at the War Ministry; and further, that this direction is charged, under the immediate orders of the Minister, with the treatment of all questions having reference to the personnel, matériel, and arrangements of the whole medical service, including the arrangements of the Military Medical School of Applied Science at the Val-de-Grâce.

Supervision of the Stagiaires, or Candidates for Appointments.

The Stagiaires, or candidates, are under constant supervision. It is the duty of the three Assistant Surgeon Majors (*Médecins Aides-Majors, 1 Cl.*), who have been before alluded to, in rotation to act as Orderly Officers (*Surveillants de service*), and to see that all orders are duly entered in the order book. The officer on orderly duty is responsible for the discipline, dress, and correct conduct of the Stagiaires, and for the proper condition of the places frequented by them. He has to supervise them in their work, and in the different exercises of the day. If anything is done by them gravely affecting good order or discipline, he is required to bring it to the notice, as a matter of urgency, of the Sub-Director, or, in his absence, of the Director of the School. The Orderly Officer sends in a report each morning at a fixed hour, to the Sub-Director, and accompanies him with the report to the Director. It is also the duty of the Orderly Officer to visit any of the Stagiaires who are sick, and, if necessary, to take steps for their admission into the hospital.

Housing of the Stagiaires.

Quarters are not provided for the Stagiaires at the Val-de-Grâce. They procure lodgings in the neighbourhood, and are restricted, as regards distance, to a radius of ten minutes walk from the establishment. On the 5th of each month, at morning roll-call, each Stagiaire must produce a receipt attesting that the hire of the lodging has been paid.

Messing of the Stagiaires.

Neither do they take their meals together, as the élèves do at the Military Medical School at Lyons, nor is there at the Val-de-Grâce any Mess like the Medical Staff Mess at Netley, at which commissioned officers of various grades dine together in common with the candidates for commissions. The Stagiaires take their meals, a certain number together, at Pensions, the number of which is determined by the Director of the School. The tariff of prices must also receive the approval of the Director. Each table at which the Stagiaires breakfast and dine together must have a President, who is responsible that order and proper conduct are preserved, and who must present on the second of each month, the table account book for the inspection of the Sub-Director, in order that he may verify the payment of the monthly account. Each table has also a Vice-President who acts in case the President is absent. The names of the Presidents and Vice-Presidents, who are changed every month and are selected by the Stagiaires who board together, must be submitted on the last day of each month to the Aide-Major on duty at the morning roll-call. Their duties begin on the first of each month. No Stagiaire can change his pension without previously obtaining the sanction of the Sub-Director, and it is the duty of the President of each table to notify to the Sub-Director any changes that may occur at the pension where he is in charge. All the Stagiaires who take their meals at the same pension are alike subject to one rule at the establishment. They must take two meals every day at the pension, fête days and days when a Stagiaire is on guard, excepted. On such occasions, and on warning the master of the pension the evening before, the day's or half-day's absence entitles the Stagiaire to a deduction in proportion on the cost of the pension. If the family of a Stagiaire is living in Paris, he may take his evening meal with his relatives provided he obtains the sanction of the Sub-Director, but he must take his morning meal with his comrades.

Uniforms of the Stagiaires.

The Stagiaires while on duty in the hospital and in the school must all appear in uniform. There is a distinct uniform for the morning, the *tenue d'école*, or *tenue du matin*, and one for the afternoon, the *tenue du jour*, the latter being worn from one o'clock. There is also a full dress uniform, the *grande tenue*, and the riding-school dress, or *tenue d'équitation*. The morning uniform consists of tunic, madder-dyed trowsers, forage cap, boots, or plain ankle boots, buck-skin or chamois-coloured gloves, while from one o'clock, in addition to the foregoing, the

sword must be worn. In the full uniform which is worn on Sundays and fête days, the goat-haired shoulder cords are replaced by embroidered shoulder straps. For the riding school the morning uniform is used, but, instead of the trowsers, breeches fastening at the knees and long riding boots are worn.

Regulations regarding dress of Stagiaires.

The school or morning uniform is allowed to be worn outside the establishment on ordinary days till five o'clock. After five o'clock, and also on Thursdays and other holidays, except fête days, either the *tenue du jour* with the sword must be worn, or civilian clothes. When out of school and not on duty, the Stagiaires are authorized to wear civil dress, but it must be suitable, not such as to occasion equivocal observations.

Grades of disciplinary punishment at the School.

The Stagiaires are subject to five various grades of punishment. Every infraction of the Orders and Instructions contained in the School Regulations and Order Book is punished according to the gravity of the fault, and no excuse is admitted for ignorance of orders. The grades of punishment are as follows:—(1) Simple arrest. Three days of simple arrest entail the loss of one day's leave of absence during the vacation. (2) Close arrest, within the locality of the school. Close arrest incurred three times entails being put in the School Orders. (3) Being put in Orders. (4) Confinement in a military prison. The sentence of military imprisonment repeated three times becomes a motive for dismissal. (5) Dismissal. (Every absence from roll-call, from a lecture, or from clinical instruction, when permission has not been officially obtained, renders the defaulter liable to the stoppage of one day's pay, in addition to the disciplinary punishment.)

The Professorial Staff.

The teaching staff of the school, as before mentioned, consists of six Professors and eight Assistant Professors. One of the latter has been recently added to the establishment to fill the Chair of Bacteriology (*Microbie*). The table which follows shows the subjects of the Courses of Instruction which the Medical Stagiaires will go through at the Val-de-Grace during the present year (1890), together with the ranks and names of the Professors and Assistant Professors who at present hold the respective Chairs:—

Subjects of Instruction during the present year 1890.

No.	Subjects of Instruction.	Grades and Names of Professors.
1.	Clinical Medicine	Prof. Méd. Prin., 2 Cl., Laveran; Prof. Méd. Prin., 1 Cl., Kelsch (in succession to each other); Asst. Prof. Méd.-Major, 2 Cl., Duponchel; Asst. Prof. Méd.-Major, 2 Cl., Antony (in succession to each other).
2.	Clinical Surgery	Prof. Méd.-Major, 1 Cl., Delorme; Asst. Prof. Méd.-Major, 1 Cl., Moty.
3.	Clinical Ophthalmology ...	Prof. Méd. Prin., 1 Cl., Chauvel.
4.	Venereal and Cutaneous Diseases (clinical).	Asst. Prof. Méd.-Major, 2 Cl., Nimier; Asst. Prof. Méd.-Major, 1 Cl., Vautrin (in succession to each other).
5.	Military Surgery, including Wounds and Injuries of War.	Prof. Méd.-Major, 1 Cl., Delorme; Asst. Prof. Méd.-Major, 1 Cl., Moty.

No.	Subjects of Instruction.	Grades and Names of Professors.
6.	Diseases and Epidemics of Armies.	Prof. Méd. Prin., 1 Cl., Kelsch; Asst. Prof. Méd.-Major, 2 Cl., Antony.
7.	Legal Medicine, Military Medical Legislation, Service, and Administration.	Prof. Méd. Prin., 2 Cl., Du Cazal; Asst. Prof. Méd.-Major, 2 Cl., Duponchel.
8.	Optometry, Ophthalmoscopy, Otoscopy, Laryngoscopy.	Prof. Méd. Prin., 1 Cl., Chauvel; Asst. Prof. Méd.-Major, 1 Cl., Vautrin; Asst. Prof. Méd.-Major, 2 Cl., Nimier.
9.	Toxicology and Chemistry, applied to special wants of armies.	Prof. Pharm.-Major, 1 Cl., Burcker; Asst. Prof. Pharm.-Major, 2 Cl., Gessard.
10.	Surgical Anatomy, Surgical Operations and Apparatus.	Prof. Méd. Prin., 1 Cl., Chauvel; Asst. Prof. Méd.-Major, 1 Cl., Vautrin; Asst. Prof. Méd.-Major, 2 Cl., Nimier.
11.	Military Hygiène	Prof. Méd., Prin., 2 Cl., Laveran; Asst. Prof. Méd.-Major, 2 Cl., Burlureaux.
12.	Bacteriology, Histology, and Pathological Anatomy.	Asst. Prof. Méd.-Major, 2 Cl., Vaillard.
13.	Mental Diseases (clinical) ...	Asst. Prof. Méd.-Major, 2 Cl., Burlureaux.
14.	Ambulance Drill and Exercises	Asst. Prof. Med.-Major, 1 Cl., Moty.

Instruction in Equitation and Sword Exercise.

The instruction in Fencing and Sword Exercise, as well as the instruction in the Riding School, are not shown in the foregoing table. The instruction in sword exercise is given between 4 and 5 o'clock on every day of the week, excepting on Thursday and Sunday; the instruction in the Riding School takes place in the mornings of Thursday and Sunday.

Duties of the Professors and Assistant Professors.

The duties of the Professors and Assistant Professors are stated in the School Regulations to consist in giving to the Stagiaires the courses of lectures and practical instruction, &c., set forth in the programme, which shows the manner in which the time of instruction is to be distributed, and in carrying out the special orders of the Director and Sub-Director of the School on these matters. The military medical officers while engaged as Professors receive the pay of their army grade augmented by one-third, in accordance with the rule which governs the pay of officers of all arms of the service while acting in professorial capacities at military schools. The Professors and Assistants must all wear their military uniform while on duty, whether in the lecture room or elsewhere.

Their pay and remuneration.

Selection of Professors.

The professors are selected from among medical officers who have formerly been assistant professors at the School, or who are actually holding the position of assistants. They are nominated by the Minister of War, after selection from two lists, each of three candidates, one list being submitted by the "Council of Improvement" (*Perfectionnement*) of the School, the other by the Direction of the Medical Service in the Ministry of War. They must be of the grade of Médecin-Major, 1 Cl., at least, and of Médecin-Principal, 1 Cl., at most. The Professorships are ten years' appointments. A professor has frequently passed to be Director of the School, and the Director of the School to be at the head of the Medical Service in the Ministry of War. The present Director was Professor of Military Surgery in the School a few years ago. The Assistant-Professors are nominated through competition only. Médecins-Majors, 1 Cl. and 2 Cl., are admitted to the competition. The duration of their appointments as Assistants is fixed at 5 years.

Their elevation to higher official positions.

Periods of study appointed for the present year (1890).

The portion of the year devoted to teaching is divided into two periods. These periods have usually each lasted four months; but for the present year (1890), the first period is one of four months, from the 1st of January to the 30th of April; while the second period is one of six months, from the 1st of May to the 31st of October. A printed table is prepared to show the order in which the courses of instruction are to be given, together with the period of the year, the days of the week, and the hours appropriated to each subject. This table is signed by the Minister of War, and by the Médecin-Inspecteur, Director of the School. Although the whole "Stage" lasts from the 1st of January to the 1st of November, the lectures on particular subjects last only for given portions of this period; some from the 1st of January to the 1st of May, others from the 1st of January to the 1st of July, others from the 1st of May to the 1st of September; while the practical instruction and exercises on certain special subjects last from the 1st of January to the 1st of November. Ambulance drill, surgical operations on the cadaver and applied chemistry, are principally carried out at the latter part of the stage, from the 1st of May to the 1st of November.

Daily routine of duties of the Stagiaires.

The following is an outline of the manner in which the time of the Stagiaires is usually passed at the School. There is a roll-call every morning at 7.15 o'clock. After the roll-call, the Stagiaires go to the hospital and take part in the clinical service of the wards, until 9 o'clock. On three days of the week clinical lectures are given from 9 to 10 o'clock, and on these days the Stagiaires assemble at the prescribed time in the Amphitheatre. At 10 o'clock they leave to go to their pensions for breakfast, and return to the School at noon. From noon to 5 o'clock there are lectures, conferences, practical instruction, sword exercise, &c., conformably to the programme for the employment of the time. Twice a week the Stagiaires go in detachments to the Chief Military Riding School of the Garrison of Paris to be exercised in horsemanship.

Each Stagiaire, on arrival at the school, is provided with a locker in a lobby set apart for the deposit of articles of clothing, the key of which remains in his possession until he leaves the school. He also receives a kind of blouse made of canvas (*un sarrau*) to wear over his uniform for its protection, while he is engaged in his various kinds of work at the school.

The Library at the Val-de-Grâce.

He has the use of the library at certain hours of the day. The library is contained in two rooms, which communicate with each other. The rooms are all that could be desired for purposes of study; they are well lighted, largely stocked with books, are comfortably furnished, and are fitted with every necessary appliance for reading and writing. A Médecin-Major, 1 Cl., on the retired list, is the librarian, and he has under his orders a Serjeant as assistant. The same officer is also the Conservator of the Museums and various collections at the school.

Pay of the Stagiaires.

The Stagiaires receive their pay monthly in arrear. The net amount is 241 fr. 50 c., about £9 12*s.* sterling a month. The sum allowed for a Stagiaire's outfit of uniform at starting is 350 fr., about £14.

Medical equipment of the Stagiaires.

Each Stagiaire must be provided with a regulation case of pocket instruments, a dissecting case, ophthalmoscope, and stethescope. He has also to provide himself, at his own cost, with a note-book of a certain pattern, in which he has to note observations on the cases of patients who are selected for the purpose by the chief of the division of the hospital in which the Stagiaire is serving.

Supply of Subjects for the Practice of Operative Surgery.

As far as I could learn, there is an ample supply of cadavers for the practice of surgical operations and for such regional anatomy as is carried out at the school. The sentimental objections to utilising the bodies of the dead for this essential part of a surgeon's education, which are so great a hindrance to the practise at Netley and elsewhere in England—objections which are really in the highest degree detrimental to the interests and welfare of the living—hardly appear to be encountered in Paris. At the Val-de-Grâce, the distribution of the cadavers is made personally by the Professor of Surgical Anatomy, who directs what regional parts are to be prepared, and superintends the dissections. None of the hospital staff, nor any Stagiaire, can proceed to make an autopsy, or to practice an operation, on a cadaver, without the authority of the Sub-Director being duly notified to the Professor of Surgical Anatomy. The professor sends a return every day to the Sub-Director, indicating the resources of the dissecting-room in order that measures may be taken in time for insuring the continuance of the anatomical work, or, in its stead, the substitution of other practical work. Each Stagiaire is required to give a demonstration, under the direction of the chief of the anatomical department, of the region which he has prepared, and every fortnight, the "Dissection Register," in which a daily entry is made of the work done by the Stagiaires, is sent to the Sub-Director, or Director, for his scrutiny and signature. The practice of surgical operations on the cadaver is directed by the Assistant Professor, and especial attention is given to familiarising the Stagiaires with the operative proceedings which are the most commonly employed in military practice.

Regulations regarding the practice of Dissection and Operative Surgery.

Practice of Ambulance Manœuvres.

The practice of stretcher drill and other ambulance manœuvres forms an important part of the special education of the Stagiaires. I visited the shed in which a collection of ambulance conveyances, stretchers, litters, cacolets, and wheeled vehicles, available for this instruction was kept. The Stagiaires are required, each in turn, to take command of their comrades, or of soldiers placed at their disposal for the purpose, when learning ambulance drill. There are two concise manuals, with copious

illustrations issued by the Ministry of War, bearing on ambulance topics; one, the "*Manuel du Brancardier Militaire,*" affords instruction on the transport of wounded between the fighting line, dressing stations, and field hospitals, by means of stretchers, mule conveyances, and ambulance wagons; the other, the "*Manuel de l'Infirmier Militaire*" has reference to the duties of hospital orderlies in the fixed and stationary field hospitals, as well as in the service of the active field hospitals, including the care of the wounded at their collection in the field and during their transport to the rear.

Practice of Chemical and Hygienic Manipulations.

As regards the practical instruction in applied chemistry and hygiene, the manipulations are ordinarily directed by the Assistant Professor, but also, when thought necessary by the Professor of Chemistry, as well as by the Professor and Assistant Professor of Hygiene. There is only one chemical laboratory, and this is under the direct charge of the Pharmacien-Major, who is the Professor of Applied Chemistry and Toxicology, but it is placed, when required, at the disposal of the Professor of Hygiene for the experimental illustrations belonging to his course of instruction. The Stagiaires are directed to exercise as much economy as possible in the expenditure of re-agents and chemical substances, as well as to take the greatest care of all instruments and laboratory utensils; while any instances of injury or waste, entailing expense, if caused by abuse or carelessness, are charged to the Stagiaires concerned. Each year the Stagiaires visit, under the direction of the Professor and Assistant Professor of Hygiene, the greatest number practicable of military establishments possessing interest from the point of view of military hygiene (barracks, old and modern, prisons, hospitals, military bakeries, etc). These excursions are settled by the director of the school on the proposition of the Professor of Hygiene. On the occasions of such visits the Stagiaires are required to prepare reports on the matters brought to their notice.

Visits of the Stagiaires to Military Establishments.

The Stagiaires are classified on entering the school according to the results of a special entrance examination, but their positions on the list are subject to changes made at certain intervals during the period of their stay in the school. These subsequent re-arrangements of the list are made on the 1st of March, 1st of May, and 1st of July, and are determined by the marks obtained by the Stagiaires as the results of oral examinations and practical exercises during the two months which precede the several periodical classifications. Before quitting the school there is another and final classification of the Stagiaires. This classification depends partly on the estimate of the work done by each Stagiaire during the whole time he has been at the school, and partly on the estimate of his merit as shown by the results of a searching examination at the conclusion of his stage (*examen de sortie*).

Classification of the Stagiaires.

This exit examination is of a very extended character and is specially organised. The fact of the school being above all intended to familiarise the Doctors of Medicine admitted as Stagiaires with the special conditions presented by military

Examination of the Stagiaires before they quit the School.

medicine, in its broadest sense, from the points of view of hygiene, treatment, and military regulations, is constantly kept in mind, and the tests to which they are subjected at this final examination are essentially practical in their scope. The trial is conducted in seven sections, and is based on the following subjects:—(1) Clinical examinations of medical and surgical cases; (2) Regional Anatomy and Operative Medicine; (3) Epidemiology and Military Hygiene; (4) Wounds and injuries of war; (5) Expert proceedings in Military Medico-legal matters; (6) Chemistry in its applications to Hygiene and Legal medicine; (7) Laws, Regulations, and Instructions concerning and affecting the Army Medical Service and its Personnel.

Mode of conducting the Final, or Exit Examination.

The jury under whose supervision the final examination is conducted, and upon whose decisions the results of the trials to which the Stagiaires are subjected depend, is presided over by the chief of the Military Medical Corps, the Médecin Inspecteur Général, or, in his absence, the Senior Médecin Inspecteur. The jury is divided into two sections, a Medical and Surgical section so far as the "Médecins Stagiaires" are concerned; there is a third section for the "Pharmaciens Stagiaires," but the proceedings which concern these officers, as before mentioned, are not included in this report. Each section of the jury is composed of an Inspecteur, as president, of either medical or surgical origin according to the nature of the section; a professor, in the department of instruction referred to in the examination; and of two medical officers, of either medical or surgical origin according to the section, who must be unconnected with the school educational staff. The president of the whole jury takes the presidence of either the medical or surgical section, according to his own professional origin, and at the close he combines and centralises the results of the two sections together.

Constitution of the Examining Juries.

The Book of Examination Questions.

The lists of questions and subjects on which the Stagiaires are to be examined are officially settled, and are printed together in a separate pamphlet (*Questionnaires des Examens de Sortie*). They are very numerous, and are all based on the subjects which have been taught in the courses of instruction. At the time of the examination, the Stagiaire draws by lot the question he has to reply to, or the subject he has to work out, whether the answer has to be given in writing, orally, or to be practically demonstrated. The clinical tests are conducted in the same way: certain patients are selected, and the Stagiaire draws by lot the names of the patients whose cases he has to diagnose and report upon. The examination is a public one. The Stagiaire may be questioned on the subject to which he has replied, or on any other subject similarly drawn from the official Book of Questions.

The Examination in the Medical Section.

The test examination in the medical section consists (1) of a clinical inspection of two patients in the medical division of the hospital. Diagnosis, and treatment recommended, must be stated; the trial must be completed within 30 minutes at most. (2). A composition on a given subject of military hygiene and

epidemiology, for which three hours are allowed. The papers must be written, without reference to notes or books, under the supervision of a member of the jury, who, when the compositions are finished, places them under a sealed cover and transmits them to the President of the Section. Afterwards, at a meeting of the jury, each Stagiaire receives his composition from the President, and reads it before the jury, who then assign a certain value to it. (3). Examination of an individual with regard to his physical fitness for military service; of a subject with regard to invaliding and discharge from service, claim to retiring pension or renewable gratuity; preparation of the medical certificates regarding the foregoing, together with an oral justification and explanation of the conclusions set forth in them. Half an hour at most is allowed for this test.

The Examination in the Surgical Section.

The examination in the surgical section is conducted under similar conditions. Under (1), two surgical patients take the place of the two medical patients; under (2), the written composition is on a subject connected with military surgery; under (3), instead of the tests in military medico-legal matters, each Stagiaire has to perform two surgical operations selected by the jury, after having given an exposition of the anatomy of the region on which the operations are practised. The duration of this trial must not exceed 30 minutes.

The juries are furnished at the time of the examination with the marks previously gained by the Stagiaires in the different branches of teaching during the year. The marks handed in to the jury superintending the medical section include those which have been awarded by the Professor of clinical medicine, by the Assistant Professor in charge of the clinical practice, and by the Assistant Professor in charge of the pathological demonstrations; as to military medicine, those which have been awarded by the Professor of Epidemiology, and those by the Professor of Hygiene; and as regards practical exercises, the marks given by the Professor charged with teaching Ophthalmoscopy, and those allotted by the Assistants who deal with the practice in the use of the ophthalmoscope, otoscope, laryngoscope, in the chemical applications of chemistry to army medicine and in military medico-legal medicine. The marks awarded by the Professor of Military Administration are also furnished to the Medical Section.

The marks handed in to the jury controlling the surgical examination include those awarded by the Professor of Clinical Surgery, by the Assistants charged with the surgical clinical practice, and with the demonstrations of bandaging and use of surgical appliances. Marks are also furnished by the Professor of Anatomy, the Professor of Operative Surgery, and the Assistants belonging to these two courses of instruction. Additional marks are supplied by the Professor of Military Surgery, and by the Assistant Professors charged with practical exercises in this branch, and with the ambulance drill. Marks for equitation are also furnished from the Riding Master to this jury.

Mode of arriving at estimates of the respective merits of the Stagiaires.

The mean of these previously gained marks is taken as one figure of valuation, the mean of the number of marks awarded by the juries at the final examination forms a second figure of valuation, and these being added together, their mean gives the co-efficient of the general value of the results of all the examinations. The classing of the Stagiaires takes place at a meeting of both sections of the Jury, and the results are then forwarded to the Minister of War with a report on the general bearing of the Stagiaires, their professional knowledge, practical ability, and with any other observations that the course of the examination may have seemed to render advisable.

Subjects of examination at the Val-de-Grâce, and at Netley, similar, but the examination differently conducted.

It will be seen, from the foregoing description, that the subjects on which the Stagiaires are tested at the final examination are very similar in nature to the subjects on which the surgeons on probation at Netley are examined before they leave the Army Medical School; but that the manner in which the examination is conducted differs in a variety of details, while it is much more formal in character and much more prolonged in duration of time.

Efforts made by the French Government to maintain professional excellence among Medical Officers after leaving the Val-de-Grâce.

The efforts to stimulate and develop the professional knowledge of the medical officers do not cease on the part of the French Government with the departure of the Stagiaires, or Médecins Aides-Majors as they become, from the Val-de-Grâce. Efforts are continued by various means to ensure a high standard of scientific attainments among them. To encourage attention to professional work two prizes consisting each of a gold medal of the value of 500 francs (£20) are accorded annually to the best work on questions of military medicine and surgery. The names of all medical officers who in the opinion of the Medical Technical Committee at the Ministry of War have particularly distinguished themselves by their professional reports, or services, are published for the information of the Army in the Official Gazette (*Journal Officiel*). No Médecin-Major, 2nd Class, is promoted to the 1st Class, or Médecin-Major, 1st Class to the grade of Médecin-Principal, without passing successfully an examination of fitness. With regard to the Médecins-Major, 1st Class, the examination is optional, who may decline it, but in doing so they forfeit further promotion. With those of the 2nd Class the examination is compulsory. The subjects of examination are laid down in special Ministerial circulars. Medical Officers on return from foreign service, as well as occasionally under other circumstances, are permitted to refresh their recollections and to make themselves acquainted with fresh advances in science at the school at the Val-de-Grâce when they can be spared from their ordinary medical duties. The nominations and promotions in the Order of the Legion of Honour are very liberally dispensed among the medical officers of the army, not only for services in the field, but also for conspicuous scientific merit and special devotion to professional duties.

Recent Improvements at the Val-de-Grâce School.

Since I commenced writing this report, Médecin-Inspecteur Dr. Gaujot, the present distinguished Director of the school at

the Val-de-Grâce, has been kind enough to furnish me with information respecting the school arrangements for study during the present year (1890), and on many other points of interest regarding the establishment. Much of this information I have already embodied in the report. It will be useful, however, in conclusion, to indicate those modifications, recently introduced in the teaching of the school, to which the Director, Dr. Gaujot, has been good enough to inform me, he attaches most importance. They are the following:—

The Bacteriological Laboratory.

1. The institution of a Bacteriological Laboratory. Arrangements have been made for the performance of one of the particular functions of this new laboratory—the examination of samples of water and dust from suspected localities, sent under orders of commanding officers—being carried on permanently.

Study in Microby.

2. The considerable development of the study of Microbes. This study is now pursued by all Stagiaires, and by many of the older surgeons.

Hygienic demonstrations at special military institutions.

3. The extension given to the practical teaching of hygiène by demonstrations in the Museum, and in outside establishments where matters of hygienic concern can be observed and studied (systems of sewerage, provision supplies, drainage operations, &c.). The Stagiaires are now conducted systematically by their Professors to these establishments.

Advanced courses of instruction for Médecins-Majors.

4. The institution of an advanced course of instruction designed for Médecins-Majors on the active list. These medical officers are ordered in successive parties, each 12 in number, to assemble at the Val-de-Grâce for purposes of study, especially to become acquainted with new scientific processes in bacteriology, ophthalmoscopy, operative medicine, and hygiene. Each party of medical officers so sent receives leave of absence from their ordinary duties for six weeks.

Institution of an Animal Vaccine Establishment.

5. The creation of a Central Vaccine establishment at the Val-de-Grâce, at which the lymph is taken direct from the cow. In addition to its use for teaching purposes, this vaccine institution affords a permanent supply of animal lymph for the whole of the army of Paris, and for a considerable number of troops elsewhere in France and in the Colonies.

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CYPRUS.

REPORT

ON THE

FEVERS OF CYPRUS,

BY

DR. F. C. HEIDENSTAM, C.M.G.,
CHIEF MEDICAL OFFICER OF CYPRUS.

COLONIAL OFFICE,
May 1886.

CYPRUS FEVERS.

Report by Dr. F. C. Heidenstam, C.M.G.

A GREAT deal has been said on the Cyprus fevers, and although their frequency and venomous character has been greatly exaggerated their existence was, and still is to a certain degree, an indubitable fact. They are mentioned by the oldest authors who have written about Cyprus, and they are now met with daily.

Amongst other authors writing of this island, Stefano Lusignan states in his "Chorograffia e breve Historia, "dell isola di Cipro principiando al tempe di Noë per fino "al 1572," page 6, although the climate of Cyprus is very fine, fevers often occur, especially in the low plains.

In Thomas Parcacchi Castiglione's work, entitled "L'isole Piu Famose del Mondo," 1663, p. 146, he states that the pernicious atmosphere emanating from the stagnant waters, and which spreads itself over the island, is one of the greatest objections to habitation in Cyprus.

P. N. Mariono Marone da Malco states in his work, entitled "Terra Santa," 1669, Chapter XXVII., p. 493, on climate, that the climate of Cyprusis beneficial in the mountainous districts, but in the plains and near the sea much water accumulates during the winter months, forming marshes which are most unhealthy during the summer season.

Giovanni Mariti in his "Viaggi per l'isola di Cipro," 1799, states, under the heading of climate, page 5: "The "opinions of a great many old authors on Cyprus are that "the atmosphere is very unhealthy, the terzana and "quartana is very common, but the effects being due "to miasma may be easily avoided;" he then proceeds to state from personal experience the means to be employed to this effect, he having suffered from it himself. On page 157 of the same work, speaking of Famagusta, he states, "that the atmosphere in question is worse than "any other part of the island, not only from the excessive

" heat, which is far more intense there than in the remain-
" ing portion of the island, but owing to the position
" of the Lake Constanza, which lies quite adjacent, and
" from which a most pernicious miasma constantly arises
" in large quantities."

L. Lacroix, in his work entitled "History of Cyprus," published in 1877, speaking on the climate of the island, says that the ancients state that the air of the island is very unhealthy, and as a proof of this statement mentions the fact that the troops of St. Ludovic, when passing through the island in 1259, all suffered severely from fever.

Capt. R. Saville, in his work "Cyprus," published 1878, states that the fevers which are prevalent in July and August are but seldom of a malignant or dangerous type, and by proper care and attention to diet they may be avoided. It is found that the fevers usually attack those who indulge in an over abundant diet of cucumbers, melons, and fruits, but comparatively seldom affect those who can afford better nourishment. Inflammations, agues, and fevers also frequently arise from imprudent exposure to either sun or wind, and from sleeping at night in the open air or near the marshes, and this risk ought to be carefully guarded against.

The term fever is supposed to signify an acceleration of the circulation, thirst, loss of appetite, elevation of the temperature, prostration of the bodily and mental powers, and a general disorder of the secretive functions. These symptoms are due to a certain cause which may be of sudden occurrence or of a slow character, mild or powerful; they may temporarily linger in action or appear at once; they may be of a most dangerous character or eventuate in a speedy recovery, according always to the power of the motor causing them, and the constitutional predisposition of the person affected.

All fevers exhibit at their commencement about the same phenomena, which at a later period take a typical character, thus facilitating their diagnoses and classification.

The difference existing between fevers consists principally in the cause from which the disease is derived. The intermittent and remittent are due to palus or paludal miasma, known as malaria, and this is the principal form which exists in Cyprus, increasing or decreasing according to the circumstances favouring or

disfavouring their origin, and the assumption that those fevers may result from other causes than from infection of malaria is simply puerile and not based on correct principles.

Paludal miasma has been generally described as a poisonous invisible effluvium emanating from marshes or marshy lands produced by the moisture of a soil rich in organic vegetable matter, and, although in the analysis of the air surrounding marshy localities no poisonous principles have been absolutely defined, the existence in the atmosphere of particles so minute as to escape not only the human vision but the highest power of the microscope has been proved.

The existence of definite organic growths in the soil and water of marshes having been detected leads to the natural conclusion that malarial miasma is a low organism which like many others exist and float in the atmosphere in an imperceptible form, pervading the human system exposed to it and varying in its effects in accordance with the constitutional predisposition of the person affected and the quantity absorbed, and in like manner to all poisons the constitution gradually becomes accustomed to its prejudicial effects.

Although the natural history of the malaria germ is still somewhat obscure, the studies of its nature having been very limited, the existence of living microbes in the systems of persons suffering from fever is an indubitable fact and can easily be ascertained by the examination through a powerful microscope of a drop of blood taken from a patient suffering from malarial fever, and not under the influence of pyretics. According to my repeated and careful observations of the blood taken from several persons suffering from malarious fever, I have detected the existence of a small spheroidal cellular body generally adherent to the hæmatin, from which it appears to derive its nourishment and sustenance as the development and growth of this parasitical element degenerates and ultimately destroys the hæmatin.

The fact once established of the existence of microbes in the systems of persons suffering from fever, it can easily be conceived that an agent which circulates in the blood by which it is carried into all the organs and tissues, destroying the hæmatin, will constitute anæmia, excite the nervous centres, obstruct the vascular departments, and cause inflammation of the viscera and spleen, more especially of the latter, which would appear to be a spot for which those growths have a predilection, since in that organ the greatest number are always detected.

The above-mentioned are identically the morbid processes which constitute the clinical and pathological manifestations of elodes, and accordingly the interval between the period of introduction into the system of the miasma and the manifestation of those disorders, as also the variety in their effects, depends, as I have before stated, in a great measure upon the quantity absorbed, and the individual susceptibility of the person infected; thus, in one person the effects are only a slight anæmia and prostration, in another fever varying in its symptomatology and recurrence, and in a third serious disorders.

Fevers due to malaria are therefore endemic only in marshy localities and in those only when the temperature is constantly of a sufficient height to foster their existence and development, and are not met with in some typical swampy localities which do not present the temperature required. It appears to me, as far as my observations take me, that the necessary temperature for the breeding of the germ is a continuous temperature of 75° Fahrenheit and upwards. The following observation amongst others supports this theory. In Nicosia fevers began and were prevalent in the middle of July 1884, the thermometer then registering over 75° Fahrenheit, while at Larnaca only 26 miles distant, owing to fresh breezes the temperature did not rise to this height until the 15th of August, one month later, and until that date fevers did not exist. In Nicosia again, in the month of September, the temperature suddenly falling the fevers abated and recommenced in October when the thermometer for several days registered over that standard.

Not only have fevers completely ceased by the filling up of marshes in the adjacent localities, but even the addition to a marsh of a substance capable of preventing the breeding of the malaria germ is enough to stop the evil effect of the fever. This view is supported by the fact that I have often as an experiment stopped for a short period the prejudicial effects from known circumscribed fever breeding areas by the addition thereto of sulphate of iron.

The miasma, when favoured with currents of air not too powerful to scatter it, may be conveyed long distances and reach high regions. I have not however seen

it rise above a certain height; which fact I attribute more to the change of temperature than actually to a limit of its powers of ascension, supposing that the transporting medium continues to present the same advantages for its transport as at the starting point. Water, owing to its great absorbent powers, is also a factor of this miasma, and through its means malarial affections are communicated at great distances when it is used for drinking purposes, and in many cases I have observed that a defective watercourse was the sole agent for the introduction of the poison to localities where no other reason for the existence of malarial miasma could be detected.

Cyprus, generally speaking, is not a marshy country, at least, if we adopt the hygienic acceptation of the word marsh. There exist however low situated localities in the plains, which during winters of heavy rain are submerged with the water, which finds its way from the surrounding heights and becomes stagnant, or under other circumstances where the soil is dry and porous large accumulations of subsoil water are met with, and lastly in many of the principal towns and villages, owing to the overflow of defective watercourses or to the want of proper drainage, water is allowed to locate in low sites and there form stagnant ponds. The above-mentioned accumulations on a soil rich with organic matter of vegetable origin form the malaria foci to which the fevers of this island must be attributed and which would account for the prevalence of fever in what could be termed an epidemic form only after very rainy winters.

Malarious fevers have been generally divided into various classes, and some of these classifications are so complicated that it is difficult to believe that one single agent can produce so many different effects, and many who have not had the occasion of clinically observing the affection are at a loss to understand those multifarious varieties or may be under the impression that malaria is the motor of several different diseases.

After 12 years' practice in more or less malarious regions, seven of which have been spent in Cyprus where I have had the occasion to carefully study fevers, I may say that although there exists a certain variety in the symptomatology the form is of a regular and almost monotonous type, altering only in its manifestations by the symptoms becoming more or less protracted or intense.

The types which are generally met with in Cyprus are the intermittent and the so-termed remittent, which is in fact the same with the sole exception that there is no clear remission, the temperature standing for a longer period over the normal and taking a continuous form.

Those fevers are miasmatic but not contagious although some authors consider them so. This assumption seems to have been made without sufficient authority and is not borne out by recorded facts. There is no proof of their communication from body to body, and it is clearly proved that intermittent and remittent fevers are never introduced into localities by patients who may have contracted them in malarious regions, neither have I met any one who had contracted the disease by contact with patients suffering from it; we have daily examples in the hospitals and in houses where there is one person ill with the fever and another in the next bed or the whole family occupying the same room and are not affected with the disease.

All ages and both sexes are alike susceptible to the infection; many causes I have remarked may however increase the predisposition or favour the development and character of the malady. The chief or principal I have noticed are constitutional predisposition, debility, fatigue, exhaustion, insufficient clothing, moral depression, improper or insufficient food, and intemperance.

Anatomical Appearances.

Post-mortem examinations of persons who have died from the effects of simple intermittent fever are rare. I have had however occasions during my long residence in malarious regions to examine the bodies of persons who have died suddenly by accident whilst suffering from intermittent fever, and I have noted these alterations, impoverishment of the red corpuscles and albumen in the blood, dilatation of the vessels, congestion of all the upper digestive organs, notably the spleen, stomach, and duodenum, and when the fever has been of long standing I have met with signs of melanæmia and occasionally hyperhæmia in different organs, defined chronic tumours of the spleen, and amyloid degeneration of the liver, and finally in rare cases fatty granular alteration of the heart and pigmentary infiltration of the kidneys.

Course and Symptoms.

The period of incubation of malarial poison in the human system is not always the same and greatly depends on circumstances and constitutional predisposition. In the ordinary course it appears that two weeks is the usual period; in many cases however the effects seem to follow the exposure, and I have met with cases where persons have left malarious localities and have suffered from its effects for some time after in localities not malarious, which fact can only be explained by the supposition that the infection had taken place previously and remained latent in the system only acting when induced by predisposing causes.

The normal type of intermittent fever presenting clear periods of paroxysms and apyrexy may occur suddenly by a characteristic chill, but is generally preceded by prodromal symptoms, the principal of which are a general feeling of physical and intellectual constitutional disorders, presenting a more or less remittent type, a general derangement of the digestive organs, symptoms of a gastric catarrh accompanied by vomiting and dizziness, also of a remittent character. These symptoms prove the infection of malaria having existed a few days.

The first paroxysm generally commences in the early hours of the day thus contrasting with the invasion of other fevers not due to malaria miasma which make their first appearance in the later hours. A paroxysm of ague constitutes three clear stages, a stage of chilliness, a stage of heat, and a stage of sweating; these are followed by an interval of relative quietness, which is a most typical phenomenon, very difficult to account for, considering the general disturbance the system has undergone and has to undergo after a few hours if the cause is not checked, except by the hypotheses that there exists a relative initial miasmatic impregnation or that the growth constituting malarial miasma like many other microbes has a short period of life, and dies leaving its germs which at a certain period hatch to follow the same course. This latter hypothesis would explain the otherwise inexplicable phenomenon of the clockwork intermission of malarious fevers, and further it is also supported by the fact that by microscopical observations moveable organisms are only detected in the blood taken from the patient in a paroxysm of fever, and that these cannot be traced when the patient is in a state of apyrexy.

The chill, which also presents a difference from that of other diseases, by its duration and violence, commences by a feeling of weakness, languor, and great depression, soon followed by a sensation of cold shivering, which gradually becomes intolerable, accompanied with oppression of the chest, hurried and oppressed respiration, and a beginning of headache and frequently vomiting, the epigastrium is painful and the spleen appears enlarged the pulse is feeble and accelerated. Although the temperature of the body is lower by a few degrees than the normal standard owing to diminution of the supply of warm blood to the periphery, that of the blood and internal organs rises rapidly during the cold stage to 2 or 3 degrees above it, and even more in severe cases, owing to the spasmodic contraction of the muscles of the skin and peripherical arteries. The secretion of urine is increased, it is limpid and of a low specific gravity. The appearance of the patient at this juncture is most typical, he appears anxious and looks doltish and miserable, the teeth chatter, the limbs tremble owing to the impeding of the circulation of the arterial blood, the skin is pale and shrivelled, and the pupillæ prominent. From the collection of blood in the veins and capillaries, the lips, the tips of the fingers and toes look blue. This stage lasts from a few minutes to a few hours, the duration decreasing with the prolongation of the disease. The hot stage then gradually commences, the colour returns to the skin, the pale look, the cyanic hue of lips and tips of fingers are soon replaced by a flushed face and coloured lips, the headache increases, the pulse is full and violent, the urine is rarer and saturated, the enlargement of the spleen greater, the surface of the body becomes dry and intensely hot, the mouth is parched and there is excessive thirst, the patient often is delirious or slightly stupefied. The temperature rises at the commencement of this stage reaching from 102 to 104, and in some cases 105 and 106, and remains so until this stage is passed, which lasts sometimes only a few hours, at others 8, 12, and 24, and in rare cases more.

The third, or sweating stage, is of a pleasant feeling to the patient, and commences with a slight moisture of the forehead and breast, increasing to an abundant perspiration over the whole body, the headache, heat of the skin, and thirst abate, the intellect becomes clear, the pulse is less accelerated and soft, the urine is darkish, and deposits sediment of urite. This stage is soon followed by an apyrexy of 24, 48, or 72 hours, and even in some cases I am inclined to believe six or seven days elapse before the commencement of the second attack. This rhythm, however, may change suddenly in any of those cases to one of the others, and sometimes an attack is closely followed by a second, but in the course of this short intermission, the patient, although much relieved, and under the impression that he is quite restored to health, is weak and somewhat dull, the digestive organs are disturbed, and a feeling of inappetence prevails; there also exists the evidence of an impoverishment of the blood which increases with the multiplication of the attacks.

It is difficult to state what the normal course of intermittent fever is, as it is generally checked or modified by some treatment, but from a few neglected cases I have met with I am led to conclude that the infection of malaria continues its action for some time, even if the patient is removed from its direct source, but in such cases the effects gradually cease, even without treatment, and no recurrence is perceived. Persons affected, remaining in malarious regions even, are freed after a time from fever, often without treatment, but only when the malaria infection has disappeared for the time being. I am also of opinion that the constitution becomes greatly accustomed to the action of malarial miasma, and its effects are limited to a great extent; this is supported by the fact that persons, after a long residence in the island, are not so susceptible as strangers. The effects, however, of intermittent fever, if not temporarily or radically arrested, develop in debilitated constitutions serious organic disturbances, the principal of which are great consumption of the vital forces, owing to the repeated high temperatures reached in attacks of intermittent fever, and a greater or lesser enlargement of the spleen. Dropsy sometimes occurs, owing to prolonged and repeated hydroæmia, without the urine containing albumen or diminishing in quantity. When the disease is of a long duration, the development of permanent organic changes in the spleen, liver, or kidneys, of the form of lardaceous degeneration, sometimes results, as also parenchymatous nephritis or hemorrhægic diathesis.

These results, however, are of rare occurrence, as the disease is generally and easily arrested before serious injury to the system takes place.

The prognosis of simple intermittent fever, generally speaking, is favourable; it may, however, prove dangerous with sickly, enfeebled, or old debilitated persons by the exhaustion of the strength, and with delicate children, who, during the cold stage, are often attacked with convulsions, resulting in general paralysis, causing death. In other cases, owing to the excessive and prolonged bodily temperature, great adynamia naturally results, causing paralysis of the heart. The hyperhæmia, the inflammation of the different organs, and the obstruction of the circulation owing to pigmentary embola of the capillaries, induce complications which also suddenly endanger the life of the patient. These anomalies consist in the sudden appearance of phenomena, strange to the ordinary symptomology of normal attacks of intermittent fever, and vary in type in accordance with the organ or organs most affected, and are manifested in the course of a normal attack of intermittent fever, sometimes at the very first attack, but more commonly at the second or third paroxysm, and in rare cases after. The common form of these abnormal, or so termed pernicious attacks of intermittent fever, are as follows:—

The algid form, which is not a prolongation of the cold stage as generally believed, but commences during the course of the stage of heat, or even in that of sweating, the patient, although tormented by a sensation of extreme heat, becomes cold, the extremities, lips, &c. return to the same cyanic hue they present in the cold stage, the pulse becomes fast and small in consequence of the impeding of the heart's action, the body is soon covered with cold slimy perspiration, the cerebral faculties remaining impaired almost to the end, when the cold becomes so intense that death results, or in favourable cases after a few hours heat gradually returns, and the danger is over for that attack.

This form is of rare occurrence in Cyprus; I have met only two cases during my seven years' practice in the island, both cases occurring at the Larnaca Hospital, and both brought from the Potamia quarries, well known as a feverish area, situated on the coast between Larnaca and Famagusta. The first, a labourer at the

quarries, aged 30, was brought to the hospital in August 1881, late in the evening, having had two attacks of fever at the quarries; when I saw him just after his arrival, although the sensorium was perfectly intact, he was very uneasy, and his body, especially the extremities, was as cold as a piece of ice; within a few minutes of my arrival, and while the necessary measures and medicines were hurriedly being prepared to restore heat, he expired. The second patient, aged 35, was brought from the same quarries in about the same condition a few weeks later; urgent and appropriate treatment, however, restored the normal heat, and the patient was saved.

The choleraic form, so called from its presenting similar characteristics to those witnessed in an attack of cholera, is frequently accompanied by the before-mentioned algid form, and commences, generally speaking, during the paroxysm, by pains in the abdominal region, a feeling of faintness, closely followed by profuse incontinent watery diarrhœa and vomiting. In cases where the patient is not in the algid state at the commencement that state soon supervenes owing to the insufficiency of, and impediment in, the circulation, caused by the thickening of the blood, and from the decrease of water caused by the profuse diarrhœa and violent vomiting, thus giving the case a great resemblance to the algid state of cholera, which becomes more and more striking if the case is prolonged through the accumulation and concentration of the blood in the internal organs which are thus affected by intense congestion, throwing the patient into a typhoid state analogous to a state of typhoid cholera. In favourable cases these symptoms gradually subside, and the patient, though extremely weak and exhausted, slowly recovers; in unfavourable cases the fever acquires an asthenic character very early, the pulse becomes small and very accelerated, there is great mental depression, and the patient dies through general paralysis; in other cases there is an apparent amelioration of the symptoms, but if the disease is not checked at once a second attack follows worse than the first.

Of this form also I have observed but few cases in the island. I will here state two which are remarkable for their similitude to attacks of cholera from the circumstances surrounding them.

The first case occurred in Larnaca during the year 1882, when cholera was prevalent in Egypt, and great fear was entertained that it would be imported here, owing to the vicinity of that country to this island. I was called one night in a hurry to the hospital by Dr. Tsepis, who was then in charge of the Larnaca Hospital, to visit a sudden case of cholera. When I arrived there and met Dr. Tsepis, he stated that a patient admitted the same day had just been attacked by symptoms of cholera, and it was most probable that this patient, a stranger, had arrived from Egypt, although he denied it. I proceeded to the ward where the patient, a strong, healthy looking young man was lying, and found that he presented all the symptoms of cholera, and appeared as if breathing his last. Several medicines had been administered by Dr. Tsepis, but with little effect, as they were at once rejected, the patient being subject to frequent and violent fits of vomiting, and he informed me that he had suffered for the last two days from indisposition, which, according to his description, appeared to be intermittent fever. He had asked to be admitted into the hospital, where a few hours after his admission he was attacked with the illness showing the before-mentioned symptoms. Sulphate of quinine was administered hypodermically, and mustard poultices applied to the abdomen, the vomiting soon ceased, the patient gradually returned to normal heat, profuse perspiration set in, 40 grains quinine were ordered to be taken in four grain doses every hour, and stimulants the next morning; but when going to the hospital at that time I met the patient returning to his ordinary occupation well, but rather weak. The second case occurred during the past summer in the Nicosia Hospital. I was called by Dr. Carletti, then in charge of that establishment, owing to the absence of Dr. Stephen on leave, by a rather startling message, "Come quick to the hospital; bad news; a zaptieh "dying with very suspicious phenomena." I hurried to the spot and found a strong young zaptieh, aged about 22, who had been admitted several days previously suffering from venereal disease, presenting the same symptoms as the before-mentioned patient. He was very low, lying on his back, totally unconscious, and appeared as if his last moments were at hand. Quinine was immediately administered hypodermically, and ap-

propriate treatment followed. I left the patient after an hour greatly relieved, and the next morning when I visited him he was up, walking about in the hospital court. At about the same hour on the second day he had an ordinary simple attack of intermittent fever which was cured by the ordinary treatment.

Another form more frequently met with in Cyprus is the soporiferous, comatose, or apoplectic, affecting the cerebro spinal. The anomaly and danger of this form consists in the predominance of symptoms physiologically imputable to the brain or the cerebrum, the patient suddenly at the end of an attack of fever has a decided annihilation of all animal and intellectual faculties, the deep stupor of the patient with the exaggerated delirium which precedes being similar to severe typhus. This form presents the following peculiarity, the coma which terminates the febrile paroxsym is very similar to natural sleep, but of a prolonged duration, and as the first attack is rarely fatal, this phenomenon is constantly considered by the friends of the patient as a salutary sleep, but in the second attack the patient sleeps never to awaken. I have met several cases of this character, one of which has remained particularly impressed on my mind as the patient was a person I highly esteemed. I called to visit him, he being indisposed, and found him rather weak, but at the time well. He told me that he had suffered the previous day from what he presumed was a bilious attack, the liver being congested. In the evening I saw him again with the doctor who was attending him. I then strongly advised quinine; shortly afterwards I left for Larnaca and I was rather startled to hear two days after that he had suddenly died. I ultimately learned that after I left he had rather an uneasy time, he became delirious but had a long sleep which was considered very favourable, the second day he had the same feeling which finished in a slumber from which he never awakened.

Post-mortem examinations of the bodies of persons who have died with this form of fever have shown melanæmia but no pigments in the brain capillaries.

The pneumonic form also is rarely met with in this island; the symptoms of this type are very similar to those met with in cases of acute pneumonia, presenting however a clear remission after every paroxysm, except in rare neglected cases when hepatization often occurs.

Sometimes also fever is complicated with bronchitis remitting with every apyrexy.

Lastly and not unfrequently we meet instead of clear attacks of fever and ague, neuralgia principally affecting the supra orbital, and in rare cases other branches of the trigemini or the cerebro spinal and vaso motor causing spasms, paralysis, and anæsthesia, but always of an intermittent type, which can only be detected as due to paludal miasma by the regular intermission and the elevation of the temperature during the paroxysms. As an example of this form, I may state a rather curious case which came under my notice in the month of July six years ago. A gentleman aged about 55, having had one or two slight attacks of fever, was suddenly taken ill with giddiness, difficulty of speech, and vomiting, soon followed by syncope, which greatly alarmed his friends who felt persuaded that he had had an attack of apoplexy, and the doctor in attendance corroborated this opinion and ordered wide venesection, which was greatly patronised at that time for that disease. The patient soon revived, and the next morning felt so well that he could proceed with his ordinary duties, when I happened to meet him; he related his case to me, stating that although he felt well he was greatly exhausted and weak. His statement as to his feelings at the time he was taken ill, as also the expression of his face, and its pale characteristic complexion, made me greatly doubt the veracity of a genuine apoplectic attack. The next day I was summoned in haste to visit him in consultation with the doctor attending him, who informed me that the patient had had a second fit of apoplexy. When I saw the patient I felt certain that malaria was at the bottom of the case; quinine was administered; he soon recovered from his faintness and had no further attack.

Those forms of abnormal or so termed pernicious fever are of rare occurrence, as I have before stated, and are only met with when an extensive epidemic of intermittent fever prevails, and are greatly attributable to the constitutional predisposition of the patient, the length of exposure, the amount of malaria absorbed, and also to the neglect of proper treatment. There has been, however, a great tendency to attribute many cases of death to severe attacks of intermittent fever, but on the other hand, I may say that many cases of this form of fever have been completely misunderstood, and this abnormal

complication has carried off patients, the cause of death being attributed to typhus fever or some dark serious chronic affection.

Continued or Remittent Fever.—This type is due to intense malarial infection, and is often met with in this island during epidemics of intermittent fever, especially towards the autumnal season; they greatly resemble in symptomatology intermittent fever, with the exception that instead of clear there are simply slight and very often almost imperceptible remissions, and a sensation of chilliness and rigour generally precedes the paroxysm. The anatomical appearances also do not differ from those met with in intermittent fever as far as the spleen and liver are concerned, but we, however, meet congestion in the brain, catarrhal and diptheritic inflammation of the intestines, and sometimes even signs of hæmorrhage into the stomach and hæmorrhagic infractions in the lungs.

The disease may be divided into three classes, mild, severe, and intense.

The first or mild class sets in with a sudden feeling of oppression about the epigastrium, mental depression, headache, and a cold feeling down the back. These symptoms are soon followed by high fever, flushing of the face, the skin being very hot and dry, the temperature rises from 103 to 105, the pulse is small and full, from 120 to 130, the tongue is furred and dry, the spleen is enlarged and mild jaundice is observed, the bowels are irregular, the fæces discoloured, and bilious matter is often vomited. A most particular symptom which I have never failed to meet in cases of remittent fever is a buzzing noise in the ears. At the commencement of this form of fever there exist irregular exacerbations, which become more and more regular, and are subsequently followed by clear remissions generally occurring in the morning; the symptoms gradually decrease, perspiration sets in, and the patient recovers. This course lasts from a few days to three weeks.

In the second, severe class, the remissions are only slightly marked at the invasion, all the symptoms of the previous form are aggravated, the patient becomes delirious and stupid, the disease lasts from eight to twenty-one days, and sometimes more, and if it ends in recovery it usually assumes an intermittent type. If death results, it is generally sudden with symptoms very analogous to typhus fever.

The third, intense class, has a striking similarity to typhus fever of a very adynamic character. There exist various disturbances of functions, and nutrition of almost all the organs, so that the symptoms vary excessively, the spleen and liver are considerably enlarged, epitaxis and hæmaturia is often noticed, and sometimes either suppression of urine or albuminuria. Inflammatory exudations not unfrequently form in the serous membranes or lungs; towards the second week petechiæ are met with on the skin, the patient soon falls into a deep apathy which is followed by collapse.

In conclusion, fevers due to malarial miasma being the principal disease, and if I may so say, the only stigma on the most fine and exceptionally healthy climate of Cyprus, and the facility and certainty with which the injurious influences which notoriously favour its development could be removed, no great marshes having to be drained, nor any great engineering skill being required, but simply a proper direction of the different watercourses, so as to prevent stagnant accumulations, it is a great pity that strenuous efforts cannot be made at once to totally eradicate this evil, owing to the want of funds which would evidently be required for the establishment of a whole system of drainage, and the laying of iron pipes in the towns, and the prevention, by proper canalisation, of the location of water on large low situated tracks of land, and the plantation of trees throughout the arid plains. But, although this desideratum has not yet been arrived at, the Government has made every effort to neutralize the most palpable evils, and the salutary effects are proved by the prevalence of fevers being greatly decreased, and their character modified in notably feverish localities where these measures have been adopted.

F. C. HEIDENSTAM.

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The Influence of Myopia on Military Service

APPENDIX No. VII.

CLINICAL LECTURE ON "THE INFLUENCE OF MYOPIA ON MILITARY SERVICE."

(*Delivered in the Army Medical School, December* 1893.)

By Surgeon-Captain H. R. Whitehead, F.R.C.S., Eng., Assistant Professor of Military Surgery, Army Medical School.

I know of few subjects which have a greater interest for military surgeons than the one we have to discuss to-day. It is not, however, only a question for military surgeons, but one of widespread national character. Many surgeons in civil life are called on to certify to the visual efficiency either of recruits for the army, or of bodies of men employed in other public services, such as railway employés, sailors on merchant ships, pilots, &c., and it is of the first importance to appreciate in our own minds the influence which the presence of myopia exerts in these occupations.

Year by year the importance of good shooting in the army is being urged upon us, and the adoption of the new rifle, sighted for extremely long ranges has made it most imperative that greater attention shall be paid to the sight of the men destined to use this weapon.

Not only in musketry is the soldier called on to exercise to the fullest extent his visual powers, but many other of his military duties, such as signalling, call for very high degree of acuteness of vision. There is also a peculiar faculty which is of paramount importance in military life, I allude to the alertness of vision. This latter function, so necessary for the soldier to possess, may be trained to a very high standard, and such training should be fully recognised as part of the ordinary education of the soldier.

The art of war has, like many other of the arts and sciences, undergone almost a complete revolution in our own times. It is not so very many years ago that the muzzle loader was the weapon with which all countries were armed; this, with its comparatively limited range compared with the new rifle (the Lee-Metford magazine rifle) is as different as a cart horse is from a thoroughbred racehorse.

The great improvement in the power and range of the weapon now used in warfare has done away with much of the personal equation of strength and bravery in the actual encounter, although these characteristics will always be most highly prized in soldiers. The Commander who now has his men sufficiently trained to move with great celerity, and to use to its full power the class of weapon with which all modern armies are now armed will inevitably stand the best chance of winning the day, other things being equal. The Government looks to you, gentlemen, to see that only suitable men are enlisted, and that their sight is of such a nature that it will not nullify the effects of a long and expensive training in musketry exercises. When we consider that the dial sight of the Lee-Metford rifle is capable of sighting up to 3,500 yards, we shall understand that in order to get the full value out of such a weapon, only those with first-class sight should be employed to use it.

We cannot, of course, in our army, fed by voluntary recruiting, pick and choose our men in the way the great continental countries, whose armies are kept up by conscription, can do, and employ those with the best sight in rifle regiments, and those with indifferent sight in departmental corps. No doubt this would be a very satisfactory way of proceeding. As our recruiting is perfectly voluntary, the supply often falls short of the demand, and we cannot therefore draw the line as tight as we should like to.

For an ideal army we should certainly demand nothing less than emmetropia from those destined to form the first lines of our fighting machine, we might, however, with safety, allow some slight measure of error in refraction in Departmental Corps.

Let us now consider in detail:—

1st. The test for eyesight applied to recruits for the army.

2nd. The amount of acuteness of vision this corresponds to.

3rd. The amount of myopia this allows.

4th. The character of the vision present in recruits who pass the test with a minimum of acuteness of vision due to myopia.

The regulations are, that recruits for the Cavalry, Artillery, and Line, shall be able to count the test dots (supplied by the State for the purpose) with each eye separately at a distance of 10 feet.

For Departmental Corps the distance is 5 feet.

For the Militia the same as Departmental Corps.

The present official test dot card was suggested by Sir Thomas Longmore, C.B., who was at that time Professor of Military Surgery in the Army Medical School. As an outcome of a correspondence between the Army Medical Department and the War Office, the military advisers of the Government in 1863 formulated the following requirement for recruits, viz.:—"That men "should not be received into the service who do not see well, to 600 yards at "least, a black centre of 3 feet in diameter on a white ground."

This corresponded to the bull's-eye of the target then in use at 600 to 900 yards.

It was obviously impossible to expose each recruit to the test as it thus stood, and Sir Thomas Longmore, acting on the principle of the equality of the visual angle, invented the test dot card. In which each circular dot at 10 feet is seen under the same visual angle as the 3-foot bull's-eye at 600 yards.

The calculation on which this is based is a simple rule of three sum.

As 600 yards is to 3 feet so is 10 feet to the answer,

$$600 \text{ yards} : 3 \text{ feet} :: 10 \text{ feet} : x.$$

the answer is ⅕th of an inch. The dots, therefore, are made of this size, and are placed at a distance of 10 feet.

For each of these dots to be seen under an angle of one minute, or $\frac{1}{60}$ of a degree, which Snellen has taken as his standard for the normal acuteness of vision (the dots being non-complex bodies), they should be distinguished under the usual condition of illumination at a distance of 43 feet, and would at this distance, therefore, correspond to $\frac{43}{43}$ of Snellen's test types, or 1 of the normal acuteness of vision. As we have already stated, the regulations only demand that the dots should be held at a distance of 10 feet for the Cavalry, Artillery, and Line, and at 5 feet for Departmental Corps, and for the Militia. We thus allow recruits for the Line to enter the service who possess only one-fourth of the normal acuteness of vision, and for Departmental Corps and the Militia only one-eighth is considered necessary.

Compared with Snellen's test types, this would represent $\frac{10}{43}$ and $\frac{5}{43}$ respectively, which, as we must all admit, is an extremely low amount of visual acuteness to require.

We might, for a moment, digress here to state that the reason we do not simply use Snellen's test types to estimate the acuteness of vision, which would, in many ways, be preferable, is, that a certain number of recruits cannot read, and although the number is becoming less every year, yet we still have to encounter this difficulty. It would seem to be just as important to note accurately on his medical history sheet a recruit's vision on joining as to place on permanent record his chest measurement, weight, and height.

Failing the general use of Snellen's types, the test dots are a handy and easily applied test.

Luckily for our efficiency as a military power, very few of our soldiers possess only just the minimum of acuteness of vision; and, in addition, the sight of the class from which our recruits are mostly drawn is good. Let us now consider what amount of myopia can pass the test. Sir Thomas Longmore, who has done so much to render our knowledge on these points exact, and whose remarks in his Optical Manual are most worthy of our very close attention, found from a large number of observations that recruits with

1·75 D of myopia could just pass the dot test at 10 feet; with 2 D of myopia they failed to do so. We may take it, then, as a perfectly established fact, that men can enlist with 1·75 D of myopia.

What will be the character of the vision of a recruit with this degree of myopia? We well know that there is only one point at which, when the eye is at rest, he will see absolutely distinctly, and this spot will be his *punctum remotum* situated a little over 20 inches from his eye. Beyond this spot everything will be more or less blurred and indistinct. At 20 feet he will have great difficulty in counting books on a shelf, and the features of individuals at this distance will be indistinct. He may be able to recognise people at this distance, but it will be from peculiarities of gait or figure, not from distinctness of vision. At 50 yards he will be unable to count accurately the number com posing a group of figures, or to describe their relative positions.

At a distance of from 700 to 800 yards is will be doubtful if he can recognise a horse and rider, especially if they are moving against a dark background, skirting a wood, for example.

Longmore says, supposing the average width of a man equipped for field service to be about 18 inches, he would in this direction subtend a visual angle of one minute at 1,710 yards. If the circumstances of ground, atmosphere, &c. were favourable, such a figure would be perceived by a soldier with normal acuteness of vision at this distance. If the acuteness of vision is only one-fourth under corresponding circumstances, the figure would only be discerned at a distance of 427 yards.

You therefore see that the powerful rifle with which we now arm our soldiers if used by a myope of 1·75 D is robbed of more than half its value.

The moral effect on the soldier of giving him a powerful weapon is no doubt very great, if he knows he can get the full value out of it, but it would be useless to send him into the field to fight unless his acuteness of vision enables him to get the best possible effects from the rifle he carries. A soldier with 1·75 D of myopia armed with the most perfect rifle ever invented, is hardly a more effective fighting machine than one with normal vision armed with the old "Brown Bess" musket.

We have kept pace with the continental powers in improving the soldier's rifle, the question must soon come up for consideration, whether or not the present vision test is sufficiently stringent to ensure his being able to use it.

Besides the consideration of the vision of a recruit with the limit of myopia in bright daylight, we have to consider the effects of alterations in the condition of illumination, and we shall find that herein lies one of the great dangers of allowing myopes of even this comparatively small degree to serve in our army. When the illumination is dull from any cause, or the atmosphere darkened by snow, rain, fog, smoke, &c., the sight of myopes becomes very greatly impaired, and the defectiveness of their vision seems to be, under these conditions, out of all proportion to the comparative slightness of the error of refraction. It is, however, at night or in twilight that the full effects of such an error of refraction becomes most apparent. At such times the pupil dilates widely and allows the marginal rays to penetrate into the eye, the result being that the diffusion rays about the image formed on the retina are greatly increased, and the image proportionately blurred. The blurring of the image is still more increased by spherical aberration which is present, to some extent, under deficient illumination of an object.

In bright sunlight the pupil contracts to a very small point, and the myope sees under his most favourable conditions in brilliant illumination; most of the marginal rays are then excluded, and the image on the retina is comparatively clearly defined.

In this connexion I may draw attention to the fraud which is occasionally practised on the recruiting medical officer. Men who are suffering from myopia to such an extent as to render them unfit for the service, have been advised to instil a drop of solution of eserine into the eye some little time before they are examined. In this way the pupil is made to contract, and the vision is temporarily much improved.

At night or on a dull day the possessor of a very small amount of myopia, is for all practical purposes, very nearly blind. Could we trust at an important outpost on service a soldier with 1·75 D of myopia? Or again as an engine driver who had to see and recognise signals rapidly and accurately

on a dull or rainy night? or as a look-out on a ship at sea? Most assuredly not.

Many of our wars are against savage nations who move with marvellous celerity and stealth, and who often choose for their attack the time just before daybreak. Should we feel confident that a myope, of the amount under discussion, would be able to observe readily the approach of such foes? It is alike unfair to the individual and courting disaster to allow the safety of a body of men to depend on the imperfect eyesight of a man afflicted with this infirmity. The strength of a chain depends on its weakest link, and perhaps the safety of an army on the indifferent sight of one individual. Longmore relates the case of an officer in the Crimean war who refused to go on picquet duty on account of his myopic condition. He stated that he could not distinguish in the dusk of the evening a Russian soldier from an English soldier. He was brought before a military medical board, and although the amount of myopia from which he suffered might have appeared trifling to a civilian surgeon, yet viewed with the special knowledge of such disabilities which military surgeons possess, his objection was upheld and he was invalided home.

In the same campaign one or two cases certainly occurred of officers being taken prisoners by the enemy on account of their myopic condition preventing them from distinguishing their foes from their friends until too late to profit by the knowledge.

We thus see that an amount of myopia, which might at first sight seem trivial and of little practical importance, has a very considerable and serious influence on military efficiency.

Nor must we omit to consider the effect of tropical climates on myopia.

Clinically, we divide myopia into the simple and progressive varieties. Should the disease have any tendency to be of the latter class, the conditions under which the soldier is called upon to serve in India and elsewhere in the tropics will most certainly aggravate the complaint, especially if the disease has gone on until choroidal changes have taken place, and a posterior staphyloma has become established.

Incidentally the deterioration of health so often caused by malarial fevers, and by even residence for a prolonged period in a hot country, has a very harmful influence on the progress of this disease. It is unadvisable to subject a person with uncorrected myopia, even of a small degree, to the glare and strain of tropical countries. The following case of a man now in hospital at Netley is so instructive, and brings out so clearly some of the important points which I wish to bring to your notice, and to particularly emphasise, that I venture to bring the case before you to-day.

Lance-Corporal S. K., aged 21, with 1$\frac{5}{12}$ years' service, states that he had fair sight before enlistment. At the age of 14 he got employment as a clerk in an auctioneer's office, and had to work long hours in a badly-lighted office. This, no doubt, had a good deal to do with the origin of his myopia. When he was nearly 18 years old he began to notice that his sight was not as good as it had been, and he thought that office work had "strained his eyes." As months went on, and his sight became worse, he determined to give up office work and enlist, which he finally did on April 18th, 1892.

He enlisted at a provincial town, as he had doubts as to his eyesight being sufficient to pass the test; he had previously gone up to the hospital and interviewed the sergeant, and had found that he was just able to pass the test when the dots were well illuminated. He selected a bright, sunny day for his medical examination; he experienced some difficulty in seeing the dots. He was, however, passed "fit." He went through his recruit's course of musketry in August 1892. At short ranges he saw the target fairly well, but could not see the bull's eye distinctly at further than 200 yards. Up to 600 yards he could see the target, and calculated the position of the bull's eye. At a further distance than 600 yards he could not see the target at all, but he could see the dummy targets for marking against the sky line, and by calculating whereabouts his target lay he got on some shots. In addition to this, when the officer in charge of the party was occupied at the other end of the line of butts, his sergeant, who was a good marksman, fired a good many rounds for him at the long ranges, and he just managed to become a third class shot.

On joining his regiment he found great difficulty when on sentry in recognising officers passing his post, especially in the evening.

In the twilight his sight was very defective, and he states that he never went out without a comrade, as he was afraid of not recognising and saluting his officers.

For the great part of his service he has, however, been employed as a clerk in the various regimental offices.

In March 1893 he was ordered out to Malta with a draft for his battalion stationed there. He was not particularly exposed to the glare of the sun, as a fortnight after landing at Malta he was taken into the orderly room as a clerk. He found, however, that the glare of the sun had a distinctly bad influence on his eyesight.

In September 1893 he had to fire his annual musketry course. At 200 yards he could now hardly see the bull's eye, except by partly closing his eyelids, and excluding the marginal rays. At 300 yards he could not discern the target. He found it was useless for him to attempt to fire his course, and he reported that he could not see, and was sent to hospital by his commanding officer. From thence he was invalided to Netley with myopia.

His present condition is as follows :—

Distant vision R.E. $\frac{6}{\text{Nil}}$ C—4 D = $\frac{6}{9}$

L.E. $\frac{6}{\text{Nil}}$ C—4 D = $\frac{6}{9}$

Near vision R.E. reads ·5 Sn at 10 inches.
L.E. reads ·5 Sn at 10 inches.

A posterior styphyloma is present in both eyes.

He thus evidently joined the service with just the limit of myopia, viz., 1·75 D, which increased in eighteen months to 4 D of myopia.

I think we have shown that uncorrected myopia of even a comparatively slight degree is very undesirable from a military point of view, and this leads up to the final consideration, namely, whether it is advisable to allow the soldier to use correcting lenses for this defect? and by this means to be brought to a condition of emmetropia.*

At first blush the question would seem to admit of no discussion, and that the correction by lenses of any error of refraction which might exist would be a most eminently sensible arrangement.

There are, however, decided disadvantages in military life to the use of spectacles, and especially in our own army. We know that in many of the continental armies the use of spectacles is no bar to military service.

The officers in our own army are, moreover, tacitly allowed the use of spectacles, at least there is no regulation against it, and by a curious anomaly a soldier is allowed by our regulations to use spectacles on one occasion, namely, on the rifle range during his musketry course. Surely if their use were anywhere desirable it would be on the field of battle, and not merely to give him a temporary aid in times of peace.

The circumstances which militate against their more extended use in our army would seem to be as follows :—

In the first place, our soldiers are seldom called upon to operate in a civilised land, but usually in the interior of some wild and distant country, and at some distance from their base of operations, and transport even of the necessaries of life, and military existence is by no means easy; under these circumstances it would be difficult to replace spectacles if broken. Certainly a small supply of spectacles of lower powers might form part of the equipement of a field hospital; but we must remember that very often our troops are split up into such small bodies—as, for instance, during the campaign in Burmah—that it would be almost impossible to send with them any, except

* At Brussels in 1875, at a meeting of the Opthalmological Congress, there was a discussion on the use of spectacles in armies. The following conclusions were adopted :—

1. The interdiction of spectacles deprives an army of many intelligent men. The Congress is of opinion that there are good reasons for admitting the use of spectacles in armies.
2. Supposing spectacles to be worn, the meeting decided that the highest degree of myopia compatible with military service ought to be completely corrected, by a —5 D lens.
3. Supposing the use of correcting glasses not to be admitted, the highest degree of myopia compatible with military service ought to be under 5 D.

the most urgently needed stores and drugs. If, then, a soldier got his spectacles broken while on this detached duty they would be hard to replace, and the man would be almost useless.

Again, in damp weather, the lenses of the spectacles get clouded by the deposition of the moisture from the atmosphere; in order to obtain clear definition the soldier would have constantly to take them off and wipe the glasses, a very unsatisfactory proceeding.

The use of spectacles would not add to the smart appearance of our troops, and would meet with some opposition on this score.

The whole question, however, seems to narrow itself down to this issue: that the State has now placed in the hands of our troops a very powerful weapon, with a very long range, and in order to get the full value out of this weapon the soldier must be practically emmetropic, or possess only such an error of refraction as may be fully corrected by lenses of the weaker powers.

It is obviously disadvantageous in many ways to allow the general use of spectacles. Can we then procure suitable recruits with emmetropia? If not, we are driven to allow men with some amount of myopia to enlist, and if we enlist such we should, in my opinion, in order that they may get the full power out of the Lee-Metford rifle, allow them to wear suitable lenses. The amount of myopia we should admit needs consideration.

It is not, however, for us to settle whether the test as it now stands is stringent enough, the regulations on the subject have been framed after careful consideration, and it is for us carry out carefully and strictly the regulations for our guidance. Many questions connected with the supply and demand, with which we may not be fully acquainted, have to be taken into consideration. It is our duty to make ourselves thoroughly acquainted with the amount of myopia the test allows of, the characters of the vision present in those who possess the limit of myopia, and the influence of this amount on the duties of the soldier.

Not to be taken from the Library.

TECHNIQUE

OF

HAFFKINE'S ANTI-CHOLERA INOCULATIONS

BY

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TECHNIQUE

OF

HAFFKINE'S ANTI-CHOLERA INOCULATIONS.

The following directions have been drawn up for the guidance of the medical men who undertake these inoculations in India.

Agar-agar cultures of the two vaccines are obtained ready from a central Laboratory,* or prepared as described later on. They must be carefully protected against direct sun-light and used within the 24 hours. The operator proceeds as follows:—

PREPARATION OF THE EMULSIONS.

1. Have ready prepared water which has been boiled two or three times (a quarter of an hour each day) in an ordinary closed kettle, with the spout plugged with cotton wool. Do not open the lid until all the water has been used up, and only remove the cotton plug at the time of taking water. *Boil the kettle afresh before each operation.*

2. At the time of preparing the *emulsions*, cool down the kettle until it is about the temperature of the hand, and remove the cotton plug from the spout with heated forceps. Thoroughly heat the extremity of the spout with a spirit lamp, and cool it down again by pouring a little water from it. After this carefully avoid touching the opening of the spout with the finger or any object which has not previously been sterilised by heat. (The same rule applies also to the points of the forceps, the mouths of the tubes and every other object after sterilisation).

3. Examine the culture against the light to make sure that the surface of the agar-agar is covered with a layer of microbes *quite uniform in appearance*; if not, the culture must be rejected as contaminated.

4. Remove the cotton plug from the mouth of the cultivation tube with the right hand, taking the plug by the end projecting from the tube—; carefully avoid contact between the remainder of the cotton wool and all unsterilised objects. Thoroughly sterilise the mouth of the test tube, by heating it

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* In India the materials necessary for these operations can be obtained from the Government Laboratory of the N. W. P. at Agra, in charge of Mr. E. H. Hankin.

in the flame, and bring it afterwards close to the spout of the kettle. Pour water in the tube up to the level of the top of the growth on the agar-agar, marking this point with your thumb on the tube before pouring out. During this manipulation carefully avoid putting the arm or sleeve over the spout of the kettle or the open mouth of the test tube.

Close the tube with its cotton plug, after having heated again its mouth in the flame. Leave the culture for a few minutes to get the layer of microbes soaked with water. Then close the spout of the kettle with its cotton plug held by forceps and thoroughly scorched in the flame of the lamp.

5. Next rotate the test tube between the two hands, until the microbes are entirely removed from the agar-agar and held in suspension in the fluid. The surface of the agar-agar in a tube ready for use must appear homogenous and free from shreds of culture. Emulsions prepared in this way should be carefully protected against direct sun-light, and should be used at once, or at most within one or two hours; they can only be kept for use longer by placing them in ice.

The emulsions of the weak and of the strong vaccines (for the first and second inoculation) are prepared absolutely in the same way.

Microscopic Examination.

6. Prepare a slide by washing it in water, or if necessary with spirit, wiping it dry and passing it slowly ten times through the flame of a spirit lamp, in order to increase its capillary attraction. Then allow it to cool.*

7. Sterilise in the flame of the lamp a platinum needle, a wire, or a fine glass rod, holding its end with the thumb, index and middle fingers of the *right* hand in the same way as you hold a pen; bring the mouth of the tube, containing the emulsion, in a sloped position to the back of the two other fingers of *the same* hand, grasp the cotton wool between the middle phalanges of the fingers, and remove it; sterilize in the flame the mouth of the tube kept in the left hand. Introduce the bristle into the emulsion and remove a drop of it, by raising the point of the bristle with a little jerk, heat again the mouth of the tube, replace the cotton plug, put down the test tube on the table; take in the left hand the slide, put the drop upon it and slightly spread it out.

* The modification of the surface of the glass, produced by this manipulation, lasts only a few hours.

8. In a similar way place drops from all the emulsion tubes to be examined on the same slide, arranging them in a line along the middle (in order to find them more easily when under the microscope).

9. Allow the drops to dry thoroughly; hasten the drying process, by placing the slide some distance above the flame of the spirit lamp, and moving it gently from side to side.

10. Pass the slide five times through the flame of the spirit lamp in order to kill the microbes and to fix them on the slide.

11. Wash the preparation in alcohol, afterwards in water, pour on the slide while wet a staining solution and allow it to stand for a moment. (The best solution for this purpose is Gentian violet made as follows: water, that has been saturated with aniline oil and filtered through a moistened paper filter, is mixed with about a hundredth of its volume of a saturated alcoholic solution of Gentian violet, and filtered again).

12. Wash the preparation in water; remove it, absorb any excess of water left on the slide with filtering paper, and allow the preparation to dry.

13. Place drops of cedar oil on the coloured spots of the slide and examine them under the microscope with the oil immersion lens. *The preparation must present a uniform field of comma bacilli.* Extraneous microbes are distinguished by their shape, and, above all, by their diameter and intensity of colour. On the slightest indication of foreign microbes the culture must be rejected as very dangerous.

Inoculation into the Human Body.

14. A syringe used for the first time for these inoculations should be filled with a five per cent. solution of carbolic acid, which should be kept in the syringe for the space of one hour to sterilize it. The needle should be strongly fixed into the syringe, and kept full with the solution. The outer surface of the needle should be washed with a cotton pad, fixed on the end of a pair of forceps and soaked in carbolic lotion.

15. Heat a small vessel full of olive or any other oil, until a drop of water introduced into it boils *instantaneously.*

16. Complete the sterilisation of the needle of the syringe by keeping it for some time in the hot oil. Remove afterwards the excess of oil from the needle with the carbolised cotton pad.

17. Empty the carbolic solution out of the syringe, refill it with air and empty it again, holding the needle downwards, in order to remove every drop of the solution.

18. Remove with the precautions stated above the cotton from the emulsion tube, keeping the latter well sloped, and sterilise the *edges* of the test tube in the flame of the lamp, without heating the walls of the tube itself. Replace the cotton in the tube, pushing it in to only half of its extent, and give the tube to your assistant, cautioning him to be careful to avoid touching the cotton and the lips of the tube. The assistant holds the bottom of the tube in his right hand and supports it with the index finger of the left hand, on which the tube rests and is inclined, so as to allow the fluid to approach the opening.

19. The operator seizes and removes the cotton from the tube by means of the phalanges of the little and ring fingers of the right hand; holds the syringe with the left hand, and the piston head with the other fingers of the right hand; then introduces the needle into the liquid in the tube, keeping the barrel of the syringe outside and avoiding contact with the edges of the tube; he then draws the liquid into the syringe holding the oblique opening of the needle downwards. This operation should be performed over a cup filled with carbolic solution, in order to sterilise any drop which might accidentally fall, while sloping the tube for the operation.

20. The operator takes back the tube from the assistant, who has kept it all the time sloped; he then heats the neck of the tube, in order to thoroughly dry the part which will contain the cotton, and replaces the latter, taking care to scorch it previously when he has reason to think it has touched any extraneous unsterilised objects during the manipulations.

21. Empty all bubbles of air from the syringe, while holding it quite vertically (the needle upwards) and closing the oblique mouth of the needle with the pad of carbolised cotton; wash the needle well with carbolic solution; screw down the stop or traveller of the piston rod to the required dose, and give the syringe to the assistant, who immediately dips the

needle in the heated oil. The assistant keeps the needle dipped in the oil during the whole interval between two operations (about a minute or a fraction of a minute), but avoids most carefully heating the body of the syringe.

22. Wash the skin of the patient at the point of inoculation with 1 in 20 carbolic acid solution, take the syringe from the assistant and see that the stop marks the correct dose. The *full dose* for an adult is half a cubic centimetre (9 divisions in the special syringes, nine minims in the English syringe); the dose for a child of ten, about a quarter cubic centimetre (5 divisions); and for a child of six months, about $\frac{1}{20}$th cubic centimetre (one division). Hold the barrel of the syringe with the middle finger and thumb of the right hand, and steady it with the ring finger. The index finger of the same hand is placed immediately on the crown of the piston, without pressing it.

23. Take between the index finger and the thumb of the left hand a fold of skin at the site washed with carbolic lotion, avoiding the veins seen through the skin, and without touching with the fingers the point where the syringe is to be introduced; bring the needle close to the fold of skin, holding the syringe *parallel* to the skin and in the direction of the fold (not at right angles to it), make a rapid puncture *strictly* in the line of the syringe and the fold, and press the piston rod almost at the same time. Remove the syringe *immediately* afterwards, any unnecessary prolongation of the operation is distressing to the patient.

24. Hand the syringe to the assistant, who immediately dips the needle in the oil, and wash away with carbolic solution the little drop of emulsion or blood which may follow the removal of the syringe.

All persons inoculated should have their names accurately recorded in special registers.

25. When the operator has finished inoculating, he should wash out the syringe with carbolic solution. For future operations, as long as it is not used for other purposes, he will only have to wash the syringe again with this solution immediately before commencing inoculations. Prolonged action of carbolic acid hardens and impairs the leather of the piston.

Five days or more after the injection of the weak virus, a second inoculation is performed, on the other side of the body, with the strong virus. The same rules are observed as in the first inoculation. To decide the dose for the *second virus*, one relies exclusively on the height of the fever produced by the first inoculation. In exceptional cases, when the fever reached 104 F., give only two-thirds of the *full dose* (*vide* supra); when the fever is below 101—102 F. give a *full dose*, even exceed it. In cases where patients have previously suffered from cholera, give for the *first* inoculation exactly the same dose as is given to others. *Carefully note the symptoms produced in these special cases.* The dose required for them for the second inoculation is settled in accordance with the same rule as those of ordinary patients.

CULTIVATION OF THE VACCINES FROM TUBE TO TUBE.

1. The *first vaccine* is cultivated indefinitely from tube to tube; on the contrary, a specimen of the *second vaccine* should be always obtained fresh from a central Laboratory, where it is strengthened by passing through animals (*vide* W. M. Haffkine, *Comptes rendus des seances de la Société de Biologie de Paris*, 1892; Prof. Grubbe, *Wiener Medizinishe Wochenschrift*, 1892; E. H. Hankin, *Brit. Med. Journal*, 1892; Wright and Bruce, *Brit. Med. Journal*, 1893; W. M. Haffkine, *Brit. Med. Journal*, 1893; *Lancet*, 1893, and other works on the subject), and the operator can himself cultivate this invigorated microbe only for a week or so.

2. To cultivate the vaccines in agar-agar tubes take for the supply a "*zigzag growth*" where the microbe has flourished in isolated colonies (see below); make thoroughly sure that all the colonies are absolutely of the same kind and have exactly the aspect of colonies of the cholera bacillus (rounded contour, smooth surface, watery appearance, thin and transparent).

3. Fix the zigzag tube on a support, in a sloping position, the opening downwards and towards you, and place the support on your right; light a spirit lamp and place it on your left.

4. Prepare the cultivation tubes by washing in water and drying their surfaces, then ascertain by careful examination that they are free from colonics of any germs. Pull out a little of the cotton plug so as to be able to catch hold of it easily with the fingers. In cases where cotton threads adhere to the walls of the test tubes, take out the cotton wool plug with the ordinary precautions, and remove

adherent threads by means of previously heated forceps keeping during this proceeding the open tube with its mouth downwards. Place the whole of the tubes to be inoculated on your left, near the lamp.

5. Remove the cotton plug from the supply tube fixed in the support, scorch the surface of the cotton plug in cases where it has been soiled with the microbe of cholera, and place it on one side; bring the lamp close to the opening of the fixed test tube, and thoroughly heat the mouth and the adjacent end. In performing this operation, keep on turning the tube in order to ensure thorough sterilisation of all the walls. Avoid at any time placing the arm under or above the open mouth of the tube.

6. Take in the right hand a bristle made of platinum or ordinary wire in a short wooden handle, or preferably a glass rod drawn out sufficiently fine. The last inch of the bristle should form a very slight bend with the rest of its length, so that it will adapt itself to the sloping surface of the agar-agar. Hold the bristle by the end of the handle, the fingers being placed as in holding a pen. Sterilise, by heating thoroughly, a greater length of the bristle than the length of the culture tube. Introduce the heated bristle, while hot, into the supply tube, and keep it there, without touching the microbes; rotate towards you the palm of the hand which holds the bristle.

7. Take in your left hand one of the agar-agar tubes prepared for the cultivation, and turn its mouth downwards; bring it close to the back of the fingers of the right hand and remove its cotton wool by means of the middle phalanges of the little and ring finger, without removing the bristle from the supply tube. Bring the agar-agar tube close to the lamp and sterilise its mouth and neck in the flame rotating the tube all the time in one direction. Then bring this tube (keeping the opening constantly downwards) close to the fixed tube and place their ends in contact.

8. Take on the end of your bristle a small quantity of the microbic material, remove the bristle from the fixed test tube, and introduce it into the tube held in your hand, performing this latter movement as quickly as possible, but taking care not to touch the walls of the tubes; once the bristle is safely sheltered in the tube to be cultivated, one can remove both the tube and the bristle to some distance from the fixed tube and complete the following procedure at leisure.

9. (See section 13.) Make with the end of the bristle a longitudinal line in the middle of the agar-agar; then with the bent end of the bristle spread out the microbes, thus deposited, over the whole surface of the culture. Remove the bristle from the tube, heat the opening of the latter (keeping it always downwards) and replace the cotton plug. Sterilise the bristle as before and replace it again into the interior of the supply tube.

10. Take a second tube for cultivation, and repeat the procedure as before.

11. If a cotton plug is accidentally dropped on the ground, or allowed to touch extraneous objects, remove the bristle from the tube in which it is sheltered, heat it in order to destroy the cholera microbes that it carries, and place it on the table; take the soiled plug with forceps, and burn all its surfaces in the flame, until it is thoroughly blackened and scorched; then heat the end of the tube (which is kept during the whole time with the opening downwards) and replace the plug. Take the bristle again and sterilise it afresh, introduce it again into the supply tube as before, and complete the operation.

12. Mark the inoculated tubes unmistakeably, in order that the kind of vaccine they contain, and the date of their inoculation shall be known.

Tubes thus prepared must be cultivated at a temperature near that of the human body. In the cold weather in India a sufficient temperature can be obtained by placing the tubes in a tin box put close to the chimney of an ordinary oil lamp. The cultures are ready for the inoculation in man in about 24 hours. In cases where they have to be used a day or two later, they must be kept at a very low temperature, *e. g.*, in a refrigerator.

13. To keep a supply for a future series of cultivations, before inoculating any other tube, prepare two test tubes with "*zigzag cultures.*" To do this, take two agar-agar tubes in the left hand, with their openings downwards, and remove the two cotton plugs (without allowing them to come in contact) with the backs of the fingers of the right hand, which at the same time keeps the bristle in the interior of the fixed tube; then take on the point of the bristle a mere trace of the microbic material, and carry it into the *first* of the test tubes to be inoculated; touch the surface of the agar-agar

with the point, and impress on it lightly a series of zigzag striæ (20—25); then carry the bristle from the *first* to the *second* tube, and make a similar series of zigzags. When the operation is successfully performed, this second tube, after growth, shows round isolated colonies at a distance from each other; otherwise too much microbic material has been taken.

14. After having finished the whole series of cultivations, take care to heat the bristle thoroughly before placing it on the table, in order to avoid contamination. Then close with its cotton plug the fixed tube, which has served for the cultivation, and remove it from the support.

15. All used agar-agar tubes, which have contained the microbe of cholera, should thus be kept corked with their cotton plugs, until disinfected. This disinfection is carried out in the following manner: take a saucepan, or *deckshy*, or other kind of basin, remove with forceps, one after the other, the cotton plugs of the tubes, and place the cotton and tubes in the vessel, then fill it with water cautiously, so as not to produce any splashing, and to avoid throwing drops of infected water on the table. Heat the saucepan to boiling point, and clean the tubes while still warm, as the agar-agar is then dissolved. *The saucepan can be afterwards quite safely used for kitchen purposes, the microbes in there tubes being destroyed at 50°c.*

16. Every thing inadvertently soiled with the cholera microbes should be immediately washed with carbolic acid (1 in 20), or with perchloride of mercury solution (1 in 1,000), or boiled in water, or well heated in a flame, or burnt, according to the material, and thus disinfected.

List of apparatus necessary for carrying out the anti-cholera inoculations.

A.—For the Operation itself.

1. Hypodermic syringe. The ordinary (Pravaz) syringe will do. The leather piston is soaked in water and kept moist with a drop of glycerine if necessary. The needle must be carefully sharpened before the operations. For large numbers are used syringes specially made for these inoculations by Collin in Paris, and containing 5 c.c.,—10 *full doses*. Such syringes can be obtained from the maker at Paris, or at Agra, from the Chemical Examiner.

2. A kettle. The lid must fit closely, and preferably its edges should overhang the borders of the opening of the kettle. It is better to have the spout curved, so that the opening points downwards.

3. Small forceps of the ordinary kind for holding the cotton wool plugs in the flame.

4. An ordinary spirit lamp.

5. A brass vessel to hold two or three ounces of oil, and of the shape of an ordinary penny earthenware ink-pot, closed by a screw or a wooden cork. It should be of sufficient height to allow the needle of the syringe to be inserted without touching the bottom. All the joints in such a vessel must be of brass and able to stand the temperature of hot, decomposing oil. If a brass vessel cannot be obtained, an earthenware ink-pot will do.

6. A tripod for supporting the above.

7. Two cups for holding carbolic lotion.

8. Two cotton pads fixed in a handle or in forceps (for washing the skin and the needle of the syringe).

9. A hone for sharping the needle, and pliers for fixing it on the syringe.

10. A bottle of carbolic lotion (1 in 20).

B.—For the Microscopical Examination.

1. A microscope with an immersion lens and cedar oil, or a very powerful dry lens.

2. Slides.

3. Platinum needle or wire, or a glass bristle.

4. A small bottle with alcohol (the methylated spirit used for the lamps will do).

5. A bottle of aniline oil and a bottle with gentian violet in powder.

6. Two little bottles for making the saturated solutions of aniline water and gentian violet alcohol.

7. A bottle with gentian violet stain freshly prepared (as explained above) every few days and kept away from the light. The stain, when in good order, must appear of a deep, opaque violet colour; its decomposition is recognised by its getting transparent and slightly rose-coloured, afterwards yellow and discoloured. It can be used until the yellow colour appears.

8. A cup of water.

9. Filter or blotting paper.

10. Spirit lamp as in para. A.

C.—For the Inoculation of the Tubes.

1. An iron or wooden stand for fixing the supply tube.

2. The forceps and lamp, as in para. A.

3. Glass bristle, or platinum needle, or wire.

4. A glass pencil or tickets, for marking the inoculated tubes.

5. A tin box for cultivating the tubes near an oil lamp or in the sun (in the latter case the tin box must be well closed).

6. Sterile test tubes of peptonised agar-agar (to be obtained from Agra, or in Bacteriological Depôts, or prepared according to the Bacteriological Hand-books).

D.—For keeping Records.

1. Books for registration.

2. Tickets to be given to those inoculated.

The particulars to be written in the books at the time of the first inoculation are as follows :—

Serial number. Place and date of the first inoculation.

Name (and father's name in the case of natives, or regimental number for Soldiers and Sepoys).

Sex, Age.

Nationality and birthplace.

Caste (Indian) and religion.

Profession and address (as fully as possible).

Intestinal disorders and remarks about the general health.

Previous attacks of cholera with the symptoms and dates.

At the time of the 2nd inoculation:

Amount of fever produced by the first inoculation (with degree if possible), and its duration.

Other symptoms, especially intestinal.

Date and place of second inoculation and dose administrated.

Each person inoculated for the first time gets a ticket bearing a number corresponding with the serial number in the book, his name and father's name or regimental number, the place and date of the first inoculation, and the date fixed for the second inoculation. On the backs of the tickets is usually printed (in English or in local dialect) the following account of the symptoms produced by the inoculations:—

"EFFECTS OF THE ANTI-CHOLERA INOCULATION.

No visible effect during the first two hours after inoculation.

From 3rd to 12th hour, a gradually developing tenderness at the point of inoculation, together with a rise of temperature (fever) and feeling of malaise.

From 12th to 36th hours, the general symptoms completely vanish; a painful induration produced at the seat of inoculation disappears gradually in a few days.

Beyond a *temporary* reddening at the point of inoculation, no alteration of the surface of the skin is produced.

A second inoculation is performed 5 or more days after the first.

The effects of the second inoculation as of the first are essentially the same.

No disturbance of the digestive functions is as a rule produced, and no change in diet or occupation is necessary.

In a few persons the above symptoms are, after the first inoculation, preceded by slight diarrhœa and feeling of cold."

The details in the book and the numbers and names in the tickets are written beforehand or during the operations; but the tickets are given to each person exclusively by the operator himself, directly after the inoculation. When operating on large numbers, the operator himself calls each man

by the ticket and watches carefully to see that the tickets follow each other in the order of their sequence, that not a single number is wanting, and not a single man not inoculated left on the register.

For the second inoculations the page of each person is found by the number of the ticket, which he brings with him. The details of the symptoms produced by the first inoculation can be entered in the book beforehand; but *the date and dose of the second inoculation are written in the register* during the operation by an assistant, and *only when the person is actually inoculated for the second time.* The tickets are afterwards destroyed or given back to the patients.

During an epidemic of cholera, in a place where inoculations have been done, attention should be directed towards ascertaining and recording, as accurately as possible, in each case whether the individual attacked had previously been inoculated, carefully noting the symptoms and especially the temperature curve in cases occurred after inoculations. Other details, for the demonstration of the resistance of the inoculated people in comparison with those not inoculated, such as the population, numbers attacked, special conditions in which the case occurred, &c., should be collected as accurately as possible. It is most desirable that all such observations should be forwarded to the Sanitary Authorities, or published in medical magazines, or communicated to the authors of the paper.

To The Librarian Royal Victoria Hospital Netley with C Sibthorpe's compliments.

TRANSACTIONS

OF THE

SOUTH INDIAN BRANCH BRITISH MEDICAL ASSOCIATION.

PRESIDENT'S ADDRESS.

LAWRENCE ASYLUM PRESS.

Address delivered on the 27th February 1895, by Surgeon-Major-General C. Sibthorpe, F.R.C P.I., *President, South India Branch.*

Gentlemen,

It was with great pleasure that I accepted your re-election of me as President of this Branch of the British Medical Association for this year and I sincerely thank you for the honor you have done me. It is with no little diffidence I take up the important post which has been so worthily filled by my predecessors. We are now in the eleventh year of our existence and many of you know with what hopes we commenced our career in 1884 under Surgeon-General The Honorable Mr. Cornish. We had then fifty-eight members on our list and, notwithstanding considerable fluctuations we had 99 members on the 31st December 1894 and four have joined this year. The year 1893 saw completed the fifth volume of our Transactions—many of which contain very valuable professional contributions and the records of several interesting discussions. Our success is also shewn in the good balance to our credit of Rupees 2,207-9-3 which is a very satisfactory feature of our work; as success in finance is a great factor in the stability and well being of such Societies and will enable us to assist Medical Officers in conducting original research.

During the year 1893 we have had sixteen new members, seven of them being local graduates, which shows the wisdom of your electing Mr. C. B. Rama Rao, L.M.S., as one of the Honorary Secretaries. Seven meetings were held, the average attendance being about twelve or rather less than half the number of members present in Madras. Amongst the papers read was a valuable contribution by Dr. Neild Cook, the Health Officer of Madras, on house drainage as applicable to Indian cities which led to a useful discussion. Surgeon-Major Browning opened an interesting discussion in March, on the use of opium. Surgeon-Captain Williams contributed a useful record of the autopsies performed in the General Hospital during the past eleven years. Surgeon-Lieutenant Elliot's paper, read in October, on the use of strychnine as an antidote for cobra poisoning was the result of his careful scientific experiments and clearly shows that no such antidotal effect exists and, moreover, that the application of the remedy is attended with great and serious danger. I have submitted this contribution to Government and it has been sent on to the Government of India.

The great Association of which we form a Branch has now about 17,000 members and its journal has a weekly circulation of 19,000 copies. In the year we started, the members of the Association numbered about 12,000, including nearly all the men of eminence practising in Great Britain and its dependencies. I regret to say that the two Branches which existed in India in 1884, and had been established before the South India Branch, have since perished. We have now, as you are aware, Branches of the Association working in Bombay, Rangoon and in the Deccan at Secunderabad. I hope the Congress lately held in Calcutta will still further bind Medical men to the British Medical Association which has done such good work generally. I would like to see our Branches able to show on their rolls all the duly qualified members of the Profession in India, whether they have been trained out here or in Europe, so that we might keep touch with the best traditions of the Profession in Great Britain and carry out the intentions of our Association in keeping up the honour and welfare of the Medical profession generally, and the prosecution of inquiry and research regarding the many problems, which being unsolved still keep medicine without the pale of the exact sciences.

The year 1895 will see some important changes made in the Administration concerning Medical relief in India, and the Madras Establishment of the India Medical Service will be merged in one service for the whole of India. It appeared to me, therefore, a good time to review the work our profession has done in the Madras Presidency since it was first occupied by the East India Company and to trace, as well as I am able, the gradual evolution of the Medical Services and the work they have done in giving relief to the sick and in effecting the prevention of disease. There is also another reason why I have selected this as the subject of my address to-night, and that is that most addresses follow on beaten lines and it seems well to break the monotony which must naturally tax the patience of the audience. The facts I have brought together will bear a permanent record of the constitution and development of our Medical Services in this part of India

which will be of considerable use and interest to the younger members of the Profession and will stimulate us all to continue the good work so well started by our predecessors.

Preliminary stage of the Medical Service in the Madras Presidency :—

According to Talboys Wheeler in his interesting book "Madras in the olden time" we find that Madras town was established in A.D. 1639 and Fort Saint George erected in 1644.

The first Medical Officer mentioned is Bazaliel Sherman, Chirugeon, *married* and that he arrived in Madras in 1676; this information appears in a list of persons in the services of the Honorable East India Company at Fort Saint George, Madraspatnam. He is graded twenty-first in a list of twenty-four officials. His salary appears to have been £30 a year with some extra allowances. The Agent and Governor's pay is given in the same list as £300 a year. Members of Council and Chaplains £100 a year each. Warehouse-keeper £75 a year. Customer and Choultry Justice and the Schoolmasters at £50 a year each. The Assistant Warehouse-keeper £30 a year and all the others under that sum.

In 1687 we find a Doctor John Heathfield who was taken prisoner by the Dutch with the ship "President" during his fifth year of service. In 1681, during his sixteenth year of service he asked the Honorable President and Council to make him a Factor. Whether the request was granted or not the records do not show. In August 1693, a Dr. Samuel Brown accused himself of having caused the death of a Mr. Wheeler, Member of Council and Sea Customer and Chief Justice of the Choultry. It appears that his servant had negligently powdered pearl in a stone mortar wherein arsenic had been before beaten. The post-mortem examination by Dr. Buckley, the Surgeon of the Hospital, states that the parts that seemed to suffer most were the stomach and intestines, which were a little inflamed, but almost wholly bared and stripped of the mucous or slimy covering with which these parts are commonly invested * * * he goes on to say "but the suddenness of his death, and the severe symptoms he laboured under before he died, were greater arguments of poison received than anything I could trace out by dissection."

The same Dr. Brown appears again to have got into trouble by assaulting a native in 1696 but was eventually discharged from confinement on giving security to the judge's satisfaction.

In 1694 it is related how Dr. Blackwall, a Surgeon in the Company's service, obtained for himself and his heirs from the Native Governor a Firman for the Governorship of Porto Novo. There appears to have been some suspicion of his loyalty, he was arrested and examined at Fort Saint George but eventually obtained his release on giving security.

In 1717 it was represented that the soldiers of the Company had suffered great inconvenience by being obliged to give their whole pay to the Steward of the hospital for sustenance during their stay in it, and were also obliged to pay half a pagoda a month towards their clothes for as many months as they stayed in hospital. These regulations appear to have had the natural effect of keeping men from reporting sick. It was then ordered that the men were only to pay the steward two pagodas a month for food as that sum was considered fully sufficient to furnish the men with good provisions.

The next incident related as occurring in 1726 is a curious illustration of a constantly recurring difficulty and shows how a canny Scot, Governor Macrae, then proposed to deal with it. He considered the cost of the hospital charges too large, and that some of them were unnecessary and ought to be reduced or discontinued. In spite therefore of the protest of the Surgeon in charge he ordered "whereas it hath been the custom for one of the Surgeons to have the immediate care of the hospital solely, they do in future act each six months by turns; that by their acting thus interchangeably, we may make the experiment whether the one cannot reduce the charge of the hospital lower than the other, which it is believed out of emulation to recommend themselves, they may do."

There is nothing to show how far these rules conduced to the comfort of the sick or how far they were successful, but some of you will remember how long the tradition guided certain officers of the Medical service.

That the system did not work satisfactory appears to be proved on a reference to an extract in Colonel Wilson's history of the Madras Army in which he quotes an order, dated January 1752, from the Court of Directors wherein it is stated that complaints

had been made that the Surgeons of these hospitals did not give due attendance to their sick and wounded Military, and that it was the custom for the Surgeons to take their pay during the time they were in the hospital. It was directed that in future the Surgeons give a due and regular attendance on the sick in the hospital and that they should discontinue to take the management thereof monthly. That the only stoppages from the sick and wounded Military in the hospitals was to be for their provisions and only so much as they usually gave for their food in health. One of the members of Council and the Officer Commanding the troops in the Fort (a Major) were directed to visit the hospital to see and report that the Surgeons were regular in their attendance, gave all the relief in their power to the sick, to note that the sick were kept clean and were given the proper provisions. Annual reports were required to be submitted showing names of patients, dates of admission, disorders of each man and dates of discharge. The Governor was also authorized to dismiss without regard any Surgeon who was remiss in his duty or unequal to it. The difficulties appear to have continued as we find in a Proceedings of Government, dated 1st December 1760, irregularities had occurred in the management of the Camp hospital and it was ordered that the rate of two pagodas a month should be deducted from the pay of patients, and that the Company should defray the surplus charge. The sick were to be provided with such diet as the Surgeons considered necessary for their cases, and it was suggested that, if the victualling could be performed by contract on the same terms as in the Garrison, it would be most agreeable in all respects.

In May 1822 Government allowed blankets, flannel banyans drawers, stockings and woollen caps as a free issue, when necessary, for European soldiers in hospital.

On the 10th November 1826 a new diet scale for European s was published in a Government order, and Surgeons holding contracts for such supplies were ordered to furnish them according to the scale and invariably of the best quality. Commanding Officers of Camps and Superintending Surgeons of Divisions were ordered to see that these orders were strictly carried out. This system was finally abolished for Europeans in 1827 and for Natives in 1829, and the supply handed over to the Commissariat Department.

Departmental development and evolution.—Col. W. J. Wilson's history of the Madras Army shows that difficulties about the management of the hospitals in the field at Waldour appear first to have led the Government in December 1760 to form a Medical Service and to appoint a Surgeon-General to superintend the whole, including the General hospital and the sick in the Field, and he was to take and keep an exact account of all hospital stores and indent on Madras from time to time for what was required. All stores and medicines were under his charge for issue and he was held responsible that only such hospital servants were employed as were required. All Surgeons were directed to report to him and he alone was authorized to make general reports to the Governor and Commander-in-Chief. He had to see that Nominal Registers were kept up in each hospital, that proper accounts of expenditure were maintained and that corrected stoppage rolls were submitted of the amounts to be deducted from each soldier.

The first Surgeon-General was Stephen Briggs, and he apparently had control over the Surgeons with the Royal Troops as well as those of the Companies' Service.

In 1767 the Senior Surgeon in the Field was empowered to engage dooly coolies for the carriage of the sick.

In April 1771 Government published a list of all Medical Officers on the establishment.

There were 17 Surgeons—two at Madras, three at Quilon, three at Trichinopoly, two at Ellore, the rest at other stations. Three Mates or Assistant Surgeons, two being at Madras and one alone at Vizagapatam. There were eight Hospital Assistants in different stations but not in all, one being alone at Chingleput, these men were not to rise above that grade.

In a despatch from home in December 1773 it is stated that complaints had been made of requisitions for medicines being excessive and the indent was cut down to two-fifths. The Directors called for a statement to be submitted with each requisition sent home showing the remainder of all medicine, drugs, utensils and instruments. Instruments, especially the cutting ones, were directed to be sent home for repairs. Surgeons were called on to send in an annual statement of the number of patients received in the different

hospitals as either in- or out-patient showing the number, who had died, or who had been discharged as incurables together with the nature of their disorders. Medicines were that year supplied by the Apothecary's Company and every package of medicines and every instrument was required to be stamped by the supplier as a guarantee of its quality.

Medical Boards and Sick certificates.—In a despatch of August 1783 it was directed that the Principal Surgeon should certify, in his own handwriting, whenever an officer required sick leave in this curious form: "We, A, B and C, Surgeons of——do hereby declare, on oath, that we are of opinion, it is absolutely necessary that Mr. D should leave this country and go to Europe for the recovery of his health, occasioned by wounds, bilious or any other disorder."

This had to be attested on oath by the certifying Surgeon and the two next in rank before a Magistrate.

Under this resolution all officers, Civil and Military, allowed to go home, lost all such promotion or rank as they would have been entitled to had they remained in India or China, and if they were permitted to return they reverted to their positions on leaving as regards promotion and rank. The only exception was leave on ill-health certified as above and confirmed by the Governor in India or the Chief Supercargo in China, such leave was to be for one year only, to be extended for another year by the Directors on proof of the patient's health not being established.

In April 1786, these rules were modified as they were not required to be acted upon as regards the temporary return to Europe of any person in consequence of any reduction carried out in the several branches of the Civil and Military establishments.

As it had been found impossible always to obtain the attestations of three Surgeons, the certificate of one was to be accepted when his patient was really in "an ill state of health." All officers were warned that in case of any collusion concerning such certificates they would be most assuredly dismissed from the Company's Service. At the same time it was noted that the dissipated and the indolent had obtained leave with too great facility which had lead to the promulgation of the rules. In the same letter

Government was directed to report regularly the deaths, resignations and removal of any officers.

On the 14th October 1784, a Government order was published re-organizing the Department which was to consist of one Surgeon-General, two Surgeons-Major and twenty-seven full Surgeons, and directing that in future there was to be no appointment made of a full Surgeon but upon an actual vacancy in the number (30) established. There was also attached a list of thirty-two Surgeons and twenty Assistant Surgeons. The Surgeon-General, one Surgeon-Major and two Assistant Surgeons forming the Presidency town allotment—the others being distributed all over the Presidency.

In a despatch, dated the 21st September 1785, we find the Directors writing as follows:—"Concerning the care of our sick and wounded soldiers to be an object, dictated as well by sound policy as humanity, that we have bestowed particular attention in examining this subject, and the investigation has pointed out the propriety of transmitting to you precise regulations for the conduct of our hospitals. These regulations have in view the removal of every chance of the troops suffering from a want of proper attendance, comfortable accommodation, good medicines, diet, hospital necessaries, etc., and to establish such a control over the several departments of the hospitals as will limit the annual expenses to what are merely necessary, and to ascertain the charges with accuracy. They have likewise in view to abolish the absurd practice of allowing Surgeons to benefit in proportion to the number of sick under their care, or to derive any advantage in consequence of the sick remaining a length of time in the hospitals, which under such a system must be too often the case, to the prejudice of the service, and to the great disgrace of humanity. But at the same time though these regulations are particularly directed against any degree of abuse, they hold out encouragement to men of ability and character to prosecute the medical line in India by establishing reasonable prospects to individuals, and a regular progression of rank from the highest to the lowest stations in the Company's service."

These regulations were divided into two sets—"Regulations respecting Military Hospitals in India". The other "Forms and

Regulations for the Apothecary in charge the Medicine Stores at the different Presidencies in India."

It was recognised that a considerable number of Surgeons and Assistant Surgeons should be required for the military establishment, but it was thought there were sufficient in Bengal for all requirements in any of the Presidencies. The despatch goes on to say—"As in the present state of our affairs we cannot admit of any unnecessary expense, we have come to a resolution, and direct that no more Surgeons or Assistant Surgeons than those necessary for our several hospitals and establishments shall draw pay or allowances from the Company. The supernumeraries must depend on their private practice, till vacancies fall; as it was not our intention in permitting Surgeons of any description to proceed to India to practice in their profession, that they should immediately on their arrival receive pay, unless appointed to some station in consequence of vacancies. From this resolution, however, it is our intention to exempt such as have been in actual service with the troops, or in detachments during the war, and we consent to their drawing their pay while unemployed."

These orders reforming military hospitals were published in order that the annual expenses may be reduced and accurately ascertained, the sick and wounded properly attended to, and the gross abuse checked of receiving into the hospitals men with trivial complaints, causing great loss and prejudice to the public service.

With the view of encouraging men of professional ability and integrity to prosecute the medical line in the Company's service, a Physician-General or Director of the Hospitals was appointed in Bengal and Madras with a salary of £2,500 per annum. A Chief Surgeon with a salary of £2,000 per annum. Head Surgeon for every hospital where 8,000 men were stationed in peace or war, with salaries of £1,500 per annum. Head Surgeons of the other General hospitals were to receive £1,000 per annum. All Surgeons of regiments were to have the pay and emoluments of a Captain of Infantry. Hospital mates the pay and emoluments of a Lieutenant of Infantry, Regimental mates the pay and emoluments of Ensigns of Infantry.

The Physician-General and Director of Bombay was to receive

£1,500 per annum and one Hospital Surgeon £860 per annum. The Surgeons to regiments and Hospital mates were treated as those in Bengal and Madras according to the rates of pay and emoluments for Captains and Ensigns on the Bombay establishment.

A Hospital Board at Head Quarters was established consisting of the Director, Chief Surgeon, and Surgeon of the Hospital for the purpose of directing the necessary regulations and arrangements for all hospitals of the Presidency.

This Board was to recommend to the Governor the most able and deserving officers to direct and superintend the duties at each hospital, and was to be held responsible for the conduct of men who were appointed in consequence of its recommendations. The charge of the hospitals was considered the most important appointment, promotions being from the most deserving regimental Surgeon. Hospital mates were to be promoted to be Regimental Surgeons and Regimental mates were to be Hospital mates. It was added, "But although the most ample encouragement is hereby given to merit, yet it must also be understood that seniority and equal merits are to have the first claims to promotion". Hospital Surgeons were given the power of suspending any of the inferior officers, reporting the same to the Hospital Board who had to lay the same before the Governor in Council to be confirmed or set aside.

The Hospital Surgeon was required to assign duties to all his subordinates, to see the sick were conveniently lodged in wholesome wards having a free circulation of air, that they were kept clean and not crowded in their apartments. That diet tables were established and strictly adhered to. They were authorised to dismiss nurses, servants or attendants who were negligent or ill-qualified for the business of the hospital. No person belonging to the hospital was to receive any reward or emoluments from the patients on pain of instant dismissal. Every patient was to be supplied with a clean *cott*, or cradle, a large pillow, fresh bed cloths, a fresh gown, cap, shirt and long drawers, a small pillow or two if necessary—and a change of all when necessary.

Soldiers were only to be received into hospital on their producing an order signed by their Commanding Officer and the regimental Surgeon or Surgeon's mate. Nominal registers of ad-

mission and discharge, etc., were directed to be kept up, and the hospital stoppage rolls were to be sent in monthly to the Paymaster. Prescription books were to be kept up as checks against embezzlements and misapplication of medicines, etc.

Weekly returns of sick were to be submitted from regiments and camps to the Hospital Surgeon.

Requisitions for medicines, etc., by Regimental Surgeons were to be countersigned by their Commanding Officers and checked by the Hospital Surgeon who sent returns of them to the Hospital Board.

Monthly returns of sick of the hospitals were forwarded with the weekly regimental returns attached to the Hospital Board in support of the requisitions for medicines, etc. The *oldest* Hospital mate was placed in charge of these medicines and appliances and was required to keep an account of receipts and issues for which the Governor was authorised to grant him a special allowance.

A Purveyor was appointed at the Presidency to take charge of all stores, Medicines excepted, he was to receive his instructions from the Hospital Board on the subject of providing hospitals with attendants, provisions and other necessaries for the sick. He was to open the necessary books and submit monthly returns to the Hospital Board. His books were to be open to the inspection of any member of Council, of the Hospital Board, or any of the Head Surgeons of the hospitals at any time. He was allowed a deputy at each hospital, who was to be under the direction of the Head Surgeon of the hospital. His books were open to inspection by the Head Surgeon and his mates as well as to the Officers Commanding Corps in the District belonging to the hospital.

All contracts for provision were to receive the approbation of the Hospital Board and these contracts were to be checked by market rates. If the pay of the patients was insufficient to cover the cost of diet, the Hospital Board has power to authorize the Head Surgeon to supply them sending an accurate monthly return to the Board.

The Medical stores were to be placed in charge of an Apothecary who had been brought up in a druggist's shop. He had to keep accounts in a prescribed form and was not to comply with requisitions unless they had been passed by the Hospital Board. He was to submit certain returns to the Board every three months concerning expenditure, vouchers and requirements. A Board, consisting of a Surgeon and two mates, as to report to the Board on any lost or damaged stores. The Board was authorised to condemn or dispose of them as they considered proper.

A guard from the nearest regiment was to be placed over each General hospital. The officer of the day was to visit it and report to the Commanding Officer of the District the daily state of the hospital. The Surgeon, or in his absence, the first mate was to accompany the officer of the day on his rounds at the hospital and to answer such queries as he might have occasion to offer, for the purpose of obtaining every necessary satisfaction regarding the situation and treatment of the sick.

The Head Surgeon of each hospital was required to inspect the regimental hospitals in their districts as often as possible without neglecting their own hospital. Officers of the Hospital Board were to frequently visit the General Hospitals at the out-stations on leave being obtained from the Governor. The Officer Commanding-in-chief at each Presidency was to see and direct that good order and discipline be kept up in all hospitals and that all the Superior officials concerned performed their duties completely. In case of neglect or misbehaviour in any of these officers he was to report the same to the Governor and Council who were to instantly suspend, remove, or dismiss them on such complaints appearing to be just and well founded.

Elaborate regulations were laid down for the management of the Medical Stores which were under the Apothecary as Medical Storekeeper.

These dealt with the receipt of stores from England, requisitioning for such stores on the basis of actual issues during the year, stock taking by Boards of Survey, issues to hospitals, and making up boxes of medicines, instruments and appliances.

There was at this time one Surgeon for each of the four European battalions and two Assistant Surgeons for the whole four, one Surgeon and one Assistant Surgeon with the Artillery, one Assistant Surgeon for the Cavalry, others were on Garrison or Cantonment duty with chief ships or residences.

In October 1810 the salaries of the Members of the Medical Board and of staff Surgeons were increased. There were sixty full Surgeons on the Establishment in 1810 and only nine doing regimental duty. Government ordered that thirty-five full Surgeons should be sent to regimental duty which with sixty-two Assistant Surgeons made ninety-seven Medical Officers at that time in Military Employment.

In 1819 a Medical Store Department was formed with the principal depôt at Madras and minor ones at Secunderabad, Belgaum, Trichinopoly, Bangalore, Cannanore, Bellary, Masulipatam and Jaulna.

In 1820 Assistant Surgeons on joining were attached to the cadets' mess in Madras.

In September 1820 Medical Officers were prohibited from demanding fees for attendance on the families of Military Officers.

In 1823 all Medical Officers were required to subscribe to the Medical Fund.

In November 1825 the Eye Infirmary was placed under the charge of the "Honorable Company's Oculist" and a building, equipment and establishment were provided by Government.

In January 1826 a Medical Officer of the rank of Deputy Inspector of Hospitals, in His Majesty's army was appointed to the Royal troops serving in this Presidency; the nomination was made by H.R.H. the Commander-in-Chief of the Royal Army. This appointment led to some difficulties as regarded the responsibilities of the Medical Board and in April 1828 the Commander-in-Chief ruled that :—" Superintendence of His Majesty's Hospitals will rest solely with His Majesty's Inspector as to professional practice, leaving that of economical concerns where it has always been, with the Superintending Surgeons of the Company's service." Hospitals for the Royal troops which were out of the reach of His Majesty's Inspector were inspected by the Companies Superintending Surgeons who reported to him.

In January 1829 the tenure of appointment of a member of the Medical Board was fixed at five years from date of appointment and the members were given extra pensions.

In September 1841 an order was issued prohibiting Civil Surgeons from having any connection with banking, trading or indigo planting.

In July 1842 the designations of the members of the Medical Board were changed from First, Second and Third members to Physician-General, Surgeon-General and Inspector-General of Hospitals and it was ordered that officers might be selected for the appointment of Superintending Surgeon without reference to seniority.

In 1858 the Medical Board was abolished and the administration of the Department was vested in a body composed of one Director-General, one Inspector-General and the Superintending Surgeons. This was changed in March 1860 by a Warrant which organized the present Indian Medical Service with its three establishments of Bengal, Madras and Bombay, this warrant assimilated the ranks of the Indian Medical Service to that of the British Medical Service under its Warrant of October 1858. The administration was constituted of one Principal Inspector-General, one Inspector-General of Hospitals and ten Deputy Inspector-Generals of Hospitals (subsequently reduced to six) with grades of Surgeon-Major, Surgeon and Assistant Surgeon.

During 1867 the British Troops were placed under an Inspector-General of the British Medical Service who was given a Secretary with three Deputy Surgeons-General and a Staff Surgeon-Major in Burma of the British Medical Service. The Native Troops and the Civil Medical duties being placed under an Inspector-General of the Indian Medical Service who also had a Secretary and six Deputy Surgeons-General. During the same year the salaries for Civil Medical staff appointments were revised and the establishment of the Officers of the Indian Medical Department was fixed at one hundred and eighty-seven.

In 1880 an order of the Government of India separated Military and Civil Medical duties; the Medical administration of the Army, both European and Native, was vested in an officer of the Army Medical Service styled Surgeon-General Her Majesty's Forces, whose designation was changed again in 1891 to Principal Medical Officer, Madras Army. He was assisted by two Administrative Medical Officers of the Grade of Deputy Surgeon-General belonging to the Army Medical Staff and four of the same grade belonging to the Indian Medical Service.

Under the same orders the Head of the Indian Medical Service in Madras was designated Surgeon-General with the Government of Madras and had to deal with all questions of Civil Medical administration and the recruiting and maintenance of the Madras Establishment of the Indian Medical Service as a whole and the subordinate Medical Services, Military and Civil. He had to supply the Surgeon-General, Her Majesty's Forces, with the authorized number of Medical Officers and subordinates to be selected by him to meet all Military requirements.

As the transfer of the Deputy Surgeons-General, who were until 1880 employed under the Head of the Indian Medical Department, increased the administrative and inspecting duties of the new Surgeon-General with Government, a scheme was organized in 1883 constituting Civil Surgeons in Medical charge of Districts as District Medical and Sanitary Officers and they were required to inspect all Medical institutions and villages in their respective Districts leaving only head quarter hospitals and other important outlying institutions for the Surgeon-General's inspection.

In 1885, the establishment of Commissioned Medical Officers for this Presidency, both for Civil and Military duties, was revised, and the strength reduced from one hundred and eighty-seven to one hundred and fifty-three, chiefly owing to the disbandment of ten Native Regiments. Since then some more appointments were abolished, *viz.*, Examiner of Medical Accounts, one Cavalry Regiment, the Residency Surgeon Travancore, the Medical Officer Nair Brigade; and nine additional officers were sanctioned for the following duties:—

Four for Extra Military duties in Burma,
Three as Additional Civil Surgeons in Burma,
Two for the Jail Department,

making a total of one hundred and fifty-nine, the present sanctioned strength of the Madras Establishment.

Rank.—According to Wilson's History of the Madras Army the first mention of rank was made in a Government list, dated April 1771, in which all Medical Officers on the Establishment were divided into Surgeons, Mates and Hospital Assistants, the last not being allowed to rise above that grade. As you may see in the History of the Medical Staff in the Army Book for the British Empire, Medical Officers at this period, and up to 1796, not unfrequently held double commissions and could act in the double capacity of Captain and Surgeon.

In October 1782, another Government order was published with a list shewing the ranks apparently according to seniority of thirty-two full Surgeons including a Surgeon-General and two Surgeons-Major. There were also twenty Assistant Surgeons from whom the full Surgeons were selected.

In January 1787 relative ranks were assigned—

Physician-General as Brigadier-General.
Chief Surgeon as Colonel.
Head Surgeon of an hospital of a garrison of 8,000 men as Lieutenant-Colonel.
Head Surgeon of all other hospitals as Majors.
Surgeons to Regiments as Captains.
Assistant Surgeons as Subalterns.

The following system of promotion was fixed in 1786 on merit, but it was to be understood that seniority and equal merit were to form a fair claim to promotion.

The Establishment was classed into five groups :—

1st class to comprehend the Hospital Board.
2nd ,, ,, Head Surgeons to hospitals.
3rd ,, ,, First Surgeons to hospitals.
4th ,, ,, Surgeons to Regiments, Garrisons and chiefships where Senior Civil Servants were stationed for the administration of Districts as at Vizagapatam and Ganjam.

5th class Mates to Hospitals, Regiments and Residencies, such as Tanjore.

In May 1832 the rank of Colonel was conferred on the Members of the Medical Board and that of Lieutenant-Colonel on Superintending Surgeons to counteract the supersession occasioned by the appointment of Inspecting Officers to Royal Troops. In 1833 it was decided that this rank was to be considered purely official, and was not to give any claim to Military command, or to increased allowances of any kind, except in cases of distribution of prize money.

In July 1842 Surgeons of thirty years' service were ordered to be designated Senior Surgeons and as such they were to rank as Majors.

In 1860 a warrant was published fixing the grades of Medical Officers as Staff or regimental Assistant Surgeon ranking as a Lieutenant and after six years service as Captain. Staff or regimental Surgeon after twelve years service ranking with Major, Surgeon-Major, on twenty years service ranking as Lieutenant-Colonel but junior to that rank. Deputy Inspector-General of Hospitals ranking as Lieutenant-Colonel and after five years service in India as Colonel. Inspector-General of Hospitals as Brigadier-General or after three years as Major-General. The Secretary of State in his letter forwarding this warrant writes of the designations and *ranks* of the Medical Officers.

In a Royal Warrant of 1866 it was decided that a Surgeon after twenty years service in any rank, shall be styled Surgeon-Major, but a Surgeon of less than twenty years full pay service might be promoted to the rank of Surgeon-Major for distinguished service.

In 1873 the grade of Assistant Surgeon was abolished and that of Surgeon was made the lowest in the Commissioned ranks.

The warrant of January 1881 fixed the status of Surgeon-Generals who were to rank as Major-Generals, the Deputies as Colonels, the Brigade-Surgeons as Lieutenant-Colonels, Surgeon-Majors as Majors and after twenty years service as Lieutenant-Colonels and Surgeons as Captains. Other warrants were published in 1887 and 1889 but without important difference as regards rank.

Consequent on the abolition of relative rank in the Army in 1886 and on the report of the Camperdown Commission in 1889 and on the representation that gave rise to it from 1886 to 1889, a Royal Warrant was published in 1892 on the lines of the one for the Army Medical Staff published in 1891 which at last gave officers of the Indian Medical Service their present position and rank in the Army, which Lord Dalhousie when Governor-General had pointed out years before was very necessary. These new ranks were declared to be substantive and were to carry precedence and other advantages attached to the rank indicated by the Military portion of the title but not to entitle the officer to Military command, except under special circumstances which were detailed, or to the presidency of Courts-Martial, Courts of Inquiry, Committees or Boards of Survey.

The compound designation of these ranks were fixed by this order and, whether we like them or not, it is clearly our duty to use them as long as we remain in the service. The importance of them in Civil life is very slight, for Commissioned Medical Officers in Civil employment take their position according to their education and merit. In life amongst military men, the question is quite different, they have all been properly trained from their youngest days to recognize Military rank, and therefore it is most important that every officer serving on an equality with them under the Army Act should have a definite rank and title expressing it, about which there can be no mistake. It is all well enough for some of them to say that the Medical profession is such a noble one that Military doctors do not require any Military designation; such has not been the experience I have sketched out for you here and the necessity of making our rank and designation clear has at last been fully recognized by Her Gracious Majesty. I often note that many Officers of the Indian Medical Service, especially in Civil employment, either forget or ignore the fact, that they have now definite rank and designations, which have been fixed by Royal authority and use, when speaking to or of each other the term "doctor," which many of them have no legal right to. This I do not think right, we should respect each others positions and ranks although we belong to about the most democratic profession there is. It is also desirable that we should use our authorized titles to support our brethren who are performing Military duty and to whom the rank designated by the title means a great deal more than to us. They have to exercise Military command and responsibility over the *personnel* of, and the patients in, their hospitals and if their titles are not used their relative position is very liable to be misunderstood by all those they come in contact with in their official spheres of duty.

Our position in the service of Government, and the ranks of the Military Assistant Surgeon recognised by the Government of India last year, will doubtless have in the future a very considerable bearing on the social position to be taken by uncovenanted Civil Surgeons, Civil Assistant Surgeons and Civil Hos-

pital Assistants—at present such officers and subordinates often complain that they have no social status whatever, and as it has now been recognised that it is desirable that Military Medical Officers and subordinates have a distinct social status relative to the other officers in the Army, whose position in society is well recognised, it appears to me very desirable that Medical men in Civil life, both in Government service and in private life, should recognize the important bearing the social position of Military Medical Officers will have upon their own.

Codes and Regulations.—On the 8th July 1786 regulations were first published for the guidance of Medical Officers in charge of hospitals but no copy of them is available.

The first Code of Regulations I have found is dated 1833, sanctioned in a Government order, dated 19th July 1833, cancelling all existing regulations militating against any part of it.

It was divided into nineteen sections with an Appendix dealing with the supply of Asiatic Medicines and Hospital necessaries.

The sections contained regulations of the following subjects :—

Section I. General regulations for European and Native Hospitals (Military).

Section II. Particular regulations relative to the sick of European Troops.

Section III. Particular regulations relative to the sick of Native Troops.

Section IV. Garrison Hospitals.

Section V. Detailed regulations relative to the professional duties of Executive Medical Officers.

Section VI. Regulations relative to subordinate Medical Services.

Section VII. General duties of Superintendents and Staff Surgeons.

Section VIII. Miscellaneous regulations (relative to Medical Officers and sick certificates).

Section IX. Regulations respecting the probationary course of newly appointed Assistant Surgeons.

Section X. Lock Hospitals.

Section XI. Regulations relative to Medical Officers attached to the Civil Department.
Section XII. Department of Vaccination.
Section XIII. Eye Infirmary.
Section XIV. Lunatic Asylum.
Section XV. Regulations, respecting the diet of Native patients in Civil and Lock Hospitals.
Section XVI. Government Dispensary (on Choultry plain).
Section XVII. Chintadrapettah Dispensary.
Section XVIII. District Surgeons at the Presidency.
Section XIX. Port and Marine Surgeon.

A Second Code of Regulations for the Medical Department was compiled by order of Government under the superintendence of the Medical Board by the Secretary to the Board, A. Lorimer, Esq., M.D., and recognized by a General Order of Government on the 26th July 1856. It was also divided into nineteen Sections dealing with—

(1) General regulations for European and Native Hospitals (Military).
(2) Particular regulations relative to the sick of European Troops.
(3) Particular regulations relative to the sick of Native Troops, instruments, &c.
(4) Garrison Hospitals.
(5) Detailed regulations relative to the professional duties of Executive Medical Officers.
(6) Regulations relative to subordinate Medical servants.
(7) General duties of Superintending Surgeons.
(8) Miscellaneous regulations relating to the inspection of Hospitals in charge of Junior officers by the Senior Surgeon of the Garrison, duties regarding Medical attendance on officers, rules regarding sick certificates and Medical Boards.
(9) Regulations respecting the probationary course of newly admitted Assistant Surgeons.
(10) Regulations relative to Medical officers attached to the Civil Department.
(11) Rules for the management of Civil Dispensaries.

(12) Department of Vaccination.
(13) Eye Infirmary.
(14) Lying-in Hospital.
(15) Lunatic Asylum.
(16) Regulations relative to the diet of Native (Civil) sick.
(17) District Surgeons at the Presidency.
(18) Rules for the guidance of officers visiting the Neilgherry Hills on Medical certificates.
(19) Regarding equipment and supplies.

In the table of diseases for Medical Returns there are some curious terms such as ambustio, apostema lumbare, atrophia, dysecea, dysopia, gelatio, ischias physcomia. Diseases were classified into fevers, eruptive fevers, diseases of the lungs, liver, stomach and bowels, brain, epidemic cholera, dropsies, rheumatic affections, venereal affections and diseases of the genital organs, abscesses and ulcers, wounds and injuries, punishments, diseases of the eye, diseases of the skin and a list of sixty-three other diseases not included under the foregoing headings.

The third Code of Medical and Sanitary regulations was compiled under the orders of Government by W. R. Cornish, F.R.C.S., Surgeon, Madras Army, Secretary and Statistical Officer to the Inspector-General, Indian Medical Department in 1870 and consisted of twenty-seven sections dealing with :—

(1) Administrative officers including the Inspector-General of Hospitals, Deputy Inspectors-General of Hospitals and the Secretary and Statistical officer.
(2) Executive Medical officers Military (British and Indian).
(3) Executive Medical officers (Civil.)
(4) Sub-Assistant Surgeons.
(5) Subordinate Medical Department, Apothecaries and Hospital Assistants.
(6) Travelling on duty.
(7) Pay of Medical Officers.
(8) Leave.
(9) Pension.
(10) Sanitary Regulations.
(11) Medical Stores.
(12) Hospital supplies.

(13) Indents and vouchers.
(14) Medical Boards and certificates.
(15) Invaliding British and Indian troops.
(16) Special Hospitals, including General Hospital, Eye Infirmary, Lying-in Hospital and Fort and Port Surgeons Department, Madras.
(17) Lunatic Asylums.
(18) Recruiting Native Army.
(19) Correspondence.
(20) Reports and returns (Military and Civil.)
(21) Transport of troops.
(22) Medical College.
(23) Hospital equipment.
(24) Medical Examiner.
(25) Budget Estimates (Civil and Military).
(26) Medical Inspection of Emigrants.
(27) Dress Regulations.

and a copy of the Royal Warrant of 1860.

This book was well edited and formed the guide in Madras for many years until preparations were made for the compilation of Volume VI, Medical, of the Indian Army Regulations, which was done from sets of military regulations which had been prepared under the orders of the Government of India for each Presidency. This volume when it was published in 1886 was very complete but owing to the numerous corrections it has become a serious labour referring to it on nearly any subject. It is now more complete as regards Military Medical matters, and it is to be hoped that the volume which is certain to be published soon after the promulgation of the final orders on the Medical re-organization, consequent on the Military changes which are to take effect on the 1st April 1895, will be still more useful.

The Field Service Department Code, Medical, republished in 1892 with its corrections, is by far the best set of regulations that have ever been compiled for Field Service and it is certain that the system would work well if Government had either the Medical Officers, subordinates or servants in sufficient numbers who understood it and who had been given opportunities of practising the system. Under the organization as at present existing the duties of administering the medical services in the field or on the line of

communication could not be carried out with any approach to efficiency, and in my opinion any attempt to conduct extensive field operations under the existing condition of the medical services would end in a complete break down with the consequent odium falling on the responsible Principal Medical Officers.

Most of the orders in the Code of 1870 referring to Medical Officers in Civil employ having become obsolete from different causes, it has become absolutely necessary that a new Code should be published containing all the orders referring to the Civil Medical Department under the Madras Government. Such a Code Surgeon-Captain Crawford is now compiling with help from the Surgeon-General's office and it will be divided into the following sections :—

(1) Civil Medical Establishment and distribution.
(2) Administrative staff.
(3) Executive Commissioned Medical Officers.
(4) Uncovenanted Civil Surgeons.
(5) Subordinate Medical Department including Assistant Surgeons, Civil and Military, Civil Apothecaries, Female Practitioners, Hospital Assistants, Service books, Travelling allowances, Vernacular examination, Charge allowances, Confidential reports, Compounders, Midwives and Hospital servants.
(6) Duties including District Medical and Sanitary Officers, Civil Surgeons and subordinates, Meteorological observations, Port Surgeons, Factory Surgeons, District Surgeons at Presidency, Inspector of Emigrants.
(7) Medical attendance and fees.
(8) Boards and certificates.
(9) Correspondence and stationery.
(10) Statistics, returns and reports.
(11) Presidency State Hospitals and Lunatic Asylums.
(12) Hospitals.
(13) Medical Store depôts and supplies.
(14) Medico-legal and Chemico-legal examinations.
(15) Sanitation.
(16) Budgets.

Each of the State Hospitals in the Presidency will have its own book of Standing Orders and the Lunatic Asylums will have a Code of their own.

In future the Quarterly sheets of Departmental orders will contain all the orders regarding the Department, and the Codes will be kept corrected up to date by the issue of correction slips.

The names of the sections in these different Codes show better the work required of the Medical services than a great amount of writing could do.

Separation of Military and Civil Medical duties.—For many years after the first regular organization of the Department in 1760, the duties of Medical Officers appear to have been confined to attendance on the Military and Civil employés of the Company.

It is impossible to say exactly, from the history of the East India Company, how early hospitals or dispensaries were first opened for the use of the general population but the history of the English in India shows that from the earliest times Medical Officers treated the natives of the country with great benefit to them and to the State.

In the Code of 1833 a few regulations regarding the diet of Civil patients are laid down. In the Code of 1856 we find definite regulations laid down for the management of Civil dispensaries and hospitals directing the Medical Officer to attend at a fixed hour every day to give gratuitous medical and surgical aid and advice to all who deserved them. Paupers requiring it were allowed to be treated as in-patients, and were to be fed and clothed while in the hospital. Patients of the richer classes were allowed to be treated as in-patients, feeding and clothing themselves. The Medical subordinate was to be resident on the spot to give attendance in cases of emergency, or to send for the officer in charge. Scales of diet, clothing, furniture and equipment were laid down. An establishment of Medical subordinates and hospital servants was formulated.

Government looked for the best exertions of Medical Officers in charge of these institutions being continued as heretofore for the advancement of their utility in relieving the suffering of the sick poor; this was to be attained by an earnest and watchful

interest in all the duties appertaining to the charges, by kind and conciliatory conduct to all applicants, and by prompt willingness to afford relief. It was also suggested that it would conduce to the regularity, order and efficiency of these institutions if they were frequently visited by the Chief Civil authorities, Judges, Collectors and Magistrates of Civil Stations and Officers Commanding Military Cantonments.

Rules regarding the custody and care of poisons, the keeping of accounts of expenditure and the compilation of statistics were also laid down.

In these hospitals it was directed that venereal cases should be kept separately and that females so affected, especially at stations occupied by European soldiery, should be encouraged to apply for medical aid and assistance, and such women were to receive every indulgence and kind consideration.

After 1870 nearly all the up-country hospitals and dispensaries were placed under the management of the local bodies formed under the Municipality and Local Board Acts. Some hospitals in Madras were also placed under the Municipality or are under Committees. The State hospitals, the Police hospitals, the Jail hospitals and a few hospitals and dispensaries in out-laying places were and are still directly manged by Government through the Surgeon-General.

Civil Medical Administration.—Amongst the papers relating to Medical Officers in India published as a blue book in 1881, it can be seen that the Government of India appreciated the importance of separating the Civil and Military Medical duties and advocated it when submitting the proposals on which the Royal Warrant of 1860 was published.

In April 1867 Government published an order on the proposals of the Medical Commission fixing Civil stations in two classes, first and second, and approving of the allotment of the appointments and duties for the Medical College and the Presidency town of Madras, but leaving to the local Government to vary the distribution of the classes and conjoint duties in such manner as from time to time may be found most expedient with reference to the qualifications of the several officers employed, provided only, that eventually all these duties are taken by the reduced number of Medical officers indicated by the Medical Commission. The salaries of all Civil Medical appointments were revised in an order published in April 1867, and it was directed that it would be open to all local Governments to modify the allotment of duties, in such a manner as from time to time may seem most desirable, with reference to the convenience of the service, provided the prescribed number of officers and aggregate of salaries is not exceeded.

Presidency house rent, according to relative rank was allowed to Medical Officers drawing less than 1,400 Rupees a month and not provided with Government quarters. This was done away with in the Civil Department on the representation of the Finance Committee in 1888 for such officers as were entitled to engage in private practice; an equitable enough arrangement in Calcutta where large incomes are gained from such practice but a hard rule in Madras where but little money is made in this way.

In 1877 the Government of India represented to the Secretary of State that the system introduced in 1865 was extravagant as well as unworkable from a military point of view, and that as regards the Civil Department, the system of supervision by the Deputy Inspector-Generals of Circles was most unsatisfactory. Attention was called to a recommendation made in 1872 that the true remedy would be found in the amalgamation of the British and Indian Medical Staff, and the separation of Civil Administrative Medical duties from the latter, each Local Government and Administration being provided with a selected Principal Medical Officer for its Civil requirements. At the same time it was pointed out that the two measures hung together, and that without reduction, consequent on the formation of a single Military Medical Staff, the Government of India could not find the means to constitute the improved civil staff, the want of which was so much felt. In sanctioning these proposals in 1880, the Secretary of State allowed a Surgeon-General for Civil Medical Administration in Madras and a Secretary. The Surgeon-General was to be Head of the Indian Medical Service in the Presidency. It was clearly laid down that the Sanitary Commissioner was not to be in any way subordinated to the Surgeon-General, and should remain as before directly under the orders of the Local Government.

On receipt of this order Surgeon-General Cornish submitted

proposals for transferring the administrative duties formerly performed by the Deputy Surgeon-Generals to the Zillah or Civil Surgeons whom he proposed to call District Medical and Sanitary Officers. These proposals were eventually sanctioned by Government in February 1883.

The following appointments for Medical Officers are now under the Madras Government.

The Surgeon-General with the Government of Madras.
The Secretary to Surgeon-General.
The Sanitary Commissioner.
The Deputy Sanitary Commissioner.
The Surgeon to His Excellency the Governor.
The Principal Medical Storekeeper.
Medical College, including General, Lying-in and Ophthalmic Hospitals.—Nine Officers.
The Additional Medical Officer, General Hospital.
The four Presidency Surgeons.
The Superintendent of the Madras Lunatic Asylum.
The twenty-four Civil Stations on List I in charge of District Medical and Sanitary Officers or Civil Surgeons.
Two Jail appointments.
The Physician to the Maharajah of Travancore.
Including the reserve for leave and sickness, these require about fifty-eight officers.

The new arrangements consequent on the changes in the Presidential Army system, are not likely to make many differences in these appointments beyond recasting the duties of the Surgeon-General and placing the Principal Medical Storekeeper under the Government of India. There is good reason for believing that the changes are not likely to interfere with the rights or privileges of officers of the Madras establishment now serving, and we all look forward with hope to the orders which may be expected shortly which will, doubtless, place us in a better position to carry on our Civil Medical duties.

There are some who consider the present system of filling the higher appointments in the civil branches of the service of the Government of India as anomalous, indefensible and injurious to Medical education in the country, and that Civil Medical employment should not be made a reserve for the Military Medical officers required by Government.

This opinion is but an outcome of a superficial view of the question. In England, Medical men are rarely the servants of the State, and one of the great objections in my mind to the present Military Medical organization is that the Officers have little or no chance of extending their professional experience beyond what they see in Military Hospitals. Under the present conditions the Government of India have a reserve of Medical men who from their earliest service have large opportunities of improving and increasing their medical, surgical and sanitary experiences. I consider the system is perfectly defensible on the grounds that the Government of India must get the best professional men it can for the terms it offers, and the Indian Medical Service has been open to all classes of Her Majesty's subjects since 1860. Since then we have had in the service a large number of gentlemen born and brought up in India, some of whom have done as good work as the average of the members of the profession in India. In the present state of the profession, as far as I know it, the Government of India is not likely to command a more highly educated class of Medical men to come out to fill its appointments unless much better terms are offered. For the Educational appointments it is not likely, that men who have a clear prospect of getting on in Great Britain would compete for service in India; even if they did come out, it is not likely that we would have less sickness or mortality amongst them than has been the case with other Europeans. An instance of this has recently occurred in Travancore where the Sircar brought out from England through the medium of the India Office a European medical officer for the charge of the Nair Brigade, but this gentleman has, after a few month's work, to return home on medical grounds, and an officer of our service is now again temporarily in charge of those troops, in addition to his multifarious duties which appear already more than any man can perform efficiently. As regards medical men trained in the country up to the present the difficulty has been to find competent trustworthy men to fill the appointments which are available for them. When such trustworthy men are available, I have no doubt the Government of India will modify its rules so that their services will be availed of. The Government has done a great deal in India

for medical education and must continue to use the services of the best men it can get to carry on the work.

Uncovenanted and Subordinate Medical Services.—The first record I found is in Colonel Wilson's History of the Madras Army showing in 1771, eight Hospital Assistants, the class already mentioned who were not meant to rise above that grade. The Subordinate Medical officers up to 1827 appear to have been private or contract servants. In April of that year, a Government order was passed organizing the Subordinate Medical Establishment into two separate branches. The first composed of Europeans, or descendants of Europeans being Apothecaries and the second natives being styled "Dressers." Both these classes were principally entertained for military duties.

The Medical College was established under Surgeon Mortimer, M.D., in 1835, for the instruction in medicine and surgery of Europeans, Eurasians and Natives entering the Medical Branch of the public service and it was opened to private students in 1838. In the Medical Code of 1856 we find that all warrant and non-commissioned Medical servants of European descent were still graded and designated either Senior Apothecaries, Apothecaries, Second Apothecaries, Assistant Apothecaries, or Medical Apprentices. There were seventy-two Medical Apprentices. The Native non-commissioned Medical servants were designated First and Second Dressers and Medical Pupils. Of the latter the strength was fixed at seventy. The term "Dresser" was done away with in 1868 and that of Hospital Assistant adopted.

In a Government Order of April 1867. a form of attestation was published for Europeans and Eurasians and others professing the Christian religion and amenable to the Mutiny Act not being Natives of India. In March last year an order of the Government of India changed the designation of Apothecaries to that of Assistant Surgeons Indian Medical Service, and a Royal Warrant gave the honorary rank of Surgeon-Captain or Surgeon-Lieutenant to the grades of Senior Assistant Surgeons granting them the precedence and other advantages of the honorary rank.

In the Civil Department we have still some thirteen of these Subordinate Officers and it is not yet settled by the Government of

India how many we are to have in future. I would be glad to see a large number thus employed as a war reserve for Military purposes.

Uncovenanted Civil Surgeons were first recognized in the G. O. of April 1867 but none were appointed in the Madras Presidency.

In 1885 definite rules regarding the employment and pay of this class of officers were published but no appointments were set apart for them and no one was taken on. They were to be of any nationality holding a medical qualification not less than the L. M. S. of an Indian University, should not exceed twenty-eight years of age and should produce satisfactory evidence of good character and physical fitness. Assistant Surgeons were eligible to be advanced to this grade by selection and one Assistant Surgeon was in 1893 appointed to act as Civil Surgeon at Negapatam.

The question of allotting certain appointments in List II to such officers is now before Government.

In a resolution of the Government of India published in November 1877, it is clearly stated that none but an officer of the Commissioned Medical Services should be appointed to any of the appointments reserved for them, and that as long as any of them remain unemployed no other Medical Officer should be appointed to the public service. An uncovenanted officer therefore should never be appointed to any Medical charge, whether it be contained in the list of charges for which Commissioned Officers are allowed or not, until it has been ascertained that no Commissioned Officers can be spared for the post.

The Government of India have since urged the filling of List II appointments by Uncovenanted Civil Surgeons, and have refused to allow an officer to be recruited for the appointment of additional Medical Officer of the General Hospital sanctioned in 1893 as long as any of the List II appointments are held by Commissioned Medical Officers.

Civil Assistant Surgeons.—In 1847 the Court of Directors authorised the formation of a superior grade of Native Medical Practitioners for the service of several principal collectorates of this Presidency to be designated Native Apothecaries, to be graded into three classes according to rates of pay and to be stationed at places

considered to be best adopted to render their services most useful to the native community and to itinerate from time to time, and particularly during the prevalence of sickness. Members of the "Dressers" establishment were eligible for promotion to this class. Their designations were subsequently changed first to "Native Surgeons," then to Sub-Assistant Surgeons and lastly to Assistant Surgeons. When the new and less expensive grade of Civil Apothecary was instituted in 1875, it was largely availed of by Government in preference to the higher grade of Assistant Surgeon and the establishment of Assistant Surgeons was no longer kept up to its authorized strength. In 1882 there were only nine instead of eighteen on the list. In 1883 the conditions of their qualifications and employment were changed and one Assistant Surgeon was attached to the head-quarter hospital under the District Medical and Sanitary Officer, to enable him to proceed on inspection tours. They were appointed joint Superintendents of Jails. There are now twenty-three men of this grade on thelist one for each of the twenty Revenue Districts (excluding the Nilgiris) and three reserve. Two-thirds of the vacancies are reserved for competitors not in Government service holding a Medical qualification not less than the L. M. S. of an Indian University, and one-third for members of the subordinate Medical establishment both Apothecaries and Hospital Assistants. Under recent orders these men are now designated Assistants to the District Medical and Sanitary Officers when so employed. Of this important class of officers there is a much larger proportion serving under other Local Governments, and the question of increasing the number of appointments for them in this Presidency is now before Government.

Civil Apothecaries.—In August 1873 the Government of India intimated that the number of Hospital Assistants to be enlisted for the Military Department must be regulated on military requirements only. Separate arrangements became necessary for Civil requirements. As Medical subordinates of the grade of Hospital Assistants were not considered qualified for independent charge of Civil Dispensaries and Hospitals it was resolved to replace them by men with an education equal to that received by Military Apothecaries. Their general educational test was fixed at the Matriculation standard of the Madras University. These students were all stipended and they passed through a similar training and were required to pass a similar examination before a Board in the College as that of the Military Apothecaries. There were six different progressive rates of pay settled on a somewhat lower rate than that of the Military Apothecaries. The first batch of students passed out in 1878 and since then most of them have been posted to Local Fund hospitals and dispensaries replacing Hospital Assistants, some being employed in Government hospitals and establishments according to the exigencies of the service when military warrant Medical Officers were not available. In 1884 this arrangement underwent a change. It was decided that from and after January 1885 Civil Hospital Apprentices were not to be given a gratuitous medical education. The medical requirements of the service being thrown open to public competition amongst candidates of all nationalities, who had educated themselves without cost to the State and whose medical qualification was not below the L. M. and S. of an Indian University, preference being given to those with higher degrees.

Municipalities and Local Boards were, as Supernumerary Civil Apothecaries of the Government Establishment became absorbed, to be at liberty to treat directly with qualified candidates making their own arrangements in regard to terms. Civil Apothecaries properly qualified were to be eligible for promotion to the grade of Assistant Surgeon. This scheme was not brought into force. No Assistant Surgeons under it have been entertained for Government Service and local bodies have not attempted to entertain such qualified men. The last of the Civil Hospital Apprentices qualified in 1888.

Since then, in 1892, ten Civil Apothecaries being required for Government service to complete the reserve, sanction was obtained to entertain candidates from amongst private men and from Hospital Assistants in the department possessing qualifications not less than the L. M. S. of the University.

In 1892 as sufficient men who had qualified at their own expense were not available, my predecessor proposed a new grade of Civil Medical practitioners on somewhat lower rates of pay than Civil Apothecaries as the Local Bodies were feeling difficulty in paying the rates of salary sanctioned for Civil Apothecaries. This was negatived by Government as a distinctly retrogressive step

and as it considered it would be better to fix salaries at rates which would tempt a better class of men who had been educated at their own expense. This subject is now before Government, and as there are about 184 hospitals of kinds throughout the Presidency which Government has over and over again decided should be in charge of men holding not less than the professional qualification of L.M.S. or Apothecaries it will be necessary to see how the Hospital Assistants now in charge of them can be replaced by better qualified men.

When the orders of the Government of India were received last year on the change of the designations of Military Apothecaries, it seemed desirable to propose a similar change in the designation of the Civil Apothecaries, but the Government of India did not consider it was expedient to call them Assistant Surgeons as the present Civil Assistant Surgeons have superior professional qualifications and the grade of Civil Apothecary only existed in Madras. It was considered that the objection raised to the change did not exist in the case of Military Officers as the prefix "Military" in their designation sufficiently marks the distinction between them and the Assistant Surgeons in Civil employ.

As the Government of Madras decided in 1884 that this class was not to be recruited any further, it will be necessary to consider what class is to take the place of the 152 officers now employed and the additions to their number which are necessary to take charge of the hospitals already opened out throughout the Presidency and to arrange for hospitals which may be expected to be opened from year to year. My own belief is that no patients requiring hospital treatment should have to be brought more than twenty miles to a properly organized hospital and that every large town should have a hospital. If this could be carried into effect a very considerable addition to the number of these men would be necessary in the near future.

Civil Hospital Assistants.—Between 1870 and 1875 much correspondence was carried on regarding the supply of medical aid to the native community. Lord Napier's scheme was to bring the benefits of European medical science within the reach of the whole native community in this Presidency, by educating at the provincial dispensaries, the native Vythians and their sons, for employment in the villages and rural districts. It was also proposed that the barber women or village midwives should be instructed in the elements of European midwifery. According to this scheme it was assumed that upwards of 4,000 "village doctors" would be required to meet the wants of the Presidency. To train these men properly it was eventually proposed to establish five provincial schools, two in the Telugu Districts, two in the Tamil and one in the Malayalam Districts. Surgeon-General Balfour's idea was that the practitioners for charge of the minor dispensaries should be properly trained in the Medical College and that the "village doctors" should have a two years training in the local dispensaries. The whole scheme however fell through.

Up to 1875 there was only one class of Hospital Assistants, *viz.*, Military both for Civil and Military duties.

In 1875 a Civil Medical Service was instituted composed of Civil Apothecaries and Civil Hospital Assistants for employment under Government in Provincial Hospitals and for service in Municipal and Local Fund institutions. It was settled that Civil hospital Assistants were to have the same training and pass the same examinations as the military men, but they were to be paid at somewhat lower rates of pay as it was hoped that they would not be so much moved about, would serve principally in their own Districts and would not be liable for military service except in their own Presidency.

In 1877 final orders from the Government of India divided the subordinate medical services into two distinct branches, one for Civil the other for Military duties. Certain allowances in addition to the pay of grade were fixed for men in special civil charges and a special allowance for knowing English. In the Madras Presidency for many years previously all Hospital Assistants had been required to know English and had received their professional training through that medium. In 1878 final orders for the separation of the Hospital Assistant branch were received from the Government of India and 200 men out of a total strength of 360 volunteered for Civil employ, but owing to the war in Afghanistan this was not carried out until 1887, when 174 men joined the Civil. There were 422 Hospital Assistants in 1875, and at present there are 350 Civil Hospital Assistants, of these 85 are employed in Government Service, 236 in Municipal and Local Fund Service and 29 in reserve or on leave. For some years the local schools that existed at Madura

and now exist at Tanjore and Nellore have been training Hospital Assistants, sent and supported by Municipalities and Local Boards for their own employment. In 1893 there were 260 Dispensaries for out-patients, which should be in charge of this class of subordinates after they have had at least five years training under a Medical Officer and have been declared fit for independent charge. There are only 350 of the three grades of these subordinates on the establishment for all duties, a number quite inadequate for the wants of the Presidency even with about 120 men trained in the local schools. This subject also is now under consideration and it is a difficult question to settle how many Hospital Assistants will be required.

Medical College.—This Institution, of which we are all justly proud, was established by the Right Honorable Sir Frederick Adam, K.C.B., in 1835. The foundation stone of the present building was laid in 1836, several additions were made in 1867 and during the past few years Government has provided a very good Anatomical Department with a theatre, a laboratory for the teaching of practical hygiene, and rooms for the practical teaching of physiology and pathology. The Chemical Examiner's Department has been greatly enlarged and improved.

There are now ten Professors including the Professor of Dental Surgery, three lecturers with seven Assistants to the Professor and a Gymnastic Instructor working in the College.

In 1889 the Royapuram School for training Hospital Assistants which had been established in 1876, was done away with and all the students sent to the Medical College for their training. This has been found a most inconvenient arrangement for both the students and their teachers. It will doubtless be necessary to re-open the school at Royapuram, and to establish provincial schools at some such places as Vizagapatam and Calicut and to develop the existing Local Fund School at Nellore and the Prince of Wales' School at Tanjore.

Female Medical Aid and Education.—Ten years after the establishment of the Lying-in Hospital in 1844 Government sanctioned the establishment of a school for midwives, European and Native, which has ever since been working and has turned out good sick nurses and midwives, who are now employed all over India, Burma, Ceylon and the Straits Settlements.

On the establishment of Sir Ramasawmy Moodelliar's Lying-in hospital in 1880, a similar school was started to train native women sent by the Lady Dufferin Fund Committee.

In 1875, on the re-organization of the General Hospital, a school of training for sick nurses was established under a Matron Superintendent and a Head Nurse got out from England and continues to do good work.

Under orders of Government in 1878 and 1880 midwives were directed to be employed and to be available at every up-country hospital. There are now 251 of these women working throughout the Presidency who attended 17,414 cases in 1894. Some are trained in the Government Lying-in Hospital, Madras, others at Sir Savalay Ramasawmy Hospital at Royapuram, and others in Nellore and Madura.

Since 1868 there has been a special dispensary for women and children which now forms the out-patient department of the Lying-in Hospital on the Pantheon Road, where it was transferred to in 1876, and is doing admirable work.

The Gosha Hospital was started by Lady Grant Duff in 1885, and has lately been re-organized and is doing thoroughly good work.

The Medical College was opened to lady students in 1875 who wished to study for any of the University Medical Degrees, or for the license of the Apothecary Grade which was left open for them. A few women have been trained as Hospital Assistants but this is now discouraged by the Dufferin Fund Committee and I hope we will see no more of them for the present, as they will not be required until we have separate hospitals in charge of duly-qualified women where their services can be utilized. Neither their primary educational standard nor the special training they get in the College fits them for independent charge.

The number of lady students that have been trained in the College is fairly satisfactory, and I hope we will see more dispensaries opened under their charge where caste and gosha women and other women who cannot or will not attend the ordinary dispensaries wiii receive advice and treatment. At present the number of ladies so trained are far too few for the requirements of the profession in this Presidency, and I would be glad to see local bodies

and native gentlemen who are interested in this subject, sending up such women for training to the Medical College and supporting them while under training under the rules of the Dufferin Fund.

Civil Hospitals and Dispensaries.—We have seen that the East India Company encouraged these from very early days. According to Colonel Wilson there were in 1841 only about six institutions outside the Presidency town.

I will not attempt to review the gradual increase of them, but take the report of 1875-76 by Surgeon-General G. Smith, M.D., as it represents the time when a distinct commencement was made to separate the Military and Civil Medical duties and deals with the year I commenced Civil Medical work under the Government of Madras. These Civil Dispensaries and Hospitals had increased in number and popularity under the authority of the Towns Improvement Act and the Local Funds Act of 1871.

Dr. Smith says "under these Acts the cost of supporting hospitals and dispensaries, with a few exceptions, has been laid on Municipalities and Local Fund Boards." In addition to these duties some medical officers had the superintendence or medical charge of jails, the medical charge of Police hospitals, and of a considerable staff of Government servants. All are required to attend and give evidence in medico-legal cases, to proceed into the districts on emergent cases, to advise regarding sanitary arrangements and to encourage vaccination.

In 1875-76 there were 134 such hospitals and dispensaries working including the five State hospitals. There were 28,968 in and 725,380 out-patients treated, 1,612 operations performed and 134 medical men employed including 41 commissioned medical officers.

In the *Government General Hospital.*—1,379 Europeans and 2,253 Natives were admitted as in-patients; and 3,001 Europeans and 9,902 Natives as out-patients. The first year in which operations were properly recorded was 1878, when there were 82 major and 486 minor ones performed.

In the *Government Lying-in Hospital.*—102 Europeans and 124 Native in-patients and 2,572 Europeans and 7,317 Native out-patients were admitted. The principal operations were 72.

In the *Government Ophthalmic Hospital.*—78 European and 385 Native in-patients and 507 European and 2,035 Native out-patients admitted. There were 127 operations for senile cataract, and the others were not noted.

In the *Government Lunatic Asylums* the total insanes were 509. Total treated in the Madras Asylum were 300 with 23 deaths.

Medical College.—In 1875-76 there were 89 students, not including the Hospital Assistant Class, who were trained at Royapuram School. In 1893-94 there were 413 students, including 261 of the Hospital Assistant Class, and 28 Chemist and Druggist students.

In 1893 the number of Civil Hospitals and Dispensaries, not including the State Presidency hospitals, was 453, of which 193 were hospitals with accommodation for 3,088 in-patients. The total treated was 3,330,970 with an average daily attendance of 22,346 including in and out-patients. There were 5,537 major operations with a mortality of only 168 and 118,314 minor operations performed.

There were 592 medical men of different classes employed including 58 Commissioned Medical Officers.

In the *Government General Hospital* there were 1,329 Europeans and 3,161 Natives admitted as in-patients and 8,171 Europeans and 41,450 Natives admitted as out-patients. There were 900 major and 6,679 minor operations performed. The year 1894 shows a still further increase of 1,548 Europeans and 3,947 Natives admitted as in-patients and 8,497 Europeans and 42,608 Natives admitted as out-patients with 911 major and 7,918 minor operations performed. The average daily sick being in 1894, 84 Europeans and 197 Native in-patients with 57 deaths amongst the Europeans and 309 amongst the Natives. The average daily sick out-patients was 49 Europeans and 293 Natives. In 1875-76, the average daily sick of Europeans was 78 and Natives 114 in-patients with 59 deaths amongst Europeans and 227 amongst Natives; the out-patient average daily sick was 19 Europeans and 81 Natives.

In 1893 at the *Government Lying-in Hospital* there were 6,826 Europeans and 19,320 Natives treated as in and out-patients. There were 230 obstetric operations and 266 gynæcological cases.

In 1893 at the *Government Ophthalmic Hospital* there were 813

Europeans and 9,174 Natives treated as in and out-patients. There were 1,124 operations for cataract out of a total of 1,804 major operations and 423 minor ones.

In 1893 at the *Government Lunatic Asylums* the population of the three asylums in 1893 was 763, of which 603 were in the Madras Asylum with 50 deaths.

This record of good work should stimulate us all to increased efforts. It is clear that the popularity of our medical institutions depends first of all on the care and attention given by the Medical officer in charge. If he is skilful in the art of his profession the public soon find it out and if to these good qualities he adds kindness and sympathy for his patients he attains popularity which is the highest and truest reward.

General Hospital.—In the history of the General Hospital compiled in 1875 under Brigade-Surgeon Keess, the first mention of a hospital in Madras is in 1679, as being in charge of Dr. Sherman in James Street in the Fort and as having too small accommodation for the sick men. In the Government records there is reference to a Garrison hospital in the Fort in 1743 and 1744, which is probably the same one. The next year the granary on the island was utilized for sick sailors from the fleet, it was the first Naval hospital in Madras and was used from 1744 to 1790, and must have been situated near the present Wallajah Gate of the Fort. The sick sailors were from 1790 to 1808 treated in the Garrison Hospital which appears in 1752 to have been moved from James Street in the Fort to outside the Fort, at the site of the present General Hospital, where several native and Eurasians' houses and gardens had been taken up and paid for. Orme mentions that one of the batteries was named the "Hospital battery," during the attack of the French in 1758 and 1759 which according to his map was situated in the same position as that of the present General Hospital. He says the battery was near the English Hospital, so that the Garrison Hospital must have been built there between 1752 and 1758 and is probably now the ground floor of the present Military Hospital. In 1808 a Naval Hospital was started on the site of the present Gun Carriage Factory and hence the name of the road passing it "Naval Hospital Road," and was used until 1831 when the sick were transferred to the General Hospital, ever since the head man of servants in the General Hospital is known as "Boatswain." In 1859 in order to provide more accommodation for the sick of the General European and Eurasian public, for officers quarters and room for treating the sick poor of the native population the General Hospital was reconstructed with a second storey. A portion of the third storey was added in 1876 for the nurses and more in 1893 for wards. I hope we will see it completed in 1895, when the Military will be moved to their proposed new hospital, and the women and children again brought back to the enlarged General Hospital, which will have about 670 beds and will then be about the finest General Hospital in the East. The present out-patient Department was erected in 1888-9 and added to in 1892 with proper arrangement for the complete separation of the sexes, good washing and dressing rooms and a convenient dispensing room; there is also provided a consulting room for the Professor of Dentistry who was appointed in 1882. This out-patient Department is as complete as any that can be seen in India.

In the years 1874 and 1875 a special committee was appointed by Government to report upon the administration of the Hospital and to make suggestions to place this, the most important Clinical Hospital in Madras, on a footing equal to the best of the hospitals at home. The increasing popularity of the institution, as shown by the increase of work done in it, has amply repaid Goverament for the liberal way it has met the increased expenditure which has been very great.

Other Presidency State hospitals were opened as follows:— The Ophthalmic hospital in 1825, the Lying-in hospital in July 1844, the hospital for lepers in 1841, the Voluntary Venereal hospital before 1836, and the Port and Marine dispensary in 1820.

The Government hospital for Women and Children is now housed in the hospital buildings in Egmore which were condemned in 1872 as unfit for a Lying-in Hospital; it was transferred in 1876 to those wretched quarters from hired premises in Vepery which had been occupied from October 1868, the date on which the women and children were removed from the General Hospital, where the accommodation provided for them had been condemned and has since been removed. An out-patient department was opened in the same buildings at Vepery and was transferred to the Egmore dispensary in 1876 and is now part of the Government Lying-in hospital. When we have the women and children

properly housed in the General Hospital, it will be much to their advantage and to the benefit of the numerous Medical students who are trained in the General Hospital, who now want the special experience in the treatment of women and children who in after life form the majority of their patients.

No small part of the good name of our hospitals must depend upon their good administration. I consider Government has been very wise under the circumstances that exist in India in trusting its Medical Officers to administer their own hospitals, but this very trust makes it all the more necessary for us to so direct these hospitals as to ensure that every anna spent is being fully accounted for and dealt with as if it came from our own pockets.

I know some Medical Officers consider that so much of their time is spent in administration that they have not sufficient left to devote to their purely professional duties. I often wonder if they contemplate what their positions would be under a different system of administration, or note the position of Medical Officers in the hospitals in England, or remember the causes of the long struggle by Military Medical Officers to get the administration of their hospitals into their own hands. To a certain extent however I sympathize with their ideas on the subject, and hope that the special Committee now reporting upon the subject of hospital management and accounts, will be able to propose some plan by which the details of the purely administrative duties can be carried out by non-professional men working under their guidance and responsible to them.

Many of the up country hospitals have accommodation for from one or two in-patients to one hundred and twenty of all classes and sexes and the larger ones are organized to treat all classes of disease. I have noted that their greatest want is more efficient internal management. It is very necessary to impress on Hospital Committees and the local authorities concerned, that no institution is worthy of the name of a hospital which is not properly housed, equipped and furnished with an adequate establishment for the care and treatment of all cases both by day and night. There should be a sufficient and competent Medical staff to treat cases of injury or serious sickness at any time they may present themselves. With this in view I have submitted certain proposals to Government laying down minimum scales of equipment and scales of establishment so as to ensure that there will be competent qualified Medical men ready to deal with any case, and that they will be furnished at least with all the necessary equipment.

Rough Estimate of the Civil hospital and dispensary requirements of the Madras Presidency not including Madras City. The total number of villages and towns in the Presidency including the Agency tracts in Ganjam, Godavari and Vizagapatam also the Feudatory States is 55,385.

First.—There are *eight* cities with a population of 50,000 and upwards. Each of which should be provided with properly equipped and organised :—

(1) General hospital of 50 beds and upwards for Medical and Surgical cases of both sexes and a properly organised out-patient department.

(2) A Lying-in hospital of at least eight beds.

(3) An Isolation hospital for cases of cholera and small-pox, for at least ten beds for both sexes and capable of extension in the ward accommodation.

(4) Sufficient out-patient dispensaries at a distance of about two miles from the General hospital where the population is most dense.

(5) A Caste and Gosha dispensary on a site convenient to the majority of such classes.

Second.—There are 201 towns with populations between 10,000 and 49,999 which should have :—

(1) A properly organised and equipped cottage hospital for Medical and Surgical cases of both sexes, with accommodation in beds varying according to the population at least at the rate of one bed per 1,000, with an out-patient Department.

(2) A Lying-in hospital for not less than four beds.

(3) An Isolation hospital for not less than one bed per 1,000 of the population.

(4) Different out-patient dispensaries as above.

(5) A Caste and Gosha dispensary as above.

Third.—There are 10,185 towns and villages with populations from 1,000 to 9,999, which all should have at least an out-patient

dispensary and when possible hut hospital accommodation for both sexes, not less than four beds for each sex, there should be separate isolation huts for cholera and small-pox cases and also for lying-in cases.

Fourth.—There are 47,991 villages with a population under 999. It will be a long time before the fringe of the Medical requirements of these can be touched, but I consider the system should be to group them into circles making similar arrangements as proposed in the third class for each circle, so that eventually no sick man would have, in rural districts, to travel more than five miles to a dispensary.

I calculate that to deal with the towns above 10,000 inhabitants, we would require about—

8 Assistant Surgeons gazetted.
210 ,, ,, non-gazetted.
657 Hospital Assistants.
210 Women practitioners.

To deal with the other villages and rural tracts, we would require about 200 more non-gazetted Assistant Surgeons and 20,000 Hospital Assistants without making any special arrangements for caste and gosha patients. To all this must be added an adequate reserve for sickness and leave.

The above figures are enough to appal anyone considering how little money is available and the small number of indigenous medical men we can now educate.

Sanitation.—In the year 1864 the suggestions of the Sanitary Commission were sent out from home for adoption in this country, and many of them were adopted in the Military Medical regulations and gave to Medical Officers their right position as Sanitary advisers to the Military authorities and made it their duty to make such suggestions as they considered would conduce to the better health of the troops. You all know how slow our progress has been and how jealously some of the older school of responsible combatant officers looked on such suggestions; a jealousy which has not even now altogether died out even in the face of the higher standard of general education. I consider it most desirable that every Military Medical Officer should thoroughly study the original suggestions of the Commission and make himself acquainted with the orders of Government which have since been published on these subjects, in order that his suggestions can be supported by chapter and verse. Certain Sanitary regulations were published in the Medical Code of 1870 adapted from the suggestions already alluded to but since then many of them have fallen into abeyance and even been neglected in principle. For instance the Government of Madras in 1867, published an admirable set of Sanitary ,rules for dealing with fairs and festivals and it is certain that if these rules had always been properly acted upon many an outbreak of cholera would have been prevented.

The Sanitary Commissioner's appointment has always been independent of the Surgeon-General, and I consider very advisedly so. The extra duties placed on District Medical and Sanitary Officers in 1883 and since have very largely interfered with their primary professional duties, but this has been somewhat modified by some orders of Government published last month. I feel quite convinced that there should be more Deputy Sanitary Commissioners with properly qualified Health Officers under them and the District Medical and Sanitary Officer, but financial difficulties will I fear put this off for a long time. The recent order of Government, for which we have to thank Surgeon-Lieut.-Colonel W. G. King, the Acting Sanitary Commissioner, directing that all the budgets of local authorities should be sent to the District Medical and Sanitary Officers, will give them an opportunity of seeing that some provision has been made for carrying out their suggestions both as regards Sanitary works and Medical relief. The order instituting a course of training for Sanitary Inspectors in the Medical College is, I consider a considerable advance. A recent order directing the Sanitary Commissioner to prepare a code of rules for the guidance of all officials in dealing with epidemics is an important one and when the rules are published there will doubtless be a great advance on our present methods.

For some two years the preparation of a set of rules to guide local authorities in submitting propositions for the establishment of hospitals or dispensaries and fixing standard plans has been under consideration. The issue of these rules and plans will conduce to a great diminution of correspondence and will it is to be hoped lead to more satisfactory sanitary arrangements in the erection of such institutions.

Venereal diseases.—We see by the rules published for Civil Hospitals and Dispensaries in the Code of 1833 regarding the treatment of women (especially in cantonments occupied by British Troops) suffering from venereal diseases that this trouble has been constantly before the authorities in this country. Special hospitals were established under the Indian Contagious Diseases Act of 1868, and worked more or less usefully according to the way the Act was carried out until they were abolished in 1888 consequent on the withdrawal of the Act. The Civil Lock Hospital in Madras was then ordered to be replaced by a specially organized system of relief, strictly voluntary in its application, for the use of all classes of patients suffering from venereal diseases. In accordance with this the present Voluntary Venereal Hospital was established in the beginning of 1890 and has been conducted with considerable success ever since, as no fewer than 651 in-patients were treated there in 1893 with an average daily sick of 67·33 in-patients.

Special Services of Medical Officers.—During the time of the East India Company, Medical Officers were selected and sent out to India on nomination by a Director. The Act of the 16 and 17 Victoria, Chapter 95, Sect. 37, changed this course and opened the service to natives of India. This was recognised in the Royal Warrant of 1860. The attempts during 1861 to 1864 to amalgamate the British and Indian Medical Services having proved abortive, for reasons you can all read in the Blue Book of papers relating to Medical Officers in India published in 1881, the Indian Medical Service was re-organised between 1864 and 1867, as regards both Military and Civil appointments, and the rates of pay were fixed on lines which have continued in force ever since, and which have, as a rule, guided the Government of India in dealing with such appointments.

Since 1760 when the Medical Department was first organised in Madras a great number of Medical Officers must have served Government, but it is not possible to refer to any exact records and as regards their services I have found it impossible to get much information. Many of these Medical Officers must have been with the troops in all the stirring times during the latter part of the last and early part of this century and gained great experience on war service. One would like to place on record some account of the men who worked, and I will tell you the little I know concerning the services they rendered. Of the East India Company's officers the following names are well known Annesley, Anderson, Currie, Wylie, Waring, Mortimer, Hooper, Jerdon, Geddes, Malcolmson, Cleghorne, Day, Gilchrist, Porteous, Shaw, Lane, Macpherson served between 1800 and 1870. When I entered the service in 1870 the following officers were still serving, whose good work many of us personally knew, Mackenzie, Balfour, Blacklock, Hunter, Duff, George Smith, Colvin Smith, VanSomeron, Paul, Chipperfield, Furnell, Cockerill, Ogg, Shortt, Cornish, King, Bidie, Rean, Donnelly, Harris, Pearse, Beaumont. Of my more immediate contemporaries amongst the officers who have been appointed since 1864 there were Macrae, Thompson, Drake-Brockman, McNally, Rogers, who have left work which will last. Doctors Iyasawmy and Moideen Sheriff distinguished themselves as Native Surgeons. In the Subordinate Medical Services the officers whose names and services I best recollect are Kearney, Wilkins, Hamilton, Kingsley, Hargreaves, St. John Lawrence and Boon.

Annesley, afterwards Sir James, was in charge of the General Hospital in the early part of the century, and has left a monumental record of professional work in two volumes, which are wonderfully well illustrated and contain some most accurate records of *post mortem* examinations which clearly show that enteric fever existed in those days, though the name of typhoid had not been invented.

Anderson, James, M.D., as you will see his epitaph in Christ's Cathedral, was highly respected; he became Physician-General and Senior Member of the Medical Board. There is a portrait of him in oil now hanging in the Medical College.

There is also a portrait in the College of Henry Harris, who was a Physician-General and Member of the Medical Board.

Geddes, William, wrote a valuable report on the type of fevers in Native Troops at Seringapatam in 1823 and 1824, which was published by the Medical Board in 1827.

Malcolmson, John, wrote the Prize Essay on the History and Treatment of Beriberi in 1835, which was published by order of Government. In a G. O. of May 1832, Government had sanctioned

a prize of Rs. 500 or a gold medal for the best dissertation on either the "Disease called Beriberi or, on Rheumatism and the Neuralgic affection occasionally a sequela of it, which is termed amongst natives Burning in the Feet."

Currie, Claud, was also Physician-General and First Member of the Board. His portrait also hangs in the Medical College. In January 1851 the following order of the Governor in Council was published "Physician-General Claud Currie having obtained permission to retire upon his pension on the completion of his tour of duty in the Medical Board, the Right Honorable the Governor in Council has much pleasure in thus publicly recording his approbation of that officer's long and meritorious services to the State, for a period of nearly forty years, during which he has evinced, in every grade which he has successively filled in the Medical Department, the most unremitting energy and untiring zeal for the public good.

Wylie, John, M.D., F.R.C.S. and C.B., was also Physician-General and First Member of the Board, his portrait also hangs in the College. The following order was published on his retirement from the Service :—

No. 24 of 1851. "Physician-General John Wylie, M.D., F.R.C.S. and C.B., having applied for and obtained permission to retire from the Service, the Right Honorable the Governor in Council cannot allow him to quit India without conveying to him in this public form, the strong assurance of the pre-eminent sense which he entertains—in common with every authority under, or in concert with whom Dr. Wylie has acted—of his very valuable and highly meritorious services throughout a lengthened period of thirty-seven years.

"Physician-General Wylie has the proud distinction of being the first Medical Officer of the Madras Army, who has been admitted to the Most Honorable Military Order of the Bath—a distinction conferred upon him by his Sovereign, in reward more especially of his gallantry in the memorable conflict of Corygaum, when, as honorably noticed by the Governor-General and Commander-in-Chief in India, he repeatedly "led on the sepoys to charges with the bayonet."

"The Governor in Council feels that it would be utterly impracticable to enlarge in the compass of a farewell Order on Dr. Wylie's great merits as a devoted public servant, and His Honor in Council must therefore content himself in recording his cordial and unqualified concurrence in the sentiments expressed by His Excellency the Commander-in-Chief on the occasion of Dr. Wylie's retirement, and which will be specially submitted to the Honorable the Court of Directors."

Waring, E. J., retired in 1865, was celebrated for his investigations regarding the indigenous drugs of India. His useful Manual is now in constant use in most of our hospitals and dispensaries. He edited the last edition of the Indian Pharmacopœia.

Mortimer, John, M.D., left his mark in the General Hospital and Medical College, the former of which he re-organised and the good work done by him is to be found in the records of that institution.

Hooper, H. T. C., retired in 1868, and *Cleghorne, H. F. C.*, retired in 1869, both did good work in Botany.

Jerdon, T. C., retired in 1868, his work on the Birds of India is still a standard one.

Day, Francis, retired in 1876, his work on Fishes is a standard one and his "History of the Permauls" is one of the best records of Western Coast history.

Johnstone, J. W. T., was well known in Madras as a successful Medical practitioner. He died in 1848 when the Johnstone's Medal was established in his memory which has ever since been the blue ribbon amongst the students as it is given to the most deserving.

Gilchrist, W., retired in 1855, was Physician-General, his son now commands the 5th Hyderabad Cavalry. The Gilchrist Scholarships were established in his name.

Porteous, H. W., retired in 1867, he was a great favourite in Madras as a practising Physician. His eldest son Colonel A. Porteous has just vacated the office of Inspector-General of Police which he so worthily filled for some years as is testified to by the formal order published by His Excellency the Governor. His second son now commands the 4th Madras Pioneers.

Shaw, James, retired in 1847. He was for many years the

leader of the profession in Madras and ended his service as Inspector-General of Hospitals at the head of the profession. He was the first Principal of the Medical College and had for years worked in the Government Ophthalmic Hospital. His portrait now hangs in the Medical College and many of his children have been and are still in the Madras Presidency.

Lane, Thomas, died in 1848, his work was principally in the Government Ophthalmic Hospital, he left two sons, both of whom served in the Madras Staff Corps the elder becoming a great Oriental Scholar. A Scholarship was founded in the Medical College in his name.

Macpherson, D., died in 1867, he was promoted to the rank of Inspector-General of Hospitals over the head of about forty officers at the request of Her Majesty for service he had performed in Bulgaria in 1853 and 1854. His son Lieutenant-Colonel Macpherson is now one of the Military Controllers of Accounts.

Mackenzie, W., M.D., retired in 1871, he was Inspector-General of Hospitals when I arrived in the country. He was an Officer with very distinguished war service also in Bulgaria, the Crimea and during the Mutiny. He was made a K.C.B. and C.S.I., and while in Madras had a great deal of influence for good. A very good portrait of him hangs in the College. One of his sons Colonel Mackenzie is now Commissioner of the Berars and several others have worked in this Presidency in other capacities.

Balfour, E. G., retired in 1877 having completed his five years' tour as Inspector-General of Hospitals. A man of great energy and perseverance, his principal work was an enormous Encyclopædia which he compiled. He first organized the Civil Hospital Assistant and Civil Apothecaries Grades, and carried through the scheme for the L. M. and S. degree of the Madras University, which was originated for the purpose of doing away with the College qualification examination, and instituting a system of training similar to that through which the Apothecaries were put, as it was found the M.B. and C.M. course was too expensive for any number of men to go through to take up local appointments. There is a very indifferent portrait of him hanging in the Madras Museum. A Balfour Memorial Medal is now given to the first female student passing the second L. M. and S. examination each year. He was also employed in the Political Department for some years as Government Agent with the Carnatic Durbar during the time of the last Nawab. He is a good Persian and Hindustani scholar.

Blacklock, Ambrose, died in 1873, he was celebrated for the work he did in the Medical College and in the General Hospital as a clinical teacher. A prize was established in the College in his name.

Hunter, Alexander, M.D., retired in 1875, he was principally noted for the work he did in the School of Arts.

Duff, Charles Murray, M.D., died in 1874, he was well known and liked as a practitioner in Madras, he died from the effects of the climate in Burma.

Smith, George, M.D., he retired as Surgeon-General in 1880 but was best known for the good clinical teaching he imparted in the General Hospital, and for his management of the Medical College of which he was for years Principal and one of the best heads it has ever had. His portrait, a very good likeness, hangs on its walls, and a prize was established in the College in his name. He was the first to originate the re-organization of the General Hospital which lead to the orders of Government in 1875, in which Government decided that it was to be kept equal to the best Clinical Hospitals in Europe.

Smith, Colvin, retired in 1885, he had been decorated with a C.B., for his services as Principal Medical Officer of the Indian Forces in Egypt in 1883. He was once known in Madras as a most successful medical man in private practice and had for some years the charge of the Women and Children's Hospital.

VanSomeren, William Judson, M.D., retired in 1880, he was one of the first Eurasians to enter the public service. He was well known and liked in Madras by a large circle of patients.

Paul, James Liston, M.D., retired in 1876, he was one of the most successful practitioners in Madras and held with credit for some years the appointments of Professor of Surgery and Senior Surgeon of the General Hospital.

Chipperfield, J. Nathan, died in 1873, he was a sound practitioner and a successful clinical teacher. He once acted as Principal of the Medical College. A prize was established in the College to commemorate his services.

Furnell, M. C., M.D., retired in 1886 having been Surgeon-General for one and a half years. He had been Principal of the Medical College and Senior Medical Officer of the General Hospital where, after the orders of 1875, he commenced to carry out the re-organization. As Surgeon-General and as President of this Branch he wrote some valuable papers on the relation of cholera to water, as a young student he narrowly missed discovering the value of chloroform with which he and other students had experimented on themselves before Sir James Simpson published his researches. There is a very indifferent portrait of Surgeon-General Furnell in the College.

Cockerill, R. W., retired in 1885, he worked hard as Professor of Surgery and Senior Surgeon in the General Hospital, he had commenced his service in the Crimea in the British service which he resigned for the purposes of taking service under the East India Company. He carried on a large private practice while in Madras.

Ogg, George Stewart Watson, M.D., retired in 1885 as a Deputy Surgeon-General; he had acted as Chemical Examiner and Professor of Chemistry and was a highly educated officer.

Shortt, John, M.D., retired in 1878, he had been an Apothecary and had gone home and qualified, he made some investigations regarding snakes and their poisons.

Cornish, W. R., F.R.C.S., C.I.E., who was well known to most of us, retired in 1885 having completed his tour as Surgeon-General with the Government of Madras. He entered the service in 1854 and for years was Secretary to the Medical Board and then to the Inspector-General of Hospitals. He completed the Medical Code of 1870. He was in 1871 made Sanitary Commissioner and prepared the report on the Madras Census which in itself is a monument of good work. During the great famine of 1876 and 1877 he organized a Sanitary Department, under Medical Officers, which did invaluable work. He will principally be remembered for the great stand he made against the starvation ration of Sir Richard Temple, for which he was afterwards made a C. I. E., although many officials who had not done half the good work he had were rewarded with higher honors.

As Surgeon-General with the Government of Madras the duty of re-organizing the Civil Medical Services fell on him and he instituted the present administrative duties of District Medical and Sanitary officers and gave them as Assistants the present Assistant Surgeons—thus practically placing on them the administration of the hospitals in their districts and the initiation of all Sanitary improvements. He was the only Medical Officer in the Madras services ever selected for H. E. the Governor's Legislative Council and was chosen for this duty on account of the important Sanitary duties which were to be entrusted to Municipalities and Local Boards under the Act then in preparation. A very admirable portrait of him hangs in the Medical College. After his retirement he was appointed as Honorary Physician to Her Gracious Majesty.

King, H., M.D., retired in 1883, he acted as Sanitary Commissioner in 1875, he had been Chemical Examiner and Professor of Chemistry in the Medical College and after having been very badly treated was made Principal of the Medical College and Senior Medical Officer of the General Hospital. His Manual of Hygiene has been the text book for years in the College. He is well known as having written one of the most sarcastic and amusing sketches that has ever been written in India, I mean "The Assyrian Inscription."

Bidie, George, M.B., C.I.E., retired in 1890, he having risen to be Surgeon-General with the Government of Madras. He was for years Secretary to the Inspector-General of Hospitals, and in 1880 became Secretary to the Surgeon-General, H. M. Forces. During all this time he was Superintendent of the Madras Museum where he worked very hard. In 1885 he was made Sanitary Commissioner and in 1886 Surgeon-General to the Government of Madras. He was made a C.I.E. in 1883 for the work he had done while in charge of the Museum. A very indifferent portrait of him hangs in the Library of the Madras Museum. In April 1890, Government published the following valedictory order: "Surgeon-General Bidie, C.I.E., having under the provisions of the Indian Army Regulations, vacated his appointment, the Right Honorable the Governor in Council resolves to place on record his high appreciation of the services

rendered to the State by Dr. Bidie, during his long and honourable career, especially as Superintendent of the Central Museum, where his labours to develop the economic products of the country were of particular value.

Rean, W. H., M.D., retired in 1886 having completed his five years as a Deputy Surgeon-General, his principal services were in the Andaman Islands, where he carefully combated the causes of the dreadful mortality amongst the convicts, he was for a time Principal of the Medical College and Senior Medical Officer of the General Hospital.

Donnelly, James MacNeale, M.D., C.B., retired in 1890, he was decorated with the C.B. as he was Principal Medical Officer to the Expedition which occupied Mandalay in 1885.

Harris, William Henry, M.D., retired in 1881; we have to thank him for the commencement of the re-organization of the Government Lying-in Hospital and for its establishment on its present site. He for years carried on a very extensive private practice in Madras.

Pearse, Robert Edmund, retired in 1889; the son of a former Head to the Department, he did excellent work as Principal Medical Store-keeper for some years and was so well liked in Madras that he was elected President of the Madras Club on more than one occassion.

Beaumont, Thomas, M.D., retired in 1885; he did splendid Surgical work in Indore in Central India, and afterwards at Hyderabad in the Deccan while Residency Surgeon.

Thompson, D. R., C.I.E., retired in 1888, he was once an Apothecary in the Subordinate Service, left it, went to England, qualified, competed for a commission and was successful. His best work was done in charge of the Medical Institutions at Royapuram particularly during the famine of 1876 and 1877 for which, on the suggestion of Sir W. Robinson, he was decorated with a C.I.E.

Drake-Brockman, Edward Forster, F.R.C.S., commenced his service in 1866. His principal services were performed as Resident Medical Officer in the General Hospital where he assisted in the initation of the movement which lead to the re-organization of the hospital. He organised the Medical College Museum and published its first catalogue. He will, however, be principally remembered as an oculist for the admirable work he did in the Government Ophthalmic Hospital between 1875 and 1892 ; the present buildings were planned under his advice and have well repaid Government for the money spent on them. Many of us remember what a sound opinion his was on professional subjects both by the bedside and in the council rooms of the Medical College and University. He carried on a large general private practice while in Madras.

MacNally, C. J., M.D., died in 1890 from exposure in the famine districts while on inspection duty as Deputy Sanitary Commissioner. He was a sound worker when in the wards of the General Hospital and has left good work in his Sanitary Handbook for India, which has been adopted as a text book. When the proposals for instituting a course of training for, and an examination in, Sanitary Science in the University, he threw his whole energy into the subject. A prize has been established in the Medical College in his name.

Rogers, T. K., M.B., *London*, F.R.C.S., died in 1884, all too early. His work as Chemical Examiner and Professor of Chemistry was admirable, and we have to thank him for the organization of the splendid laboratory in the Medical College.

Iyasawmy, a native Surgeon, who retired in 1889 was for years Civil Surgeon at Cuddapah where he did admirable work. The fine hospital in that station was planned by him. He was nominated Honorary Assistant Surgeon to the Viceroy.

Moideen Sherriff, Khan Bahadur, a most trustworthy Native Surgeon and Fellow of the Madras University, died in 1892, he was for years working in the Triplicane Dispensary and carried on a very successful private practice. He compiled a very useful Supplement to the Indian Pharmacopœia for which he was granted the rank of Honorary Surgeon. He was also given the honorary title of Khan Bahadur.

Kearney, W., Honorary Surgeon, retired 1889, was for many years Assistant to the Professor of Medicine.

Wilkins, R., Honorary Surgeon, retired in 1885, was for many years an Assistant in the Medical College and taught Botany.

Hargreaves, J., Honorary Surgeon, retired in 1884, was Civil Surgeon of Chatrapur.

St. John Lawrence, was the Senior Subordinate in the General Hospital, and he and Mr. Boon carried on very large private practices in Madras.

Sir Neville Chamberlain's opinion on Medical Work in India.—Some of our military comrades have fully appreciated the important work we have to do as medical men practising in this country, and I will make no apology for repeating the generous tribute of one of the most respected of them, which Surgeon-General Bidie in his address in 1888 brought to the notice of the members then present.

Sir Neville Chamberlain who was at one time Commander-in-Chief in this Presidency and whose great war services on the North-West frontier are well known has recorded :—" You are right in supposing that I have expressed an opinion that the peaceful and civilizing influence of the work done in the hospitals and by Regimental Surgeons on the frontiers of India has been in political importance equivalent to the presence of thousands of bayonets. I have had this opinion because no account of military coercion or of purity of administration could have exercised the same pacifying effect on the hearts of the natives that has been produced by the sympathetic care and successful treatment of diseases, many of which had been previously considered incurable. Throughout my service in the frontier of India I have not known a time when the halt, the lame and the blind have not flocked into our cantonments or into our camps in search of relief from suffering ; and however distasteful may have been the sight of our soldiers, or however galling the idea of subjection to the British yoke, the people have come with confidence from far and wide to seek medical aid. The fame of the English doctors has spread beyond our frontiers into the remotest hills and glens, and the difficulties overcome and the suffering endured in order to reach a medical officer might seem incredible to those unable to realize what it is to be living under conditions devoid of medical and surgical aid. Another humanizing and reconciling influence has been the careful and sympathetic treatment of the wounded enemy, who have fallen into our hands, and the fact of their being liberated and sent back to their houses when cured. It is becaus of such unexpected philanthropy that, as conquerors, we had a position in the minds of the people which would not otherwise be possible. The great question to be solved in the future is that of how we can best bridge over the chasm which separates the rulers from the ruled. The means of accomplishing this end may be mainly hoped for in the sympathy to be created between the races; and I think the medical profession will always have it in its power to give most important aid towards the attainment of this object."

This generous record of such a soldier reminds us that our work is as highly appreciated now by some of our warriors as it was amongst the Greeks as we find in the Iliad, when Macheon the soldier Surgeon and friend of Nestor was wounded, it stated that :—

> "A wise physician skilled our wounds to heal
> Is more than armies to the public weal."

I am glad to see before me some officers of the Madras Service who, I know, while serving on the frontiers in Burma and in the savage hill tracts in that country, did all they could to keep up our good name and win the confidence of the people who knew nothing previously about the power of Western Medical Art, when intelligently practised. Some of their names will live long in those savage lands and I hope the hospitals they established will be gradually improved and continue to carry on this important branch of education.

Concluding Remarks.—Gentlemen, I have to thank you for the very patient hearing you have given me. My attempt to deal with this large and interesting subject will not have been in vain, if it stimulates us all to try and carry on the good work so well commenced by our predecessors and help to improve and consolidate it. Many of them have devoted their best energies to carrying out the trust our Queen and country has placed in them and with a good deal of success as shown by these facts I have collected which must encourage us in what sometimes appears hopeless tasks.

With the compliments of writ

Gen. Col. Notter

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THE IDENTIFICATION OF THE INDIVIDUAL

WITH SPECIAL REFERENCE TO THE SYSTEM IN USE IN THE OFFICE OF THE SURGEON GENERAL, U. S. ARMY

BY

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ASSISTANT SURGEON GENERAL, U. S. ARMY

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THE IDENTIFICATION OF THE INDIVIDUAL

With Special Reference to the System in Use in the Office of the Surgeon General, U. S. Army[1]

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My purpose is not to enter into a general discussion of the identification of the individual nor of the various methods proposed for its accomplishment. Time would not permit, for the bibliography alone of this subject would occupy many pages, as an examination of the Catalogue of the Army Medical Library will show. I shall confine myself to a sketch of the system of identification of the individual soldier now in use in the Surgeon General's Office, indicating the necessity for it, the principles upon which it is based, an account of its practical workings and of the results obtained, and incidentally of the Bertillon system of anthropometry, with which the army system is to some extent allied.

It will doubtless be remembered what a serious embarrassment to the government the reënlistment of deserters, bounty-jumpers, and other undesirable characters in the army became in the later stages of the civil war; how that, stimulated by the enormous bounties paid by towns and county governments and the large prices paid for substitutes, men would enlist and desert, repeating the process many times. As noted by Dr Robert Fletcher in his interesting paper on "Tattooing," read before the Anthropological Society in 1882, an effort was made during the civil war, by marking men on discharge with nitrate of sil-

[1] Read before the Anthropological Society of Washington, May 5, 1896.

ver, to secure their detection at subsequent attempts at enlistment, but it had to be abandoned. Probably at that time, in view of the vast army then in service, the frequent changes, the hurry and confusion of actual warfare, no effective plan could have been carried out.

Familiar as we were with the existence of the evil during war times, one would hardly think that it could exist to any serious extent in peace and in our present army, yet this reënlistment of deserters and dishonorably discharged men became so frequent that in 1888 it was evident that something must be done to prevent it. The efforts that were being made and have continued to be made to procure men of better character for the army and to elevate the tone of the enlisted men added to the importance of keeping out of the ranks deserters and men who have been dishonorably discharged.

I quote one instance of "repeating" which has occurred since the identification system has been in use, else it would not have been known. It illustrates the persistence of these repeaters and at the same time the value of the method which has detected them.

Patrick Timlin enlisted February 28, 1891; was dishonorably discharged in the same year. He enlisted as *William Swift*, January 14, 1892; was identified by outline card and discharged promptly for fraudulent enlistment; again enlisted as *James T. Casey*, May 2, 1892; was again identified and again discharged for fraudulent enlistment; again enlisted as *Thomas J. Casey*, September 15, 1892; was identified and discharged for fraudulent enlistment. Lastly, he enlisted as *James Pearson*, May 25, 1894; was identified and dishonorably discharged, with confinement for one year.

The system of M. Alphonse Bertillon had already become known and undoubtedly suggested the army system now in use to Dr Charles R. Greenleaf and Dr Charles Smart, of the United States Army, who were then on duty in the Surgeon General's Office, and to whom the credit of devising and putting it into successful operation is due. Messrs B B. Thompson and Walter S. Kaye, clerks in the identification division of the Surgeon General's Office, are also entitled to much credit for their highly intelligent and efficient services in connection with the successful working of the system. The identification division of the Surgeon General's Office is now in charge of Major Smart.

Colonel Greenleaf and Major Smart have already published brief articles on the subject in the medical journals in 1891 and 1892, but the subject has not, I believe, yet been presented to this Society, nor have the later modifications of this method or its results up to a recent date been given.

A brief reference to the Bertillon system is necessary to an understanding of that with which my paper is specially concerned.

"The anthropometric system," as he calls it, of M. Bertillon had been in successful use in Paris since 1882, but it was probably not until 1885 that the author made it known to the world, which he then did by an address before the International Prison Congress in Rome, in November of that year. Its merits were so obviously superior to the imperfect methods in use, that depended only on photographs or personal descriptions, that it was rapidly adopted throughout Europe. In September, 1887, it was adopted by the Wardens' Association of the United States and Canada, which had been organized earlier in that year. A school of instruction in the method was held in Joliet, Illinois, in 1888, and the system was soon adopted by the principal penitentiaries, houses of correction, and police departments. Central bureaus have been established for the filing and examination of measurements made at different stations. The object is, as is apparent, to ascertain the previous history of the arrested men, to identify old offenders and to separate them from the new and less hardened ones, and thus provide for more intelligent efforts at reformation.

The Bertillon system depends essentially on the accurate measurements of certain osseous structures, most of which it is fairly assumed do not change materially during adult life. They are:

1. The length of the figure.
2. Measurement of the outstretched arms.
3. Measurement of the sitting figure from the bench to top of head.
4. Length of the head.
5. Width of the head.
6. Length of right ear.
7. Width of right ear.
8. Length of left foot.
9. Length of left middle finger.
10. Length of left little finger.
11. Length of left forearm.

Appropriate instruments, such as calipers, sliding scales of various styles, etc, are employed to obtain accurately the desired measurements.

These measurements are entered on a card which contains photographs, full face and right side of head and profile, with a notation of peculiarities of feature, such as the nose and color of eyes, form of ear, etc, according to a definite system, and last a description of scars, birth-marks, and other peculiar marks. These three—the measurements of the body, the photographs and description of the person, and the distinctive marks—form the basis of the system.

The cards containing the data already referred to are put into file-boxes and classified according, first, to the length of the head, then by the width, by the length of the left middle finger, and so on, each subdivision being again divided into the small, medium, and large, each one having, of course, definite limits. By comparing the measurement of the head of the suspected recidivist with those of the cards on file and then successively eliminating those who have different measures of other parts, it is easy, of course, to find the card, if one exists in the cabinet, in which all the measurements will practically coincide, the final detection being made by the photograph and personal description and distinctive marks. The measurements therefore serve not only as a means of identification, but as an index to find the other data upon which the final decision is made.

M. Bertillon has published a recent (1895) edition of his work describing his system, in two volumes, text and album of plates. The principles remain unchanged, but the work is much expanded by very minute and exact directions for the required procedures. The difficulties in securing exactness in taking these measurements have led to the most detailed instructions, even to instituting a sort of drill, the motions of the person examined being made in three movements or times and each measure made from two positions of the examiner. A special chair is devised in which the subject sits to be photographed, and the instructions as to describing the personal peculiarities are most thorough and painstaking and illustrated, as in all parts of the work, with cuts and photogravures. The scars and marks come last and take a subordinate though important place. Only the marks found on the head, upper extremities, and trunk above the waist would seem from the instructions to be ordinarily recorded.

The United States Army system was, as I have said, probably suggested by that of Bertillon. The first scheme that suggested itself was the possibility of causing all soldiers to be vaccinated at some exact and unusual spot, and thus become marked as having been in service. Accordingly, a circular was issued by the Surgeon General in December, 1888, requiring that all vaccinations on soldiers should thereafter be made on the outer aspect of the left leg at a point four inches below the head of the fibula, and that every man be so vaccinated when enlisted or reënlisted. It was an ingenious plan, but unfortunately so many soldiers became disabled temporarily by the inflammation resulting from the vaccination on the leg that in December, 1891, the circular had to be revoked. The scars then made are of value even now as evidence of former service.

The failure of this scheme led to effort to see if the scars, birth-marks, moles, and other natural or acquired marks could be utilized as means of identification. In carrying out this plan, the third division of the Bertillon system, already described, that of distinctive marks, is amplified and extended and becomes the sole means of identification, and when classified by the regions of the body in which they are found furnishes its own index. No measurements are taken except of the height of the person and of the size of the marks, and no photographs made.

The Bertillon system is without question a thoroughly scientific one, most complete and comprehensive, and has demonstrated its thorough efficiency and adaptation to its purpose by the success with which it has been practiced for the detection of criminals and its extension to almost all civilized countries, including even Japan.

The United States Army system cannot be compared directly with it, for it was devised for the special needs of the army service. It is a sort of "short cut," to use a popular phrase; it is simpler, avoids the use of special instruments and of the camera, but will be shown, I think, to have demonstrated its value and sufficiency by the results it has accomplished. Let us see how it is carried out.

In accordance with orders issued in April, 1889, for every man who enlists or reënlists the medical officer makes out an outline figure card such as is here illustrated, figures 1 and 2. This card shows name and organization, age, height, and color

Name, *John Smith.*

Organization, *M. S. (mounted service).*

Age, *23.* Height, $67\frac{3}{4}$ *inches.*

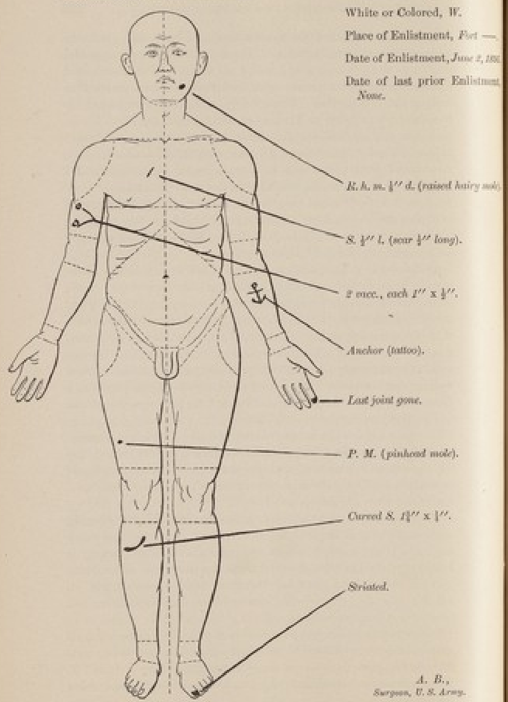
Hair, *L. Br.* Eyes, *Blue 7.*

White or Colored, *W.*

Place of Enlistment, *Fort ——.*

Date of Enlistment, *June 2, 1895.*

Date of last prior Enlistment, *None.*



A. B.,
Surgeon, U. S. Army.

Station, *Fort ——.*

Date, *June 2, 1895.*

FIGURE 1—Front of Outline Card.

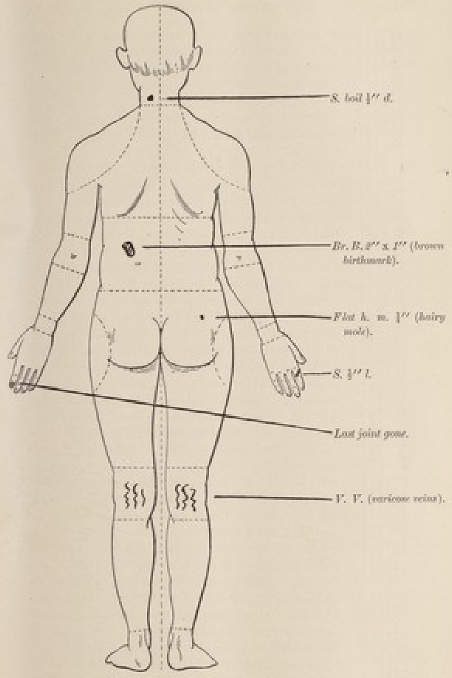
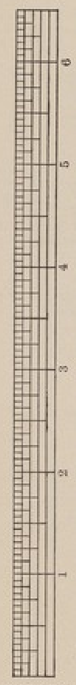


FIGURE 2—Back of Outline Card.



SCALE FOR MEASURING SCARS.

of hair and eyes, the latter according to the scale on a colored chart, and on this card, as the most important data, are entered the scars, tattoos, amputations, moles, including birth-marks, the location, nature, and size of the marks being accurately indicated, as shown in the above figures. Both front and back of the body, it will be seen, are represented.

On their receipt at the Surgeon General's Office, where they must be sent at once, these cards are filed alphabetically. Immediately on the desertion or dishonorable discharge of an enlisted man, a report of the fact is made to the Surgeon General. On receipt of this report the original enlistment outline figure card is taken out of the alphabetical file-case and transcribed on office outline cards, like the original card, except that the outlines are on the same side. This is done in order that a separate card (one to four are made) may be filed for each of the prominent regions in which important marks are found and because both sides, front and back, of the original card are utilized to save space, while this arrangement would be inconvenient for the office cards used for identification. The original outline card of the deserter is then returned to the alphabetical file. Transcripts are also made of the outline cards required to be sent in for every convict discharged from the military prisons or dishonorably discharged at a post. These office transcripts, of which I have said there are usually one to four for each man, are placed in one of two file-cases which are called the "transcript files," the arrangement of which is given in figures 3 and 4. It will be noted that the classification, corresponding to regions, is marked off by dotted lines on the figures on the outline cards. Scars form the most important group, and are arranged first as to location, *L. B. head* (left back head); *R. B. head*, etc; then according to height of subject, those upon individuals under 67 inches being placed together, etc. The scar-files, it will be

seen, take up not only one entire case but a small part of the second. Then come the tattoos, which are similarly classified according to regions and subdivided by heights. Then amputations, which include, of course, only such minor losses as would not interfere with a soldier's duty, as portions of fingers and toes, yet forming, as will be readily seen, a very valuable means of identification. Then moles, including birth-marks, also classified as to regions, and finally, a separate but small division in red (indicated by italics in the figure) for the colored soldiers. It should be added that a special file of peculiar and unusual tattoos, such as are not likely to appear but once, is kept, which sometimes leads to prompt identification without search in the regular way.

You will see, therefore, that the classification runs as follows: 1st, as to race, white or colored; 2d, as to nature of prominent scars, tattoos, amputations, moles, etc; 3d, as to regions in which these marks are found, and 4th, as to the height of the individual. There are 120 drawers in the file-case, each one having a capacity of about 400 cards. The number of transcript cards to date is about 36,700 for about 12,150 deserters and discharged soldiers. The cards of recruits and reënlisted men now number about 58,900.

Of course, time had to be given for the accumulation of cards from recruits before the plan could go into effect, but it became operative in July, 1890, and has been in successful operation since, but slight changes in the system having been required. Originally the date on the cards for whites were transcribed into two books—one for men with blue eyes and one for men with brown eyes. The leaves of the book were tagged so as to show divisions as to height in quarter-inches, and the pages ruled in perpendicular columns, in which were entered the more important scars and other marks. This arrangement was found defective, owing to the uncertainty as to the color of eyes, which was liable to be given differently by different observers, and a like uncertainty as to the measurement of height, and was abandoned for the one now in use, which has been found to work satisfactorily.

Let us see, briefly, its practical operation. The outline figure card of the recruit is, when it comes in, inspected to see if he states he has had previous service. If he does, it is placed in the

Scars. L. B. head, under 67.	*Scars.* R. B. head, under 67.	*Scars.* L. neck.	*Scars.* R. neck.	*Scars.* L. buttock, under 67.	*Scars.* R. buttock, under 67.	*Scars.* L. leg, under 66.	*Scars.* R. leg, under 66.	*Scars.* L. shoulder, L. U. arm.	*Scars.* R. shoulder, R. U. arm.
Scars. L. B. head, 67 and over.	*Scars.* R. B. head, 67 and over.	*Scars.* L. breast, L. chest.	*Scars.* R. breast, R. chest.	*Scars.* L. buttock, 67 and over.	*Scars.* R. buttock, 67 and over.	*Scars.* L. leg, 66–67.	*Scars.* R. leg, 66–67.	*Scars.* L. F. arm, under 67.	*Scars.* R. F. arm, under 67.
Scars. L. F. head, under 67.	*Scars.* R. F. head, under 67.	*Scars.* L. abdomen.	*Scars.* R. abdomen.	*Scars.* L. thigh, under 67.	*Scars.* R. thigh, under 67.	*Scars.* L. leg, 68 and over.	*Scars.* R. leg, 68 and over.	*Scars.* L. F. arm, 67 and over.	*Scars.* R. F. arm, 67 and over.
Scars. L. F. head, 67 and over.	*Scars.* R. F. head, 67 and over.	*Scars.* L. groin.	*Scars.* R. groin, Penis.	*Scars.* L. thigh, 67 and over.	*Scars.* R. thigh, 67 and over.	*Scars.* L. foot, under 67.	*Scars.* R. foot, under 67.	*Scars.* L. B. hand, under 67.	*Scars.* R. B. hand.
Scars. L. cheek, L. ear.	*Scars.* R. cheek, R. ear.	*Scars.* L. scap., L. I. scap.	*Scars.* R. scap., R. I. scap.	*Scars.* L. knee, under 67.	*Scars.* R. knee, under 67.	*Scars.* L. foot, 67 and over.	*Scars.* R. foot, 67 and over.	*Scars.* L. B. hand, 67 and over.	*Scars.* R. palm, R. fingers.
Scars. Chin.	*Scars.* Nose, Lip.	*Scars.* L. lumbar.	*Scars.* R. lumbar.	*Scars.* L. knee, 67 and over.	*Scars.* R. knee, 67 and over.	*Scars.* L. heel, L. toes.	*Scars.* R. heel, R. toes.	*Scars.* L. palm.	*Scars.* R. thumb.

FIGURE 3.—*Plan of Transcript File-case No. 1, showing Labels on Drawers and Classification.*

Scars. L. fingers.	*Tattoo.* L. shoulder, L. U. arm.	*Tattoo.* R. shoulder, R. U. arm.	*Tattoo.* Head. Trunk.	Amputa- tions.	*Moles.* L. chest.	*Moles.* R. chest.	*Moles.* L. buttock.	*Moles.* R. buttock.	*Colored.* Scars, head.
Scars. L. thumb, under 67.	*Tattoo.* L. F. arm, under 66.	*Tattoo.* R. F. arm, under 66.	*Tattoo.* Thighs, Knees, legs, Feet, &c.	*Moles.* Nose, lip, Chin, ears, F. & B. head.	*Moles.* L. abdomen.	*Moles.* R. abdomen.	*Moles.* L. thigh, L. knee.	*Moles.* R. thigh, R. knee.	*Colored.* Scars, arms.
Scars. L. thumb, 67 and over.	*Tattoo.* L. F. arm, 66–67.	*Tattoo.* R. F. arm, 66–67.	*Moles.* L. cheek.	*Moles.* R. cheek.	*Moles.* R. & L. I. scaps.	*Moles.* R. & L. groins, Penis.	*Moles.* L. leg, L. foot.	*Moles.* R. leg, R. foot.	*Colored.* Scars, trunk.
Tattoo. B. F. arms, under 66.	*Tattoo.* L. F. arm, 68 and over.	*Tattoo.* R. F. arm, 68 and over.	*Moles.* L. neck, under 67.	*Moles.* R. neck, under 67.	*Moles.* L. scap., under 67.	*Moles.* R. scap., under 67.	*Moles.* L. shoulder.	*Moles.* R. shoulder.	*Colored.* Scars, legs.
Tattoo. B. F. arms, 66–67.	*Tattoo.* L. hand, under 67.	*Tattoo.* R. hand, under 67.	*Moles.* L. neck, 67 and over.	*Moles.* R. neck, 67 and over.	*Moles.* L. scap., 67 and over.	*Moles.* R. scap., 67 and over.	*Moles.* L. U. arm.	*Moles.* R. U. arm.	*Colored.* Moles.
Tattoo. B. F. arms, 68 and over.	*Tattoo.* L. hand, 67 and over.	*Tattoo.* R. hand, 67 and over.	*Moles.* L. breast.	*Moles.* R. breast.	*Moles.* L. lumbar.	*Moles.* R. lumbar.	*Moles.* L. F. arm, L. hand.	*Moles.* R. F. arm, R. hand.	*Colored.* Tattoos, am- putations, blue eyes.

FIGURE 4.—*Plan of Transcript File-case No. 2, showing Labels on Drawers and Classification.*

alphabetic file with his prior card, with which it is compared, as he might, though a deserter, have reënlisted under his own proper name or have personated some other man. If he denies prior service, his card is then compared with the cards of the deserters and other undesirable men in the transcript file referred to. The examining clerk first observes the race of the recruit and his most conspicuous marks, noting from three to six of the latter. For instance, a white recruit 68 inches tall has, besides numerous smaller marks, a scar on his left forearm one inch by one inch, two scars on his left knee one-half inch in diameter, a scar on the calf of his right leg three-fourths inch in diameter, a raised mole on his left calf one-eighth inch in diameter, and a raised mole between right scapula and right shoulder one-eighth inch in diameter. In making the comparison the clerk will take the most conspicuous mark, the scar on forearm, first. He will withdraw from the transcript cabinet the drawer containing the cards of white deserters with scars on left forearm who are 67 inches tall and over, and beginning his comparison at 67 inches height will continue it to 68½ inches, allowing an inch for growth and a half inch for shrinkage. Should the examination on this mark be fruitless, he will make a similar examination for each of the other marks noted, after which, if the man is not identified, his outline card will take its place in the regular alphabetical file. If, however, the man is identified in the progress of the search, copies of the outline cards of his current and former enlistments, together with copies of the examination forms pertaining thereto, are transmitted to the Adjutant General by letter reporting the identification. If the man is a deserter the Adjutant General will by telegraph order his arrest, sending the papers in the case by mail. If not a deserter, the telegram will be omitted. When the papers reach the post where the recruit is stationed the case will be investigated under the direction of the commanding officer, who usually requires the surgeon there to examine the recruit with special reference to the description of the former soldier and express his opinion on the question of identity. If the investigation made by the direction of the post commander satisfies him that the recruit is identical with the former soldier, he will cause appropriate charges to be preferred against him, which, when approved by the department commander, will be tried before a general court martial. In many

cases the recidivist is simply ordered to be dishonorably discharged, by order of the War Department, without the delay of a court-martial.

The following notes of cases of identification will, I think, be of interest:

Wade L. Shields enlisted June 9, 1892; discharged without honor, Co. A, Fourth Artillery, early in 1893; presented himself for enlistment at Cincinnati, August 9, 1894, with the discharge paper of Walter B. Dent, formerly a sergeant in his battery, who had been discharged October 1, 1893; pretended to be Dent and was so enlisted. On receipt of his description in the Surgeon General's Office it was ascertained that he was not Dent but was Shields, and the matter having been brought before the Adjutant General, he was accordingly discharged without honor early in 1895. The genuine Walter B. Dent reënlisted within a few weeks thereafter. Shields next appeared at Fort Warren, Mass., where he was enlisted February 20, 1896, as Lee W. Shields, having concealed his former enlistment. He was in due course identified, tried, convicted of fraudulent enlistment, and is now (April 14, 1896) serving out his sentence at Fort Columbus, New York.

John H. Anderson, a colored man, enlisted January 22, 1891, and deserted July 11, 1891, from Co. H, Twenty-fifth Infantry; was soon apprehended and discharged, and served a term at Fort Snelling, where he was set at liberty October 1, 1892. Soon after, it appears from his story, he began to drink heavily, was arrested and confined in the St Paul reformatory, where he was released in August, 1893. Failing to get work and desperate from hunger and privation, he surrendered himself as Felix Newsome, who had deserted from the Twenty-fifth Infantry in August, 1891. He was brought to trial as Newsome, plead guilty (no witnesses to identify being brought forward, in view of his plea), and sent to Leavenworth for a year and a half. Soon after his incarceration there, in January, 1894, he applied for release, setting forth the above facts. An outline card forwarded from the prison established beyond doubt that the prisoner was Anderson and not Newsome, and he was accordingly set at liberty May 26, 1894.

Michael Jones, a military convict, was released from confinement at Alcatraz island May 15, 1890. He enlisted again at Fort Douglas, Utah, July 26, 1890, as William Brady; was identified by outline card, and acknowledged his identity. Pending receipt of order directing his discharge, he deserted, and the order was revoked. He next appeared at Fort Monroe, Virginia, where he was enlisted December 22, 1890, as Michael A. Jones, concealing former service. He was identified by the cards as William Brady, *alias* Michael Jones, and admitted that he was ex-convict Jones, but denied that he had enlisted and deserted as Brady at Fort Douglas. This denial he persisted in until upon trial he was confronted by witnesses from Fort Douglas who recognized him, and he was thereupon sentenced to dishonorable discharge with three years confinement at Leavenworth.

The results of the work have been as follows: From July, 1890, to April 28. 1896, 537 men have been identified, 209 as deserters, 180 as soldiers whose previous service was terminated by dishonorable discharge (with or without imprisonment), and 148 as frauds of a minor grade. Of these 49 deserted before final disposition was made of their cases, and 13 others are at present awaiting final action; 402 were discharged the service by sentence of court-martial or by orders from the Adjutant General's Office, and 73 were retained in service, of whom 9 were subsequently discharged by sentence of court-martial, 4 were discharged without honor by orders from the Adjutant General's Office, and 20 deserted.

During the calendar year 1890, 18 identifications were made; in 1891, 88; in 1892, 123; in 1893, 88; in 1894, 80; in 1895, 101; and in 1896, up to April 28, 39.

In addition to the 537 cases noted, 184 identifications were made of men who had left the service—deserters, 113; military convicts, 34; others, 37. Three applicants for enlistment were identified at the instance of the recruiting officer, making in all 724 identifications made.

During the calendar year 1895 the whole number of identifications was 121 (including 19 cases of men who had left the service and 1 applicant for enlistment identified at the instance of the recruiting officer). This number represented the "repeating" element of 4,929 recruits whose outline cards have been examined—*i. e.*, of every thousand recruits enlisted from civil life 24.55 were identified through the outline-card records as deserters, military convicts, or otherwise bad characters.

It may be asked if no failures have occurred; if no men have

been identified by the cards who did not prove to be the same. It cannot be said that any distinct failures have occurred. The records show that in fifteen cases the Surgeon General has reported that men were probably (not positively) identical, in which the commanding officers have stated that, after investigation, they did not believe the men to be the same. Undoubtedly some of these cases were cases of true identity; also there have been five cases in which the evidence was considered sufficient to justify trial by court-martial, but in which the court acquitted the prisoners. One of these men was dishonorably discharged by order of the War Department immediately after and one acquitted man at once deserted. The failure to convict in these cases probably arose from other causes than failure of the evidence of identity.

It will be noted that the number of identifications was greater in 1892, soon after the system went into effect, showing evidently that the knowledge of the existence of this system has deterred the class it seeks to exclude from reënlistment—a result as satisfactory as an increased number of detections would be.

It has been objected that the reception of a scar or a tattoo mark after the enlistment card is made out might lead to the non-detection of the repeater, these marks not being on the original card. This objection might have some force if only one scar or mark or the scars and marks in one region only of the body were considered, whereas the scars and marks on an average of three regions are examined, and all have value in determining the question of identity.

Again, it may be said that in process of time these cards will accumulate so as to render identification very tedious. This difficulty is in a measure met by taking out of the files those of men shown by their cards to have reached the age of 40. Thirty years is the limit of age for enlistment, and it is presumed that no recruit would be taken who was ten years older than that age. If the number of cards in any drawer becomes unmanageable, the difficulty can be met, if necessary, by still further subdividing the regions of the body represented.

The system I have just been describing is specially adapted for army use from its simplicity and facility of application. No apparatus and no camera or elaborate personal description is required. Army recruiting parties sometimes move about from town to town and could hardly carry apparatus with them. To comply with the instructions of Bertillon in taking the eleven measurements of his system (each twice), take two photographs, record a careful description of facial peculiarities, and then of distinctive scars and marks would require more time than can ordinarily be given to each recruit at his examination.

Again, as has been pointed out by Lieutenant Colonel Greenleaf, it is well to avoid for recruits the use of a system such as that of Bertillon, which is associated with the detection of criminals. Even the present system has been objected to on the score of its similarity to that used for the identification of criminals, and still greater would be the objection if exactly the same system was used. It is not the greater personal exposure or indignity in the Bertillon system but its use with criminals that is objected to. There would be a certain advantage if a common system of identification could be used for all classes, private individuals, soldiers, sailors, and criminals, but in the present state of feeling in our community it cannot be. Some such system as that now in use in the army must for the present at least be relied on.

Lastly, the success which has attended the use of the army system, covering a period of nearly six years, is perhaps the best proof of its value. Failures to identify have been made, no doubt, but the large number of undesirable men excluded from the ranks amply justifies its inception and continuance. It met with little favor with the military authorities at first, but it is now relied on as an indispensable agency in maintaining discipline and in improving the standard of character in the ranks of the army.

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EPIDEMIOLOGY

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Epidemiology.

INTRODUCTORY

Definitions, Endemicity, Sporadicity, Specificity, Receptivity.

THE term *epidemic* was originally applied to a disease attacking a number of persons at the same time or in close succession. Thus, Paulus Ægineta says, "We call those diseases epidemic and common that attack many persons together," and the word is often used in this sense at the present day. Haeser in his *History of Epidemic Diseases* treats of ergotism and scurvy as epidemic maladies. Ergotism, as we know, is an intoxication, and scurvy a disease of malnutrition; yet, as both frequently affect large numbers at the same time, they may properly enough be classed as diseases, *ἐπί*, upon, *δῆμος*, the people. Hecker, in the same way, includes the dancing mania of the Middle Ages along with the Black Death among epidemic diseases, because, although psychical in its nature, it spread by a sort of moral contagion and became widely prevalent. In common life we speak of an epidemy of suicide, of sunstroke, of lead colic, and so forth, meaning no more than that these diseases are unusually common at a given time, and without regard to their nature or causation.

Although this use of the word is etymologically correct and sanctioned by the best authorities, we shall, in this article, make a distinction between common and epidemic diseases—restricting the term epidemic to that group of infective or micro-parasitic maladies which has the common property of spreading from time to time in a community. This property of attacking larger or smaller numbers of a population simultaneously or in succession implies a common origin of the units constituting an epidemy. The individual cases must be connected either by filiation, the one from the other, or by derivation from a common source of infection. This definition excludes intoxications, dietetic and psychical diseases, as well as those arising from physical agencies, such as heat or cold.

The distinction formerly recognised between pestilential and epidemic diseases, founded on theoretical and obsolete views of their causation, has now little more than historical interest. Some modern authorities, however, reserve the name of pestilences to plague, yellow fever, and cholera, on account of their extension, from time to time, over large regions and the terrible mortality to which they give rise when they become widely epidemic. Epidemiologically these three diseases present certain notable peculiarities. They are each endemic in one or more centres from which epidemic extensions take their start. They also exhibit in a high degree those variations in spreading and killing power which, in a more or less marked way, characterise all epidemic maladies. These peculiarities, and others that could be mentioned, do not, however, require that plague, cholera, and yellow fever should be placed in a separate class by themselves.

The relation between epidemic and endemic diseases requires a few words of explanation. The fact that certain diseases are restricted to, or specially prevalent in, particular localities must have been a matter of common observation from the earliest times. The treatise of Hippocrates "On Airs, Waters, and Places" is, in fact, a dissertation on what we should now call endemic influences. A formal distinction, however, between endemic and epidemic diseases is not to be found in the works of the Greek, Roman, or Arabian physicians, but appears to have been made for the first time by Galeazzo di Santa Sofia in his *Liber de Febribus*, published in 1514.

Strictly speaking, there is no natural class of endemic maladies. Diseases, the most diverse in their characters, have their favourite or exclusive haunts. Endemicity depends on one or other of the following circumstances:—(*a*) The telluric or climatic conditions peculiar to a region favour the saprophytic growth of a pathogenic microbe, as in the case of cholera, which finds in Lower Bengal and some other places the conditions which enable it to maintain a continuous existence. (*b*) Conditions peculiar to a particular region or locality favour the life of some insect or other animal which serves as the intermediate host of a pathogenic parasite, as in the instance of the mosquito in relation to malaria, or which acts as the carrier of a disease, as in the case of the tsetse fly. (*c*) The habits of life and social circumstances of a people in some cases account for a disease clinging to a locality. Overcrowding, want of ventilation, the housing of cattle along with man, and imperfect burial of the dead, are common to all plague centres. (*d*) The presence or absence of other forms of animal or vegetable life may determine the endemicity of a disease. Moulds, for example, favour the growth of the yellow fever bacillus.

The division of diseases into epidemic and endemic, as if they formed two mutually exclusive classes, comprehending between them all infective maladies, is quite inadmissible. The same disease may be at once endemic and epidemic. Cholera, as we have just said, is endemic in Lower Bengal, but at intervals it becomes so prevalent there as to assume the character of an epidemy, and from this endemic centre it spreads over continents. Malaria is endemic in more or less defined regions, but in certain seasons it becomes epidemic in its endemic haunts, and extends far beyond its usual limits. The converse of epidemic is not endemic but sporadic (σποράδικος, scattered).

An epidemic disease often occurs sporadically in inter-epidemic periods. This results from an attenuation of the virus which permits its infecting only a few specially susceptible individuals, from a want of facilities for diffusion, or from a temporary insusceptibility on the part of the population. Whether an infective disease be sporadic or epidemic will depend on two factors: (*a*) the resistance of the virus, that is, its capacity of retaining its vitality outside the body; (*b*) the facilities which the contagium has for effecting an entrance into susceptible subjects. It is the latter factor that is of the greatest importance in this connection. Gonorrhœa is an infective disease, the virus of which is reproduced in great abundance and for a considerable time; but the gonococcus rapidly loses its infective properties outside the body, and the infection being only communicable by the direct application of the virus to certain mucous surfaces, which in ordinary conditions are not exposed to the contagion, it is impossible that the disease should occur otherwise than sporadically. The virus of measles, on the other hand, although by no means resistant, being readily communicable by simple proximity to the sick, has the opportunity of becoming rapidly diffused through a community.

It follows that if a sporadic infective disease should undergo a change in its mode of communication it may assume epidemic characters. Such a change took place in the case of syphilis in the end of the fifteenth century. The contagium, from being localised and communicable by sexual intercourse only, became generalised in multiform eruptions on the skin and mucous membranes, known as the "pockes," by which it was communicated in the ordinary intercourse of social and family life, and hence became rapidly diffused over Europe. As soon as the disease resumed its old type, it lost its epidemic characters. The difference between a sporadic and epidemic disease is, thus, not in the nature of the virus, but in the mode in which it is propagated.

We have omitted from our definition of an epidemic disease the property of specificity, which is, in a sense, implied in the fact that it is caused by a *contagium vivum*. If we use the term, the meaning we put into it must be wide enough to cover the following facts:—(*a*) Microbes presenting marked morphological and biological differences give rise to the same disease. The vibrios of cholera differ so much from one another that they are supposed by some to belong to different species.

(*b*) A complex of microbes may be concerned in producing the lesions of a disease. In most cases one microbe can be clearly identified as specific; the others, so to speak, form its retinue. The presence of the specific microbe determines the appearance of the others. It has been proved that the products of the cultivation of the bacillus of yellow fever promote the growth of the coli bacillus, the staphylococcus aureus, the proteus vulgaris, and the streptococci. This explains the frequent presence of these organisms in yellow fever, in many cases of which the specific bacillus is crowded out by these intruders. In non-amœbic dysentery a variety of organisms are always present, and it is impossible at present to say if any one of them, to the exclusion of the others, is concerned in originating the dysenteric process. Whether this form of dysentery is strictly specific, in the sense of being always due to one organism, is uncertain, but that it often assumes epidemic characters is abundantly evident.

(*c*) A great variety of symptoms and lesions may be produced by the specific microbe itself apart from the existence of a mixed infection, such as we meet with in yellow fever. Simple variation in virulence does not, as a rule, materially affect the nature of the lesions, but the port of entrance of a microbe has a remarkable influence on the gravity of the symptoms, and even on the lesions of a disease. We know how the manifestations of plague differ according as infection takes place by the skin, the respiratory passages, or the alimentary canal. Inoculated small-pox is a mild disease compared with that contracted in the ordinary way. If we were to go out of the field of strictly epidemic diseases, we should find a remarkable illustration of the influence of the port of entrance on the character of a disease by comparing the symptoms and lesions of cutaneous and pulmonary anthrax. To sum up, we may say that, with a few doubtful exceptions, all epidemic diseases are specific, and the symptoms and lesions produced by the pathogenic organism are the same under the same conditions. The marked differences in these respects observed in certain diseases depend either on the virus effecting its entrance by different ports, or on the association of other organisms causing a mixed infection.

The presence of the specific organism of an epidemic disease is not sufficient to determine an epidemy. For this, among other things, a susceptibility or receptivity on the part of a community is essential. Susceptibility to all infections is increased by conditions which lower the resistance of the system generally, or that of the surface through which infection takes place. Insufficient nourishment, muscular exhaustion, mental fatigue, exposure to cold or excessive heat, and vicissitudes of temperature all predispose the body to infection, although one set of conditions does not predispose to all diseases indifferently. The experiments which establish the influence of these agents in rendering the body amenable to particular contagia are too well known to require that they should be mentioned here. But the vast importance of predisposition as determining whether infection shall, or shall not, follow exposure to the specific cause is not sufficiently recognised. A few illustrations of the effect of predisposition in determining the epidemic spread of disease must suffice.

The germ or germs of dysentery are ubiquitous. It is sufficient to subject a body of men for a time to exhaustion, want, alternations of heat and cold to ensure an outbreak of dysentery, and once produced, the disease becomes epidemic, and spreads to those not subjected to these hardships. The history of every long and trying campaign furnishes evidence of the influence of predisposition in giving rise to epidemic dysentery.

The microbe of typhus is unknown, but it, too, appears to be widely diffused and ready to come into evidence as soon as circumstances affecting the susceptibility of a community favour its pathogenic activity. It is sure to make its appearance sooner or later among those whose resistance has been broken down by want or disease, if they are confined in dark, filthy, unventilated dwellings on sea or on land. Creighton records a very remarkable instance of typhus being generated (if we may use the expression) in an Egyptian frigate, having on board 476 men, 200 of whom were convicts. The voyage to Liverpool was long and stormy, preventing ventilation 'tween decks. The vessel, besides, was in a horrible state of filth. There was much sickness of a diarrhœal kind among the men, but *no fever* appeared on board. On arriving in the Mersey these men, who were themselves free from fever, communicated typhus to the English who were brought into contact with them, or who went on board the vessel. In all thirty took the infection, and eight died.

Kelsch has recently shown how certainly the fatigues consequent on the annual manœuvres in France, by their effect in reducing the resistance of the body to the virus, are followed by outbreaks of enteric fever. In the

same way malarial fever readily becomes epidemic among those subjected to the hardships of war, or who suffer from want. It is for this reason notably a disease of the poor. Duboué's experience in France is that of all who have seen much of the disease in the tropics. "L'infection palustre," he says, "est rare, très rare dans la classe aisée. Les huit dixièmes des cas d'impaludisme que j'ai observés, je les ai vus dans la classe peu aisée ou misérable, et les quelques exemples que j'ai notés parmi les gens riches s'expliquent presque toujours par des imprudences hygiéniques." We shall have occasion in the sequel to notice the effect of an increased vulnerability of the air-passages produced by atmospheric conditions in determining the seasonal incidence of small-pox and measles.

What we call immunity is a lessened susceptibility, original or acquired. This plays an important part in limiting the spread of epidemic diseases. What would have been the fate of our race if one attack of an epidemic disease afforded no immunity from another? When a cholera wave passes over India the population acquires a partial immunity, lasting, as a rule, for two or three years. Hence epidemic waves follow with considerable regularity every fourth year. It has been shown that the ingestion of the cholera bacillus in food or water, while it may fail to give rise to the infection, nevertheless confers a certain degree of immunity. Abel and Claussen found the vibrio in the stools of thirteen out of seventeen persons who had been brought into close contact with cholera patients. They had imbibed the virus without succumbing to the disease, and had doubtless in this way acquired a partial and temporary immunity. We may thus suppose that a very large number of a community among which cholera has been raging and who have escaped an attack, become temporarily immune. Otherwise it would be difficult to understand why the disease should not spread every year in India, seeing that in the worst outbreaks those who have acquired an immunity by passing through an attack form only a small proportion of the population. A similar process of temporary immunisation by imbibing non-infective doses of the virus takes place in other infections. Is it not possible, then, that something similar occurs even in the case of contagious diseases? The increase of virulence observed in the earlier stages of an outbreak of measles or small-pox is generally explained on the assumption that at the beginning of an epidemy only the more susceptible are attacked, in passing through whom the virus gains in intensity. This theory, whether true or not, implies that others who imbibe the virus do not contract the disease on account of their greater resistance. We may suppose that in the case of those who receive the virus without developing the disease, the pathogenic organism is destroyed *in situ* by the action of the cells; but it does not follow that the bacterial products are without effect on the economy. This view of the possible immunising influence of non-infective doses of the virus of contagious diseases is not to be dismissed as purely fanciful, for Copeman has shown that protection against the effects of subsequent vaccination or inoculation is afforded by the introduction of the virus, although there may be no local manifestations. Should it be proved that the action of the virus—say of small-pox or measles—in doses insufficient to give rise to disease confers a temporary immunity on those subjected to it, some difficulties in connection with the decline of epidemics and the intervals between successive outbreaks would be removed or lessened.

Methods of Study.—Classification.—Epidemiology is a branch of natural history—that branch of it which treats of the micro-organisms to which the microbes of epidemic diseases belong. A complete natural history of these organisms would include, among other things, their epidemiology. The life of an important group of these parasites is limited to man, and their life-history is comprised in their epidemic activity. The most interesting phase in the life of the others is not that which is passed by them as harmless saprophytes, but that in which as parasites they take their share in the tragedy of human life, bring misery into the domestic circle, and, as in the case of plague, determine the fate of empires and modify the progress of civilisation.

The natural history of the parasites of epidemic diseases embraces their bacteriology and their epidemic manifestations. Bacteriologically, we have to study them in their relation to other organisms to which they are allied or which affect their growth; their morphology; the media in which those of them that can be grown outside the body can be best cultivated; the influence of physical agencies—temperature, humidity, and so forth—on their growth and virulence. But this is only a fragment of their natural history. We have to observe their behaviour as human parasites in order to discover how they spread, the influence of meteorological agents on their diffusion, the vehicles by which they are introduced into the body, the personal and social conditions which influence infection, the circumstances that determine the decline and extinction of epidemics, and much more that cannot be learned by bacteriological research. But our knowledge of the natural history of these organisms is not complete until we know something of their epidemic history—their varying prevalence and fatality at different epochs and the symptoms they have exhibited in past times.

We must beware of concluding too positively from the behaviour of an organism under experimental conditions how it will comport itself in its epidemic career. Cholera cultivations die out rapidly when placed in the soil, but an outbreak of cholera occurred in 1890 at Puebla de Rugat in Spain, which could only be accounted for on the supposition that the vibrio had retained its vitality in the soil for a period of five years. Under the direction of Pettenkoffer 5 litres of a bouillon containing an estimated number of seventy-two millions of the typhoid bacillus were poured into a well containing 680 litres of water. They had all disappeared by the third day. Our experience of actual epidemics of water-borne typhoid is very different from the results of this experiment. We must be equally on our guard not to infer from what we see of an epidemic disease at the present day that it has always presented the same characters. In recent outbreaks of plague little has been heard of carbuncles, petechiæ, and other eruptions. Yet so characteristic were carbuncles of this disease, as seen in Europe in the sixteenth and seventeenth centuries, that it was often spoken of as *carbuncular* plague, and the eruptions known as *the tokens* were looked upon as more certain evidence that a disease was plague than the buboes themselves.

The micro-organisms of some of the more important diseases are still unknown, but those that are known belong to the coccus, rod, or screw forms of the schizomycetes, or to the hæmatozoa.

Classifications based on their morphology and modes of reproduction, however necessary for the bacteriologist, are of little service to the epidemiologist, for they fail to bring together groups of disease having common epidemiological features. The symptoms, lesions, and epidemiological characters of a disease afford no certain indication of the bacteriological class in which we are to look for its cause.

A classification based on the parasitic habits of the micro-organisms and the modes in which they are communicable is that which is most useful to the epidemiologist.

One important class of epidemic diseases consists of those caused by *obligatory* parasites. These organisms do not grow outside the human body. External conditions—light, air, temperature, humidity—are relevant to their prevalence only in so far as they (*a*) attenuate their virulence or destroy their vitality; (*b*) favour or hinder their diffusion; (*c*) increase or diminish the susceptibility of the body generally, or that of the surfaces through which infection takes place, to their invasion.

To a second class belong diseases caused by *non-obligatory* parasites capable of saprophytic life outside the body. This class is usually divided into two groups: diseases due (*a*) to facultative saprophytes, or organisms essentially parasitic, but capable of growing more or less vigorously in external media; (*b*) to facultative parasites, or organisms essentially saprophytic in their habits, but capable of invading the human body. The distinction is a real one as applied to non-epidemic infections. The bacillus of tetanus, for example, is a truly facultative parasite. Its life is that of a soil saprophyte, but when accidentally introduced into the body it is capable of growing in the tissues. The distinction, however, between facultative saprophytes and facultative parasites is more arbitrary in the case of the organisms of epidemic diseases. The most saprophytic of them develop a high degree of parasitism when they are epidemic. It is doubtful, indeed, if any saprophyte can give rise to an epidemy until its virulence has become exalted by successive transmissions through the human body. In other words, facultative parasites must become, in a sense, facultative saprophytes before they can spread extensively. The cholera vibrio, for example, is looked upon as the type of a facultative parasite, but it loses its virulence by continued growth as a saprophyte. This is true at least in non-endemic regions, and it is open to doubt whether the cholera germ, even in places where it is endemic, can maintain indefinitely the virulence necessary to give it spreading power, unless by frequent passages through the human body.

Some of the non-obligatory parasites approach closely in their epidemic characters to those of the obligatory group. The scarlet fever germ, for example, whatsoever it may be, is capable of saprophytic growth, as milk epidemics prove, but when widely epidemic, scarlet fever appears to spread almost exclusively by contagion, and its epidemic characters are then practically those of a disease due to an obligatory parasite.

The same may be said of diphtheria. Its bacillus grows as a saprophyte, and during its epidemic prevalence the saprophytically grown virus often gives rise to the disease, but there is reason to believe that when the disease is epidemic it is mainly spread by contagion. When not grown from time to time on the body it loses its virulence. It will thus be seen that epidemicity implies an increase in the parasitism of microbes, those most akin to saprophytes in their habits approximating to the characters of facultative saprophytes, the latter, again, to those of obligatory parasites. It seems highly probable, indeed, that all infective microbes were originally saprophytes, and it cannot be confidently affirmed that any one of the obligatory group has so completely lost its ancestral habits that it cannot grow in some medium outside the body.

There is some reason for believing that the bacillus cultivated by Copeman and Klein from variolous crusts by incubation in a hen's egg is the long-sought-for virus of variola. In that case, the most obligatory of all parasites will have been proved to be capable of saprophytic life; but from all we know of small-pox we may rest assured that in respect to the actual mode of its propagation it is strictly obligatory. When small-pox or measles are introduced into an island with a limited population, and not in frequent communication with places where these diseases are always more or less in evidence, they die out as soon as the susceptible are exhausted. Neither of them can maintain itself in the surroundings of man until a sufficient number of unprotected persons accumulate to set agoing a new outbreak.

It follows from what we have said that a definitive classification is at present impossible. The following groups, however, indicate to some extent the epidemic affinities of the more important of the diseases with which we are concerned:—

1. Diseases caused by obligatory parasites and spread by contagion. To this class belong small-pox, measles, whooping-cough, mumps, chicken pox, and less certainly typhus and cerebro-spinal fever.

2. Diseases caused by non-obligatory parasites which spread by contagion; but as their contagia are capable of saprophytic growth, they are also diffused by infection. In this group of contagious-infectious diseases are scarlet fever, diphtheria, and erysipelas, and probably relapsing fever, influenza, and dengue.

3. Diseases caused by non-obligatory parasites which are spread mainly by infection. The microbes of this group, although derived more or less remotely from a previous case, multiply outside the body, and are introduced into the system by means of air, water, food, or in the instance of plague, and perhaps of yellow fever, by inoculation. This group comprises cholera, plague, Malta fever, enteric fever, dysentery, and yellow fever.

4. Malarial fever is caused by a hæmatozoon. It is communicable by the sting of a malariated mosquito, but the etiology of the disease points to other modes of infection. It is still uncertain if the parasite of blackwater fever is distinct from that of malaria.

Isolation of, and avoidance of communication with, the sick, or contact with contaminated articles are the means of limiting the spread of diseases belonging to the first class. Defective sanitation is only of importance in promoting their spread in so far as it predisposes the body to infection.

Isolation is still the most important means of limiting the spread of the second group. But here the need of protecting milk and food from contamination is obvious. Sanitation also comes into greater prominence, inasmuch as an impure soil may serve as a breeding-place for the germs, while noxious effluvia and sewage gases may at once predispose to attack, and serve as vehicles for the infection.

In respect to the third class the first indication is to prevent the introduction of the germ into a healthy country or locality by measures of quarantine, inspection, and disinfection proper to the particular disease to be guarded against, and suited to the circumstances of the community. Of primary importance for the safety of a community is attention to purity of air, soil, and water, with free ventilation and sunlight, so as to deprive the microbe of breeding-places, prevent the contamination of the vehicles by which the contagium is conveyed into the system, and subject the virus to the action of the natural agencies that are antagonistic to its vitality.

The prevention of malarial diseases requires that a country be rendered unfit for the life of its insect host by means of drainage and cultivation. Individual prophylaxis does not come within the scope of this article.

To sum up: for an epidemy of a disease belonging to the first and second groups there must be (*a*) the virus; (*b*) a susceptible population; (*c*) free inter-communication between the sick and the susceptible. For the epidemic prevalence of a disease belonging to the third group there must be (*a*) the virus; (*b*) a breeding-place for it outside man; (*c*) means of transport from place to place; (*d*) a vehicle for its diffusion; (*e*) a susceptible population. Isolated cases of an epidemic disease may occur when some of these conditions are absent, but in order that an infectious disease should become widely diffused, they must all be present.

General Epidemiology

Epidemic Movements—Law of Anticipation—Associations and Antagonisms—Evolution and Involution of Epidemics

Epidemic Movements.—The distinguishing feature of epidemic diseases, as the name implies, is their alternating periods of quiescence and recrudescence, but other movements, less obvious, because more gradual in their evolution, have also to be considered. Some of the more important epidemic phenomena fall under the following heads:—1. Secular mutations occurring during the course of centuries. 2. Multiannual nutations, to use the phrase of Ransome, or fluctuations in prevalence and virulence extending over periods of from ten to fifty years. 3. Epidemic waves or explosions recurring at more or less regular intervals of a few years. 4. Seasonal fluctuations. 5. Oscillations at irregular intervals measured by days or weeks.

I. Secular Mutations.—Under the term secular mutations are comprised (*a*) changes in the relative importance of a particular disease or class of diseases, developing during the course of ages; (*b*) the appearance of new epidemic diseases, or the extension of old ones to regions from which they had been previously absent; (*c*) the extinction or modification of epidemic diseases; (*d*) the temporary assumption of epidemic characters by sporadic infectious maladies.

(*a*) A study of the history of epidemic diseases shows a certain malady or class of maladies coming to the front on the epidemic scene, playing the chief rôle for a longer or shorter time, and then retiring to give place to others. We have an example of this kind of secular movement in the predominating importance of plague in the sixth and seventh centuries, and, again, from the fourteenth to the middle of the seventeenth century. Other instances are afforded by the remarkable prevalence of typhus in the seventeenth and eighteenth centuries, its gradual decline in recent years, and the varying prevalence of malaria, dysentery, and the contagious class of diseases in different historical periods.

(*b*) The English sweating sickness is the best-known example of the advent of a disease of which no trace is previously to be met with in history. Its sudden appearance in 1486, its repeated periods of apparently complete extinction, followed by new outbreaks, and its final disappearance in 1551, form an altogether unique episode in the annals of epidemiology. Whether dengue is to be reckoned among new diseases is not so certain, but its history does not reach back beyond the last quarter of the eighteenth century. Cerebro-spinal meningitis, if not new, escaped recognition up to the year 1837.

The epidemic diseases mentioned by Hippocrates are malarial fevers of the various types now known, continued fevers of long duration, presenting some of the features of Malta fever, possibly diphtheria, dysentery, summer cholera, mumps, erysipelas, puerperal fever. Plague, too, was known in his day, although it is not described in any of his authentic works. The list of epidemic diseases has increased considerably since the time of Hippocrates by the evolution of new diseases or by the extension to Europe of maladies previously restricted to other regions. Respecting the existence of small-pox and measles in ancient times Dr. Adams says: "After having read, we may say, every word of every ancient writer on medicine that has come down to us, we can confidently affirm that the Greeks and Romans are altogether silent on the subject (of small-pox and measles), and we are indebted to the Arabians for the earliest accounts we have of these diseases." In this conclusion we agree, and we are even inclined to doubt the vast antiquity claimed for small-pox in India and China. The historic evidence of this antiquity is doubtful; the improbabilities of its being restricted for ages to one country, great. Had small-pox prevailed in the East from remote antiquity, as some hold, it is difficult to understand why it should not have rapidly spread to Europe if the disease had then possessed the contagious character it now exhibits. The constant intercourse between the East and West in ancient times afforded ample opportunities for its spread.

But whatever may be the antiquity of small-pox and measles, their extension to Europe, which is one of the most notable secular movements of epidemic diseases, does not date before the sixth century. In recent times other diseases have extended their limits. Yellow fever has in our day become acclimatised in Brazil, and in the past and present centuries it has frequently overrun great parts of North America, and has made repeated incursions into Southern Europe. One of the most remarkable instances of the extension of a disease previously confined to a comparatively limited area is that afforded by the repeated pandemics of cholera during the present century.

(*c*) History, too, affords examples of the extinction or modification of old diseases. No form of sickness now known corresponds to the plague of Athens as described by Thucydides, to that of Antoninus (166-68 A.D.) described by Galen, or to that of Cyprian in the third century. The modifications in prevalence and virulence which epidemic diseases have undergone in historical times are apparent. Malarial fever and dysentery dominated the pathology of England in the days of Sydenham; they are at present not only among the rarest of diseases, but they have lost much of their old virulence. When do we hear now of the pernicious attacks described by Morton which "sub larva algoris funesti, vomitionis indesinentis, choleræ morbi, colicæ ventriculi, apoplexiæ, syncopes, spasmi universalis, pleuritidis, vel alterius morbi secure delitescens, medicum a scopo suo non raro abducit"? Typhus fever, so prevalent in past centuries, seems to be verging towards extinction. On the other hand, the quasi-epidemic diseases of the respiratory organs—pneumonia and bronchitis—have gained in importance, and since the first appearance of Asiatic cholera the mortality from diarrhœal diseases has enormously increased, although of late years it seems again to be somewhat on the wane. The mortality from this class of diseases per million living in London since the beginning of registration has been as follows:—

1838-40	1841-50	1851-60	1861-70	1871-80	1881-90
274	782	1030	1040	949	748

This increase has not been confined to London or England. According to Lombard the deaths in Berlin from diarrhœa and cholorine formed 18·6 per 1000 of the deaths from all causes from 1835 to 1838; by 1868-69 they had risen to 109; in 1872 to 134; and in 1873 to 173 per 1000. Is this great increase caused by the acclimatisation in Europe of an attenuated descendant of the vibrio of Asiatic cholera?

(*d*) The temporary assumption of epidemic characters by sporadic infective diseases is best exemplified in the epidemic spread of syphilis in the end of the fifteenth century. Something analogous, but not so much to the point, is observed in the spread of leprosy in Europe in the Middle Ages, and in New Caledonia and the Sandwich Islands of late years.

Space forbids us entering into a discussion of the causes of these secular movements. They may be referred to one or more of the following circumstances:—(*a*) Variations in the prevalence and virulence of the *contagium*, brought about by altered conditions under which the micro-organism is grown, or the association of pathogenic microbes with non-pathogenic organisms which exalt or attenuate their virulence. (*b*) Changes in the

circumstances and habits of peoples as regards food, dwellings, occupations, modes of life, and whatever affects the susceptibility to disease. (*c*) Changes in the facilities for the spread of certain diseases by social and political upheavals and movements of population. (*d*) The assumption of parasitic characters by microbes formerly purely saprophytic.

II. MULTIANNUAL FLUCTUATIONS OR NUTATIONS.—In following the course of a contagious disease, such as small-pox, measles, whooping-cough, scarlet fever, or diphtheria during a long series of years in a community in which it is constantly more or less present, it will be remarked that it has periods of slowly increasing and decreasing mortality, quite distinct from the epidemic explosions recurring at shorter intervals. These long-period fluctuations appear on a chart as alternate ebbs and flows, or swells and depressions, on which the short-period outbursts appear as waves. Or rather a diagrammatic representation of the course of one of these diseases through a series of years presents something of the appearance of an undulating mountain range, studded with numerous abruptly projecting peaks, arising alike from height and hollow—those shooting up from the depressions being often the highest. These undulations or long-period swells are frequently spoken of as epidemic cycles, but if carefully examined they are found not to be strictly cyclical, as they are neither of equal height nor do they recur at regular intervals. In diagram 1, Chart I., showing the ratio of deaths from small-pox per 1000 of the deaths from all causes in London from 1700 to 1800, we observe a distinct increase in the mortality during the first decennium, the swell attaining a maximum from 1715 to 1720. It then subsides slowly and irregularly to 1733. Then follows an ebb up to 1745, when another long swell begins, which seems to end about 1783. Another upward movement is in progress when the epidemic force of the disease was arrested by the introduction of vaccination. In diagram 3, Chart I., representing small-pox in Sweden from 1749 to 1800, it will be seen that there is a marked swell from 1749 to 1773, corresponding with that observed in the London chart for the same period. Unfortunately, we do not have the material for deciding how far these swells coincide in different countries, but the curves of small-pox in London and Sweden in the second half of the eighteenth century suggest that these swells are not entirely local. In diagrams 1 and 2, Chart II., similar swells and ebbs are to be observed in the mortality from measles. The first swell in the London chart seems to have been about its height in 1838. There is a distinct fall from 1846 to 1852, when the ebb is at its lowest. So far as can be gathered from the statistics of the pre-registration period, the increase began in 1834. It thus covered a period of about 18 years. Another more indefinite swell extends from 1853 to somewhere about 1871, forming another period of 18 years. Then follows a steady rise from 1872, which is beginning to subside when the record closes. The very marked rise in the measles mortality in New York (Chart II., diagram 2) coincides with the latter part of the London period. Whooping-cough (diagram 3, Chart II.) shows a very slight rise from 1841 to 1850; it then remains pretty much at the same level from 1851 to 1870, after which the fall has been steadily progressive. We are not, however, to conclude that this is a permanent downward movement, for an examination of the charts for Sweden, published by Ransome (*Epidem. Soc. Trans.* vol. i. N.S.), shows that this disease has what he calls a nutation period of about 50 years.

Scarlet fever and diphtheria are eminently mobile diseases. They vary much more in prevalence, and especially in virulence, from time to time than do diseases of the purely contagious class. The scarlet fever seen by Syden-

DIAGRAM 1.—Small-pox in London, 1700 to 1800. Rates per 1000 of deaths from all causes.

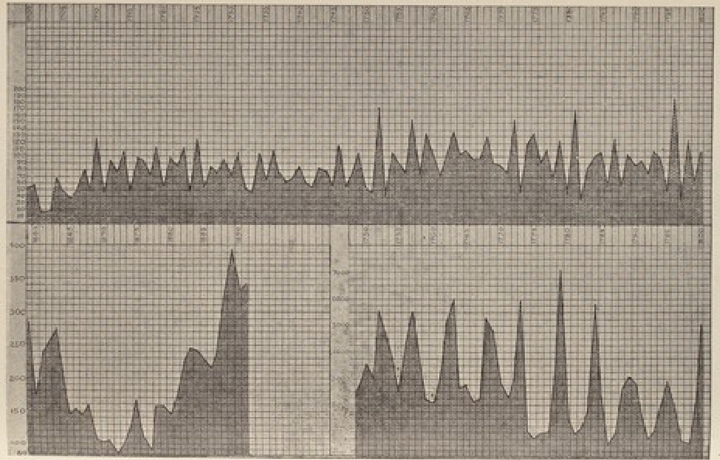

DIAGRAM 3.—Diphtheria, mortality per million. London, 1859-1891.

DIAGRAM 2.—Small-pox. Sweden, 1749-1800.

CHART I.

DIAGRAM 1.[1]—Measles, annual mortality per million. London, 1838-1895.

DIAGRAM 2.—Measles, actual number of deaths. New York, 1865-1896.

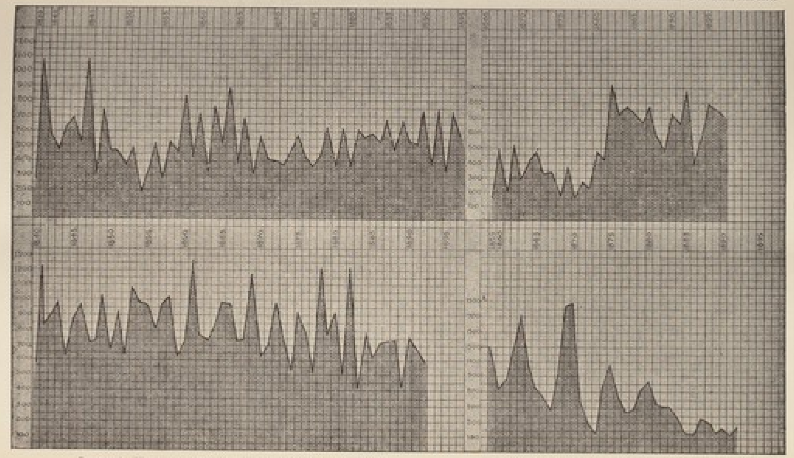

DIAGRAM 3.—Whooping-Cough, mortality per million. London, 1840-1892.

DIAGRAM 4.—Scarlet Fever, mortality per million. London, 1859-1892.

CHART II.

[1] In diagram 1, Chart II., the figures at margin have been placed one line too high. To obtain the correct ratio of deaths per million add 50 to numbers indicated on diagram.

ham was so mild that when it proved fatal "the sick died of his doctor." Graves observes that scarlet fever assumed a very benign type in Dublin soon after the year 1804, and continued mild up to 1831. "It then increased in severity, and in 1834 the disease assumed the form of a destructive epidemic." There would thus seem to have been a period of three or four years during which the pathogenic agent of the disease was slowly gaining in virulence before the epidemy attained its maximum intensity. The fluctuations in the mortality from this disease from 1859 to 1892 are depicted in diagram 4, Chart II. During the twenty years 1871-90 scarlet fever has been gradually losing ground in London and elsewhere, but those acquainted with its history will hesitate in ascribing this decrease, as is often done, exclusively or mainly, to the influence of isolation hospitals. Diphtheria presents the same variations in prevalence and virulence which we observe in scarlet fever. Its virulence may, indeed, be often observed to increase during the progress of an outbreak, the early cases presenting the characters of a simple sore throat, developing later into the most malignant type of the disease. From this mobility of type, diphtheria appears for a series of years in widespread and fatal epidemics, then subsides, to recur in local outbreaks only at irregular intervals. We have no exact statistics to guide us, but according to Hirsch there was a general remission of the disease, except in France, from the end of the eighteenth century until about the year 1858. From this date it has been one of the most fatal epidemic maladies of young persons not only in Europe, but in Asia Minor, the United States, Canada, and other countries.

During its long periods of activity diphtheria undergoes marked fluctuations in prevalence. The first swell in London covers the period 1859-72. A second and greater swell succeeded, which, so far as diagram 2, Chart I., shows, reached its height in 1889. These alternate ebbs and flows in the diphtheria death-rate of London do not correspond to those observed in New York and Philadelphia.

The causes of these swells are obscure. We are unable to say with any certainty whether as respects small-pox, measles, and whooping-cough they denote an increased prevalence only or an increased virulence as well. The long-period movements of scarlet fever are certainly dependent upon, or associated with, an increased virulence of its contagium, although how this is brought about is unknown.

The greatly diminished small-pox mortality consequent on the introduction of vaccination was followed by a notable increase in the deaths from measles and whooping-cough. The possibility, therefore, of these long waves being to some extent complementary to other diseases affecting infant life is not to be overlooked. It will be observed from the charts that as the death-rate from whooping-cough in London has fallen, so has that from measles risen. Perhaps the diminishing mortality from scarlet fever from 1870 may also have contributed to increase the fatality of measles during the same period. But after a careful examination of the deaths from infantile diseases in New York, we fail to find a decrease in any of them to which the enormous increase of measles from 1880 onwards can be ascribed. As one cannot die of two diseases, the suppression or decline in one cause of death will leave a greater number of possible victims for another. But this being admitted, it really explains nothing, for if the increase of measles be the result of the diminished ravages of scarlet fever and whooping-cough, to what, we ask, is the decreasing fatality of these diseases due?

Some have sought for an explanation of such phenomena in atmospheric constitutions favouring the prevalence of this or that disease or group of

diseases. It is here that a few words may be said about the doctrine of constitutions, which occupies such an important place in the history of epidemiology.

The constitution or *katastasis* of Hippocrates was an annual one, determined by sensible states of the weather—heat, cold, dryness, humidity, the direction and force of the winds, and so forth. Diseases, according to him, were not caused by the weather prevailing just at the time when they appeared, but by this in relation to the weather in the seasons preceding. As Bacon puts it, an epidemic constitution "results from a precedent sequence and series of the seasons of the year." This doctrine was founded not on conjecture but on observation, and will remain true, for a certain class of diseases and within certain limits, for all time. It largely explains the varying prevalence of the diseases with which Hippocrates was acquainted in different years and seasons.

Sydenham's constitution differed from that of Hippocrates. It was not an annual one, but of uncertain duration, and it was not caused by sensible but by occult qualities of the atmosphere, and finally it was conceived in order to explain phenomena which, to a large extent, were outside the observation of Hippocrates—such as plague, spotted fevers, and small-pox. Epidemic diseases, to use Sydenham's own words, "are engendered through occult and inexplicable changes in the atmosphere, and continue their devastation during the persistence of the mysterious skiey influences in question." There is nothing in nature corresponding to this conception.

It is clear that neither the constitution of Hippocrates nor that of Sydenham throws any light on these multiannual fluctuations with which we are dealing. Another doctrine is that of Haeser, who asserts, on historical grounds, the existence of two, to some extent mutually exclusive, constitutions, which he calls respectively a typhous constitution, during which typhus and typhoid fevers, plague, and malarial fevers predominate; the other an exanthematous constitution characterised by a general and excessive prevalence of scarlet fever, small-pox, measles, dysentery, diphtheria, and puerperal fever, all of which, he thinks, are related maladies. These constitutions are supposed to alternate at varying periods, extending over, it may be, twenty or thirty years, and determining the type of disease over continents. He supposes that these constitutions are the result of meteorological and cosmic influences affecting alike the vegetable and animal kingdoms. The historic evidence in support of these views does not appear conclusive. The facts that have just come under our notice indicate that the periods of prevalence of the individual members of the exanthematic group do not always correspond. Their ebbs and swells do not coincide as they should do if Haeser's doctrine were true. If these movements are caused by atmospheric and cosmic influences, we should have to postulate a separate constitution for each member of the exanthematous group. It must be admitted that these nutations are amongst the most inscrutable of epidemic phenomena.

III. Short-period Waves.—It will be seen from an examination of Chart II. that epidemic waves of measles follow one another with considerable regularity every other year in London and New York. The same holds true of most large cities. This biennial wave is scarcely less marked in England and Wales as a whole, although the years in which the wave occurs in the country do not always coincide with those in which it appears in the capital. In sparsely populated localities these waves occur at longer and quite irregular intervals. In the seventeenth and eighteenth centuries the intervals between the successive waves of measles in London were less regular than at the present day, but the tendency to biennial explosions was even then quite apparent.

Chart I. shows that there was generally an epidemic outburst of small-pox every other year in London in the eighteenth century. The interval between the waves is four years in Sweden (see Chart I.), instead of one year as in London.

The intervals between the successive explosions of whooping-cough in

London are longer and more variable. Two years, more or less, intervene between the waves. The height of the wave in all these diseases is often seen to bear an inverse relation to the swell. This is easily understood, for the more constantly and severely a contagious disease is present in a community the less material will be left for the recurring explosions. But it deserves notice that for a series of years severe explosions are the rule, followed by another series in which they are much less marked. Compare, for example, the period 1838-66 (Chart II., diagram 1) with the succeeding period.

These explosions, whatever may be their cause, are not, as a rule, determined by a recurring increase in the virulence of the contagium. Indeed, the case-mortality in epidemic years is often lower than in the years of minimum prevalence. In the years 1872 and 1894, for example, measles were epidemic in Hamburg, but the case-mortality in the former year was 2·74, and in the latter 3·4 per cent. These waves are local explosions for the most part, not brought about by increase of virulence. But every now and again in the case of measles and small-pox, and perhaps also in that of all contagious diseases, virulence waves intrude. Thus a severe epidemy of measles occurred in Hamburg in 1892; the case-mortality reached 7·3 per cent. This was no local outbreak. Its impulse is to be traced in diagrams 1 and 2, Chart II., in London and New York, and it was felt at Paris, and doubtless in other widely distant places. The epidemy of small-pox in 1871 was such a virulence wave, which swept over the greater part of the world. Nothing is really known of the causation of these virulence waves, nor much of the frequency of their occurrence.

The ordinary biennial wave of measles that appears in large towns is evidently connected in some way with the diminution of susceptible subjects in the intervening years, and the interval necessary for accumulating a fresh mass of material for a new explosion. The fact that the failure of the epidemic wave in one year is sufficient to alter the biennial rhythm is conclusive on this point. Another proof is to be found in the occasional lengthening of the interval after an unusually high wave, as in the year 1839, and again in 1845 (diagram 1, Chart II.). But in what way does this thinning of the ranks of the susceptible necessitate a more or less definite interval to elapse before a new outburst can take place? In other words, why should these diseases proceed by way of successive explosions, and not occur continuously? Why should the virus, which is never absent from a large town, not spread in the intermediate years (see Chart IV. p. 22) among those who had escaped in the previous epidemy and among those that are being constantly added by the natural increase of the population, instead of waiting for an accumulation of subjects in order to clear them all off at one stroke? Ransome, who has devoted much attention to this point, thinks that "all the facts would be accounted for if we suppose that these diseases can only become epidemic when the proximity between susceptible persons becomes sufficiently close for the infection to pass freely from one to the other. When an epidemy has cleared away nearly all the susceptible, it is only when the meshes of the network of communication are again sufficiently close for it to include all the susceptible persons in one great haul that it can return." It cannot be doubted that the intervals between epidemics have something to do with the diminished numbers and density of the susceptible, but this "density" explanation is not without its difficulties. If a definite density of the susceptible were required before a disease can become epidemic, can we suppose that anything like the same densities will be attained in the same time in places where the outbreaks occur at the same intervals? If, as is generally believed, measles are only communicable by a proximity so close as that afforded by personal intercourse—say a few feet or yards—the density of the susceptible can never be such as to enable the infection to pass from one to another. The fineness of the meshes of the net can only be relevant to the epidemic spread of the disease if it secures the inclusion of the susceptible automatically, so to speak, that is, by the infection passing from one to another, from point to point, apart from that accidental intercourse between the sick and the healthy which does not depend on any given density. Perhaps if we knew more of the manner in which the contagion really spreads in epidemic times, some or all of these difficulties would disappear. We think it by no means improbable that the interval may have a relation to a temporary immunity conferred on a population generally—on those who have not been attacked, as well as those who have—during the previous outbreak; just as in the case of cholera a severe epidemy confers an immunity for three years on a community.

IV. Seasonal Fluctuations.—"All diseases occur at all seasons of the year, but certain of them are more apt to occur and to be exacerbated at certain seasons." This aphorism of Hippocrates applies especially to epidemic disorders. The seasonal prevalence of diseases due to non-obligatory parasites is determined, as a rule, by climatic conditions affecting their saprophytic growth. Apparent exceptions occur, and the season of greatest prevalence in some localities is not that in which the virus seems to have the best chance of multiplying outside man, but that in which it has the greatest facilities for diffusion. But peculiar local conditions may convert a summer or autumn disease into a winter or spring one by actually favouring the growth of its organism at these seasons. We have an instance of this in the case of enteric fever, which is least prevalent in Munich in October, the month when it attains its maximum in England and in most other countries, and it is interesting to note that two out of the three epidemics of cholera that have visited Munich (1836-37 and 1873-74) have also fallen on winter. It is thought that the breeding-places of the virus of these diseases at Munich are situated at a considerable depth, and that the optimum temperature for the growth of the virus is found at the seasons in which they are actually most prevalent. These apparent exceptions do not invalidate but confirm the rule. All the diseases of this class are not in the same degree or in precisely the same manner influenced by climatic conditions. The cholera vibrio does not grow at a temperature under 60° F., and its optimum ranges from 80° to 104° F. This explains why epidemics of cholera in temperate climates are so generally restricted to summer and autumn, severe winter outbreaks being among the rarest of events. The vibrio is rapidly destroyed by drying, hence extensive epidemics do not occur during the long dry season in the Punjab and Central Provinces of India. The vibrio cannot multiply in very dilute nutrient solutions, hence the extensive floodings occurring at certain seasons in Bengal, Assam, and other countries are followed by a fall in the cholera wave. Another explanation of this recession of cholera during the season of floods is suggested by Woodhead. He holds that when the cholera bacillus in the fæces passes directly into a soil so damp that it holds insufficient oxygen to satisfy its saprophytic requirements it remains an anaerobic organism readily and rapidly killed; but when the depth of the drying zone is greater, the soil contains more air, the organisms multiply, become more hardy, resist putrefactive organisms, acquire saprophytic habits, and become more dangerous.

The bacillus of enteric fever is able to multiply at lower temperatures than that of cholera. It maintains its vitality for weeks when repeatedly subjected to a temperature below the freezing point. It is also much more resistant to drying than the cholera vibrio; these facts explain why typhoid fever is not so distinctly a seasonal disease as cholera.

The season of our home cholera is even more strictly regulated by meteorological states—among which temperature occupies the first place—than its Asiatic congener. As Sydenham says, "Cholera begins in August, and within the limited barriers of one single month runs its course." But outbreaks of choleraic diarrhœa, closely dependent as the disease is on a high temperature, may occur in mid-winter, and not only so, but the very lowness of the temperature is in these cases the cause of its appearance. Such epidemics have frequently happened in Altona on the Elbe, when the highly impure water derived from that river, after it has received the sewage of Hamburg, has been distributed to the population on account of very severe frosts having deranged the filtering apparatus.

As an epidemic disease dysentery is to be classed among the summer-autumn group. Of 705 outbreaks recorded by Hirsch, 528 occurred in summer and autumn and only 14 in winter; but in many parts of India the disease, attacking as it often does those debilitated by the malaria of autumn, is most prevalent in winter. No disease is more dependent on temperature than yellow fever. In determining the seasonal evolution of cholera, humidity as well as temperature counts for much, but the fluctuations of yellow fever appear to be determined by temperature alone. As Hirsch shows, it only exists throughout the whole year in regions where the mean winter temperature does not fall below 68°-72° F., and in these it attains to epidemic diffusion only in the hot season. In higher latitudes, with an isotherm of less than 68° F., yellow fever occurs as an epidemy only in years when the temperature comes up to that of tropical regions, and then principally in the hot season. In places with a still cooler climate the disease occurs almost without exception in the hot season only. A fall in the temperature to, or near to, freezing point puts an end to an epidemy. This coincidence in the fluctuations of yellow fever with those of the thermometer stamps the saprophytic character of its microbe.

The seasonal relations of plague demand further investigation. The fact that the disease generally raged in Europe in summer and autumn and died out in winter, and that, on the other hand, it shows little tendency to invade distinctly tropical regions, seems to indicate that the growth or diffusion of the bacillus is inhibited both by high and low temperatures. It is said that its epidemic progress in Mesopotamia is checked by an air temperature of 86° F. and stopped by one of 113° F. (Payne). There is little evidence, however, that the temperatures met with in those parts of India where it has been lately raging have in any way modified its epidemic evolution. The mean temperature at the height of the first epidemy in Bombay was 74°-76°; in Poona, 81°-85°; in Surat, 81°-91° F. The slight difference between the temperature of the month in which plague was at its height and that in which it began rapidly to decline in a particular locality, and the considerable differences in the temperatures at which it rose and fell in different places, forbid us ascribing any marked influence to climate in controlling its course. The climate of Bombay is never so high or so low as to affect its epidemic evolution. Other climatic conditions than temperature probably come into play (see *Brit. Med. Journ.* 23rd Dec. 1899).

Some of the contagious-infectious class of diseases attain their maximum

and minimum with great regularity at fixed seasons in a given country, but at different seasons in different countries. It is possible that in one country their seasonal prevalence may be determined by circumstances favouring their contagion, in another by those favouring their infection. No doubt these two factors—contagion and infection—are not of equal importance in respect to their spread in all countries, nor in the same country at all times. Diphtheria in most countries is at its minimum in the third quarter and at its maximum in the fourth or first quarter. In London, Baltimore, Alexandria, and some other places the minimum falls on the second and the maximum on the third quarter. In England the more prevalent the disease is, the more pronounced is the autumn rise, a circumstance which seems to indicate that in epidemic years infection plays a greater part in its spread than in ordinary years.

Scarlet fever differs entirely as regards the season of its maximum and minimum prevalence in different countries. In London it begins to increase in May, and its maximum falls with great regularity on October; and it is noteworthy that its season has remained unchanged from the days of Sydenham. In Berlin, Hamburg, Copenhagen, and the Netherlands the seasonal incidence of scarlet fever is similar to that of London, *i.e.* it is least prevalent in the second, and most prevalent in the fourth quarter. In Paris and in the United States its maximum and minimum are just reversed. The only explanation we can offer of this strange phenomenon is that in some countries infection, in others contagion, plays the most important part in its spread.

Small-pox and measles differ from all other epidemic diseases in respect to their seasonal fluctuations, and these practically correspond all over the world, and have remained unchanged from the earliest times. They were winter or spring diseases in the time of Rhazes; they are so now. They break out now in winter, now in spring. In one place winter outbreaks are more frequent; at another place spring epidemics are more common; and, as we shall presently see, the relative frequency of winter and spring explosions varies in the same place in different series of years. Chart III. represents the monthly distribution of cases of measles in Edinburgh for ten years. It conveys the impression that the disease occurs continuously all through the year, with two maxima, in April and December respectively, and two minima, falling the one in September, the other in January. But if we look at Chart IV., representing five of the ten years, it will be seen that distinct epidemics occur either in spring or in the late autumn or winter. This seasonal incidence of the disease (and it is the same in small-pox) is observed all over the world, in North America as in Europe, and at corresponding seasons in the southern hemispheres.

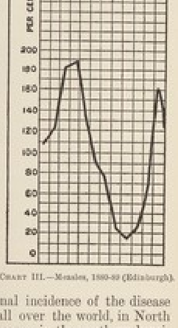

CHART III.—Measles, 1880-89 (Edinburgh).

The explanation of the epidemic prevalence of measles and small-pox in winter and spring is not to be sought for in the action of meteorological influences on their contagia, but in the effect of season on the susceptibility of the body generally, or on the vulnerability of the upper air-passages. The winter increase of small-pox all over the world coincides with the first notable fall in the temperature. It occurs in October in London and New York, in November and December in India, and at corresponding seasons in the southern hemisphere. In London small-pox and measles begin to increase in the fortieth, and bronchitis in the forty-first week. From this we infer that the same climatic conditions which determine respiratory affections also favour the infection of measles and small-pox. The change from winter to spring once more upsets the physiological balance, and the great vicissitudes of temperature peculiar to this season render the system more susceptible to the infection. This explanation is in harmony with what we know of the action of climate in determining the seasonal prevalence of diseases

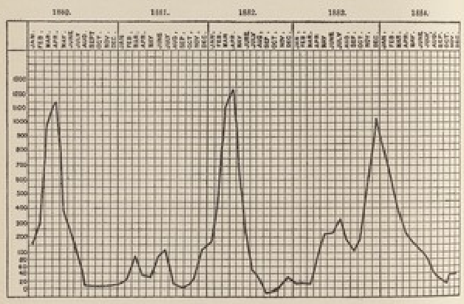

Chart IV.—Monthly intimations of Measles (Edinburgh) for the several years 1880-84. (Littlejohn.)

due to non-obligatory parasites. Climate in this case acts by preparing the soil for their growth. It is the same in the case of the obligatory parasites. The soil of the obligatory parasite is the human body, and climatic conditions which render the body more suited for its reception and growth at one season than another determine its seasonal prevalence.

An important peculiarity in the seasonal fluctuations of small-pox and measles is that the mildness or severity of an epidemy has the effect of changing its seasonal incidence. It will be seen from Chart V. that mild epidemies of measles fall on the fourth quarter, and severe ones on the second quarter.

A somewhat similar change takes place in the seasonal prevalence of small-pox, as will be seen from Chart VI., the maximum in epidemic years being transferred from the first to the second quarter.

It would appear that virulent waves both of measles and small-pox occur most frequently in spring, but how this should be the case has still to be discovered.

The seasonal movements of whooping-cough are different from those of small-pox and measles. In Europe generally, this disease is most prevalent in the first or second quarter, in the United States in the third quarter.

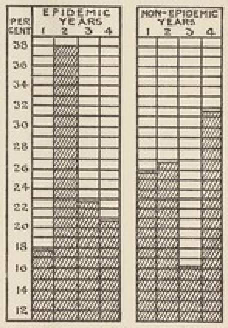

Chart V.—Quarterly incidence of Measles (London) in epidemic and non-epidemic years.

Influenza is so erratic in its visitations that there is little time to study its seasonal evolution in any particular locality. It has been thought by some that its prevalence is unaffected by season. This is a mistake. A very full record of epidemies of influenza has been compiled by Hirsch. It will be found from a study of these that epidemies of influenza for the most part begin in winter, but as they spread they appear in a particular country earlier or later in the year, according to their distance from their point of origin. Of 14 Russian epidemies that spread to other parts of Europe, 11 began from November to January. Of 240 outbreaks in different regions in the northern hemisphere 84 occurred in the first, 45 in the second, 46 in the third, and 67 in the fourth quarter. We are justified, then, in classing influenza among diseases of the cold season, although it often spreads in the warmest weather. Dengue, which some have thought to be a form of influenza, differs essentially in its seasonal characters. It is not only a disease of warm countries but of the warm season. It is most prevalent in summer and early autumn.

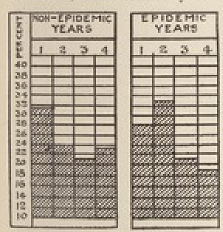

Chart VI.—Quarterly incidence of Small-pox (London) in non-epidemic and epidemic years.

The seasonal fluctuations of malaria, from what is known of its causation, may be inferred to be closely connected with the seasonal activity of the insects in which the parasite develops; but this requires further investigation. In the meantime it is to be noted that malarial fevers begin to increase in Northern and Central Europe in February, and attain their maximum in April and May, a season when insects of the mosquito species are little in evidence.

The laws regulating the seasonal fluctuations of epidemic diseases may be thus stated: Diseases of the infectious group are most prevalent in the seasons when the climatic conditions favour the saprophytic growth of their organisms. The seasonal fluctuations of the contagious group are determined by meteorological influences predisposing the body to infection. Both of these factors are in operation in regulating the seasonal movements of diseases belonging to the contagious-infectious group.

V. Oscillations.—The evolution of an epidemy is marked by minor and major oscillations. Small explosions at irregular intervals of days are doubtless caused by a spark of the infection falling accidentally upon an accumulation of combustible material. The major oscillations are more regular, and have been shown by Ransome to correspond to a large extent in places so far apart as London and Manchester. They appear to be caused by weather.

The Law of Anticipation.—Sydenham remarked that "if fevers, continued or intermittent, appear unnaturally early, the season that follows will be exceedingly favourable to the development of epidemics." We have satisfied ourselves that this law holds good as respects intermittent fevers in India. In years when malarial fevers are epidemic they invariably begin to increase before their usual period. But this law is of much wider application. An anticipation in the usual period of rise is observed in the case of most contagious diseases in this country in epidemic years. The rise in scarlet fever, for example, begins a month earlier in years when it is epidemic than in non-epidemic years. This is a point of considerable practical importance, inasmuch as when a rise is observed in the cases or deaths from any of these diseases at the period when they are usually at their minimum, precautions should be taken against an impending outbreak.

Associations and Antagonisms of Epidemic Diseases.—The physician who attended John Evelyn for small-pox in Geneva in 1646 justified his having bled his patient before the appearance of the eruption by saying that but for the bleeding the distemper would have turned to plague or spotted fever. Few doubted at that time that diseases so widely different as plague, small-pox, and spotted fever could be converted one into the other, under changing constitutions of the atmosphere, or as a result of treatment.

It was another common belief in the Middle Ages, supposed to be supported by observation, that an unusual prevalence of small-pox, measles, spotted fevers, or agues heralded an outbreak of plague. Concoregio (1438) says: "Multiplicantur autem præcipue variolæ, et sic ad experientiam visum est, in anno, qui præcedit pestilentiam futuram de proximo. Et est tanquam signum prognosticum ejus, quando ultra consuetum veniunt." In the same way Bacon affirms that "the lesser infections of small-pox, purple fever, and agues in the preceding summer, hovering all winter, do portend a great pestilence in the following summer." Spotted fevers of unwonted malignity preceded the outbreaks of plague in London in 1625 and 1665, the plague of Nimeguen in 1636, that of Naples in 1656, and of Moscow in 1771; but it must be remembered that spotted fevers and agues were then so common that one or other was almost sure to precede any outbreak of plague.

We have already alluded to Haeser's doctrine, founded, as he believes, on historical evidence, that the exanthemata, diphtheria, and dysentery prevail together for a long series of years, and then give place to the typhus class of maladies. The scattered records of disease before the registration era form, we think, an insecure basis for this deduction.

Since registration began in England we have had four groups of years marked by an extraordinary prevalence of small-pox, scarlet fever, and measles, and, curiously enough, these were on each occasion—contrary to Haeser's doctrine—associated with typhus. These periods were 1838-40, 1847-48, 1862-64, and 1869-72. The first three of these periods were times of much distress, which may explain the prevalence of typhus, but the considerable recrudescence of the disease, which took place in 1869-71, cannot be so accounted for. The great prevalence of small-pox, scarlet fever, and measles in these years seems to point to some atmospheric conditions which favoured their spread.

Sydenham held that as one nail drives out another, so one epidemic disease displaces another; but experience proves that two or more epidemic maladies, affecting the same or different age-periods, may prevail in the same place and at the same time. Witness the frequent association of epidemies of typhus and small-pox, of typhus and dysentery, of diphtheria and scarlet fever and measles. Nor does an epidemic disease extinguish for the time common forms of sickness, as some have asserted. Thucydides remarked that the year in which the plague raged in Athens was notably free from other diseases; and Sydenham says that the year of the great plague of London was in other respects healthy, "so that all who kept clear of the plague never were better than then." When a large portion of a population is carried off by a plague, fewer are left to die of other diseases. Plague may also prevail in an otherwise healthy year, but there is no proof that the existence of a plague suppresses other maladies.

One or two instances of apparent antagonism between epidemic diseases must be admitted, although they cannot be explained. When epidemic malaria overran New England from 1864 to 1884, it was noticed that as the malarial wave advanced in Connecticut typhoid fever receded. From causing four or five hundred deaths in a year, it so decreased in prevalence that in one of the malarious years the deaths from typhoid fever fell to one hundred and fifty-nine. As malaria disappeared typhoid fever came once more to the front. It has also been observed in some instances that epidemics of malarial fever have suddenly ceased when cholera appeared. But the reverse has also been observed. It is recorded that intermittent fever disappeared entirely from Marienwerder (where it was previously epidemic) on the cessation of cholera in 1831, and only reappeared with the return of cholera in 1849. It did not, however, disappear along with the cholera as before, but remained the predominating sickness in that locality until 1856, when it again diminished in frequency (Hirsch). We have no satisfactory explanation to offer of these strange associations and antagonisms.

Evolution and Involution of an Epidemy.—On examining the course of the great epidemy of small-pox in England and Wales in 1837-39, Farr found that the deaths in the first two quarters of its progress increased at a uniform rate of 30 per cent. From the third to the fourth quarter, the increase was only 6 per cent, after which the numbers for a short time remained stationary, like a projectile at the summit of its curve. The deaths then decreased through six quarterly periods at successive ratios of 5, 10, 15, 20, 26, and 31 per cent. Vague notions have been, and are, entertained that some such law will be found to apply to all contagious diseases. It has been conceived that an epidemy, like a projectile, describes a definite trajectory, so that, given the ratios of increase at two points in its course, its further progress could be calculated.

The evolution of an epidemy follows no fixed law. Indeed, the ratios of increase and decrease of the *same* disease differ in different outbreaks in the *same* locality. That this must necessarily be the case will be evident if we reflect that the course of an epidemy—say of small-pox or measles—depends on a number of factors that are never present and operative in the same degree in any two outbreaks. These factors are: (*a*) the spreading-power of the virus, which is a variable quantity; (*b*) the number of centres from which the epidemy starts; (*c*) the facilities for the spread of the contagion, dependent on the number of the susceptible, their aggregation, and the degree of intercourse among them; (*d*) the seasonal influences, which accelerate or retard its spread. The last-named factor has an important effect on the ratio of increase. Scarlet fever, for example, is normally at its minimum in the second quarter. During an epidemy, the deaths in the second quarter, it is true, exceed those in the first, but the rate of increase during that quarter is invariably slowed by inhibiting seasonal influences.

These considerations would lead us to anticipate considerable diversities in the evolution of the same disease. But every epidemy of a contagious disease in a large community has, nevertheless, its period of rise, its fastigium, and its period of decline. Normally the ratio of increase is an accelerating one up to a certain point, when it becomes retarded, and the rate of increase in the number of attacks then becomes less and less until the fastigium is reached. The decline now commences. At the beginning it is slow, then it proceeds more or less rapidly for a time, and slows down again, as the disease approaches its sporadic level.

How are we to account for these stages? We can readily understand that, once an epidemy has been set a-going, it will advance more and more rapidly as the contagium becomes more and more multiplied and diffused. As the numbers of the susceptible decrease and their density diminishes, an arrest of the rate of spread will take place, and at a certain point the tide must turn, and the number of attacks become fewer and fewer until the outbreak subsides. Does this mechanical theory of numbers and density account for the trajectory described by an epidemy? The retardation in the rate of spread is not to be accounted for solely by the reduction in the actual number of the susceptible, for the number attacked subsequent to the slowing of the ratio of increase is greater than that up to the point when the retardation begins. But the diminished density of the susceptible has to be taken into account; for although the thinning process is in operation from the beginning of an epidemy, and is to some extent counteracted by the increasing diffusion of the contagium, yet when it has reached a certain point the diminished density must have an effect in slowing the rate at which attacks proceed. Other factors modify the course of an epidemy, but the governing factors are the numbers and density of the susceptible, and, as has already been said, many who have not passed through the disease may acquire a temporary insusceptibility. But the question here arises, Does the infective agent undergo changes of virulence during the progress of an epidemy?

The case-mortality varies according to the different phases of an epidemy, as will be seen from the following figures, which give the number of cases of measles, the deaths, and the percentage of deaths to cases in thirteen four-weekly periods, based on the Hamburg returns for the sixteen years 1879-94. The deaths in one period are credited to the cases in the preceding period :—

Four-Weekly Periods.

	1.	2.	3.	4.	5.	6.	7.
Cases . . .	4017	3568	3525	3564	6888	10,721	9284
Deaths . . .	166	136	180	255	444	508	256
Percentages . .	4·1	3·9	5·1	7·2	6·4	4·7	2·8

	8.	9.	10.	11.	12.	13.
Cases	4695	2382	2637	4094	5638	5359
Deaths	166	101	156	205	213	167
Percentages	3·5	4·2	5·9	5·0	3·8	3·1

The case-mortality will be seen to rise in the third period, when the cases are at their minimum. A further rise occurs in the fourth period, when the increase in prevalence has begun, but is still insignificant. With the first epidemic bound, in the fifth period, the case-mortality begins to fall, and continues falling rapidly as the epidemy attains and passes its fastigium in the sixth and seventh periods. A reverse movement then sets in, and the case-mortality rises until the minimum prevalence is reached in the ninth period. As the winter epidemic extension begins in the tenth period, the case-mortality shows a further rise, but no sooner does the disease become widely prevalent than the case-mortality again begins to fall. In short, the virulence of the disease, measured by the case-mortality, appears to bear throughout pretty much an inverse relation to its diffusion.

Now the question arises, is the increase and decrease of the virulence of the contagium a cause or a consequence of the increase and decrease of prevalence in the varying phases of an epidemy? It must be remembered that virulence and

spreading-power are not necessarily related, for the case-mortality is often low in rapidly and widely-spreading epidemies. Besides, a diminished case-mortality may mean either an increased killing power of the virus, or an increased resistance on the part of those attacked, so that fewer succumb to the disease. Upon the whole, it appears probable that the case-mortality becomes lower as a consequence of the wider diffusion of the disease. The question how this occurs cannot be fully discussed here.

There is a tendency at the present day to refer the evolution and involution of epidemies exclusively to changes in the virulence of the contagium. It is assumed that at the outset of an epidemy only the more susceptible are attacked, and that in passing through these the virus gains in intensity and spreading-power. The turn of the less susceptible then comes, in passing through whom the virus becomes attenuated. The virulence of a germ is undoubtedly exalted or attenuated according as it is cultivated in susceptible or resistant bodies, but it is not so obvious why the virus at the early stage of an epidemy, when it is by no means deficient in potency, should select only the more susceptible for attack. It is more probable that the wide diffusion of the virus in a community increases the resistance of the susceptible, and thus brings about an attenuation of the microbe.

The decrease in the virulence of the contagium (granting that the decreased case-mortality indicates a decreased virulence) may be brought about in other ways than by merely passing through more resistant subjects. When the contagium, for example, is widely diffused, it is reasonable to suppose that the infection is, in many cases, propagated by fomites. The virus, subjected for a varying time to the influence of light and air, will become attenuated, and thus give rise to a milder type of the disease.

The course of an epidemy of one of the infectious diseases is much more uncertain and irregular than that of a contagious disease. Its outbreak, extent, fluctuations, and duration are largely dependent on circumstances that are variable and contingent, such as the sanitary state of a town into which the infection is introduced, the water-supply, and such like.

An accidental contamination of milk or water by the virus of cholera, scarlet fever, or enteric fever often gives rise to a sudden outburst, which rapidly subsides if the contamination is not renewed. No distinct periods of rise, fastigium, and decline are to be looked for in explosions of this kind. They present the characters of a wholesale poisoning rather than those of an epidemy. Further, when an infectious disease assumes an epidemic character, its course may be modified or arrested at any stage by a change in the weather unfavourable to the saprophytic growth of the virus, as in the case of yellow fever, or from the virus being deprived of its vehicle of diffusion, as when, during an outbreak of cholera, an infected water-supply is closed.

Another circumstance which contributes to make the evolution of epidemics of infectious diseases irregular is the great variability in the virulence of their contagia. A cholera outbreak may run the whole or a part of its course as a severe diarrhœa. Enteric fever may present itself under the guise of a febrile gastro-intestinal catarrh. Plague in the course of a single epidemy may assume different forms with varying diffusive powers. All these circumstances cause the greatest differences in the course of an epidemy of an infectious disease at a particular time and in a given locality. But if we take the course of an outbreak in a whole country for a limited period, or in a given locality, over a number of years, these irregularities disappear, and the epidemic evolution of an infectious disease will be found, on the large scale and in the long run, to be governed by the conditions which promote or hinder the saprophytic growth of the contagium.

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REPORT

ON

HORSE BREEDING IN FRANCE.

BY

VETERINARY-MAJOR MATTHEWS,
Royal Horse Guards.

1893.

INTELLIGENCE DIVISION, WAR OFFICE.

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1893.

Report on Horse Breeding in France.

Haras and Remounts of France.

Origin of haras.

The haras date their origin from feudal times, when the barons kept large establishments of brood mares and stallions for the production of the war horse. Since the crusades, Arab stallions of high caste have been almost continuously imported. The decimation of the French nobility at Crécy and Agincourt, as well as the ruin involved by the disastrous wars during the reign of Charles VI., caused horse breeding to be neglected. Under Louis XI. the lords of the manor kept stallions and mares, rearing a large number of horses. As, however, power passed from the hands of the barons to the Crown, the maintenance of their haras was no longer a personal obligation, and when Cardinal Richlieu finally destroyed their authority, they abandoned their lands, and drew nearer the court. Committed to the care of stewards, these establishments declined, and with them the renowned breed of war horse. In the reign of Louis XIII. the troops were paid and cavalry mounted at the expense of the king. No authentic documents exist to show what became of the haras at this period, and the difficulties of the "remount" experienced by the king were increased under Louis XIV., who realized the necessity for instituting State haras.

Institution of State haras.

By a Decree of Council, 18th October, 1665, stallions purchased abroad were distributed throughout the provinces of the realm. If the writings of the time are to be relied on the haras were scarcely as successful as could be desired, a fate often attending newly-started institutions. Other decrees completed the measures taken by Colbert, their founder. These State efforts, made under Louis XIV., produced good results, quaintly attributed by one writer to the exertions made by the courtezans from their anxiousness to please the king, and no less to the remunerative results of horse breeding. The resources thus created were depleted by continual war, and the difficulty in remounting during the war 1688-1700 caused a hundred million in specie to be spent out of the country, and it was not till 1717 that material improvement took place, under the regency of the Duke of Orleans, who, having seen the difficulty of procuring horses, directed attention to the haras which had been neglected during the war.

Haras of Pin and Pompadour.

The haras of Pin, in Normandy, and of Pompadour in Limousin, did good work, and the sale of their produce contributed a good deal towards their cost.

Directorate of haras.

From 1764 to 1789 the administration of the haras was confided to four directors.

The Minister of War controlled the frontier provinces. The Minister of the Privy Purse had 20 généralités* of the interior under him. M. Polignac had the province of the south; while the généralités of Rouen, Caen, Alençon, Limoges and Riom were united under the Master of the Horse, who also controlled the haras of Pin and Pompadour.

Except these, the haras in the rest of France were managed by the intendants, and, as might have been foreseen, such divided responsibility resulted in various systems, some of which retarded improvement. The best results were obtained from those directed by the Master of the Horse, which furnished hunters, harness, and riding-school horses, as well as the military establishments of the king.

Change of directorate (1806).

With the reinstitution of the haras in 1806 advantage was taken of the lessons taught by experience, and the direction of the haras was given to the Minister of the Interior, which besides being an economy, produced uniformity. But dependent on politics the change of administration was frequent, and measures adopted by one were too often entirely changed by the successor, which resulted in the loss of time and money.

Effect of the invasion of 1815 on haras.

The haras were put to a severe test as to their capacity for production by the invasion of 1815, which arrested their improvements and necessitated a reconstruction in 1816, still under the Minister of the Interior. In 1829 a new attempt at improvement was made, and a commission, presided over by the Duke Escars, appointed to investigate the horse breeding of the country, make known its needs, and the means necessary to produce them. But the expedition to Algiers took away the president, and subsequent events prevented it completing its labours. The reduction of the money voted at this time somewhat crippled the haras, nevertheless in 1834 the use of English thoroughbred horses was decided on to improve the breed of the heavier classes, as their blood had already improved the lighter ones, though the theory of the superiority of the English thoroughbred was received with doubt and reluctance by the breeders. After a brilliant period the haras again became the subject of discussion in 1848, and were restricted in their sphere of action by the Decree of 1852. Large importations of horses have been made from time to time, as fashion dictated, from Germany, from England, or from Hungary; in the present day these wholesale importations are discouraged.

Introduction of roaring into Normandy.

It is noted in the records of the haras that in 1764 numbers of stallions were bought in Holstein which produced indifferent stock, and French breeders assert that roaring was introduced into the Norman breed by them.

Importation of English horses.

In 1784, Prince de Lambesc imported 20 English hunter and harness sires, but using the best mares to mount the establishment of the king, only employed the broken-down and worn-out mares for breeding; but for the revolution, 1789, he would have increased the number of English brood mares at the haras.

* Districts or circuits.

Change of control retarding improvement.

The progress or improvement of breeding was hindered by the difference of opinions held by those who so quickly succeeded one another in their control, and the revolution caused the sale of the stallions. The selected mares were requisitioned for the army, and at length the sale of the pastures deprived the country of resources accumulated during a century. This state of things lasted 25 years, when Napoleon, feeling, as did Louis XIV., the need of a good breed of horses to supply the military and commercial requirements of the country, imported in 1814 a large number of English mares and stallions; at the same time causing the English system of management to be adopted.

Haras under Napoleon.

Haras of Pin.

The haras of Pin, founded shortly after the death of Louis XIV., was formerly known as Haras d'Hiemes or d'Exmes. Its grounds extended a league and a half in length and $\frac{3}{4}$ league in breadth. The stables were built in 1714, and the chateau in 1735; its products were excellent, and the five departments L'Orne, L'Eure, La Calvados, La Seine Inférieure and La Manche produced from 1,500 to 1,800 horses annually, at an average price of 600 francs (24*l*.). The greater number being reared in the neighbourhood of Alençon (Orne). These were used in the royal stud, the military establishment of the king, and by cavalry of all arms. The haras also supplied stallions for other parts of France.

Haras stallions before the revolution.

The royal haras, in Normandy and Limousin, possessed before the revolution 80 to 90 stallions, half Norman and half foreign, covering 2,000 to 2,400 mares annually.

Deprived of their pastures, which were sold in the first three years of the Republic, the haras became depôt for remounts.

Reinstitution by Napoleon.

In 1806 Napoleon repurchased all the buildings and pastures and established there 10 Norman stallions, 23 from Mecklembourg and Holstein, as well as some English mares, which, it is recorded, were not readily acclimatized, and their first foals were of little value.

In 1814, the haras mares and foals were sold for want of funds, and there were no mares till 1818, when it was determined to buy thorough and half-bred English and some Norman mares.

1830.

In 1830 the haras possessed 70 to 80 stallions, covering from 2,300 to 3,800 mares annually.

The revenue of the haras was from 58,000 to 60,000 francs per annum.

In 1852 the jumenterie was abolished, and the haras became what they have since remained, depôts for stallions.

School of haras at Pin.

The school of haras, inaugurated in 1840, was suppressed and not re-established till 1874, and at the present time has four pupils, who qualify, by a 12 months' course, for officers of the haras, as sous directeurs.

The foregoing gives a brief outline of the history of the haras. To-day they consist of depôts for the national stallions carefully selected with regard to conformation and soundness, and employed to cover at nominal fees the mares of private individuals. An exception to this rule is the experiment now being made at Pin, where six heavy Percheron mares are rearing foals by Arab sires, at present six months old, and symmetrical beyond expectation. This experiment is being made with a view to introducing some blood into this excellent breed as well as, if possible, to change its colour from grey, so as to render it more generally useful for military purposes.

Effect of American demand for heavy Percherons.

The large American demand during the past 10 years, and the enormous prices given, have led to the Percheron being produced only in its heaviest class, and there is now a great dearth of the lighter class, so well known as the Percheron "postier."

Amelioration of breed.

Efforts for improvement and cultivation of the breed can only be controlled or directed by the State on the sire's side, and hence the inducements which are held out for the amelioration of the mares. These consist of State premiums at concours, plates for trotting, flat races, and steeplechases, as well as the large annual demand for the army, which in peace amounts to between 7,000 and 8,000 horses.

The officers of the haras advise owners as to stallions most suitable for their mares, advice which is disregarded when owners desire to produce cart foals in view of their being more speedily marketable, regardless of the suitability of the dams.

Organization of Haras.

Organization of haras.

The administration of haras is composed of a director-general, 6 inspectors, and 22 directors of depôts, with an equal number of sous directors, veterinary surgeons, superintendents and palefreniers in the proportion required. The haras depôts number 22, sub-divided in the covering season, February to July, into 499 stations, distributed according to the equine population.

The establishment of brood mares (jumenterie) at Pompadour, in Limousin, is the only one belonging to the State.

The haras are under control of the Minister of Agriculture and Commerce.

Their utility has often been the subject of controversy though at present few think private enterprise would unaided be equal to the required production, as the holdings of agriculturists are too small to meet the demand unaided by the State.

The supporters of the haras, the breeders of coach horses, the dealers and competitors for premiums, assert that the attending improvement is considerable, whilst some assert that the frequent changes of system have lessened it. There is no disputing the fact, however, that haras depôts of Pin and St. Lo supply the Anglo-Norman trotter of to-day, such an important mainstay for many purposes, both military and commercial, though it is late in arriving at maturity, which is reached at six years.

English invasion.

What is termed the "English invasion" of horses took place in the sixties, but did not survive the opposition it encountered from breeders, who argued that the Crimean war had shown that the French troop horse were more hardy than the English, all of which they assert died.*

To-day the amelioration of their breed is effected by the Arab, Anglo-Arab, and the Anglo-Norman trotter; the latter has excellent travelling action, and thanks to the "trotting" blood, flexes both knees and hocks well.

Constitution of haras in 1887.

The following gives the constitution of French haras in 1887.

On 1st January, the effective of stallions was 2,514, composed as follows:—

Thoroughbred English horses	198	
" Arabs	125	
Anglo-Arabs	124	
	—	447
Half-bred (mostly Anglo-Norman) ..		1,765
Draught		302
Total		2,514

The effective prescribed by law is 2,500.

Of the half-bred stallions, 1,424 were of a light type, of which 407 were considered as three-quarters bred; 235 classed as coach horses, and 106 Norfolk trotters, bred in England or France.

During the year 1887, the losses by casting and death amounted to 262, or about 10 per cent. Only 25 deaths occurred, which affords evidence of the care bestowed on the horses.

Purchase of Arab stallions in Syria.

Six of the highest caste Arabs were purchased in Syria, as well as some Arab mares of pure blood. The stallions averaged 212*l.* 19*s.*; the mares 276*l.* (this includes travelling expenses of purchasers).

Effect of American demand on horse market.

It was noted in this year that officers buying stallions in France encountered brisk competition from the American buyers, whose purchases, hitherto confined to draught, now extended to other classes. Advantageous as this was to breeders, it caused an increased outlay on the part of the State to procure suitable horses.

Jumenterie of Pompadour.

The Jumenterie (brood mare establishment) at Pompadour, in Limousin, is composed of 60 mares for the production of pure bred Arabs, and Anglo-Arabs for sires.

On 1st January, the mares numbered 60, reduced during the year by casting and death to 39; 15 mares bought in Syria, and fillies bred in the establishment completed the number.

* The recorded death rate was actually 86 per cent.

The products of the jumenterie on 1st January, 1887, numbered—

Colts	35
Fillies	38
Total	73

There were foaled this year 20 colts and 20 fillies; died, 4 colts, and 3 fillies.

The Covering Season of 1887.

Covering season of 1887.

Showed an increase in number of mares served. The number of stallions employed was 2,460 in 652 stations.

In 1886 there were 2,474 stallions in 637 stations.

The following shows breed of stallion, and number of mares covered:—

			Mares.	Average of service.
Thoroughbred—				
English	190	434	7,445	39
Arab	124		4,848	39
Anglo-Arab	120		5,219	43
Half-bred		1,728	81,112	47
Draught		298	19,720	66
Total		2,460	118,344	48·00

Fees paid for stallions services.

The fees paid for use of stallions amounted to 815,544 francs (32,621*l.* 15*s.*).

Auxiliary stallions.

1,240 "approved" stallions belonging to private individuals, but licensed after examination by Government, covered 58,963 mares.

A third class, "authorized," usefully, but not absolutely, sound, supplied 176, covering 3,812 mares. The number of foals produced was 108,671.

Concours or Competition for Premiums

Concours.

Were six in number, designated "Concours régionaux hippiques," held at Rennes, Poitiers, Melun, Nevers, Grenoble, and Tulle, 798 were entered; 637 exhibited, and 333 premiumed.

The concours for brood mares, foals, and fillies, gave the following results:—

Description.	Number.	
	Entries.	Premiumed.
Brood mares	8,898	5,140
Three-year olds	4,099	2,219
Two-year olds	3,107	1,213
Yearlings	584	224
	16,688	8,796

The greatest importance is attached to the effect produced on horse breeding by the award of these premiums, both in keeping the animals in the country, and increasing the care bestowed on them while growing.

The endowment of these premiums amounted for the year 1887—

Amount of premiums.

	Francs.
Premiums given by the State ..	726,350
" " departments..	452,641
Total	1,178,991

(Or 47,199*l.* 14*s.*)

Races.

Races.

The races received an endowment of 6,949,310 francs from the following sources:—

Donors.	Flat Races.	Steeple Chases.	Trotting Races.
	Francs.	Francs.	Francs.
State	251,300	..	331,200
Departments	62,400	33,200	93,275
Societies (apart from their own meetings)..	439,000	303,900	7,000
Societies	2,485,750	1,991,855	268,145
Towns..	236,125	140,050	56,050
Various railways, agricultural shows, private individuals	140,750	68,400	40,910
	3,615,325	2,537,405	796,580
	£ = 144,613	£ 101,096 s. 4	£ 31,863 s. 4
	or a total of 277,572*l.* 8*s.*		

The number of race meetings was 545, and of plates, 2,936.

Stud Book.

Stud book.

The entries of thoroughbred brood mares were 2,822.
The following is a comparative statement of the breeds in—

	1887.	1886.
English	2,135	2,142
Anglo-Arab	505	468
Arabs	182	169

A stud-book of half-breds was proposed in 1886 to satisfy the demands of foreign buyers, notably Americans, who attach considerable importance to authentic records of breeding.

Exports and Imports.

The export movement commenced in 1884, more marked in 1885, became larger in 1887, surpassing by 24,306 head that of the imports, as follows:—

Description.	Imports.	Exports.	Difference in favour of Exports.
Entire horses	488	3,320	2,832
Geldings	7,187	18,255	11,068
Mares	1,122	8,865	7,742
Foals	1,415	4,078	2,663
	10,212	34,518	24,305

These figures are 20,977 higher than those recorded in 1884, and 10,925 higher than 1885.

Of the horses exported—

Belgium bought	11,000
Germany "	6,308
Italy "	5,000
Spain "	3,600
Switzerland "	3,528

America, the most important buyer of heavy draught horses took 3,000, at prices ranging from 6,000 to 8,000 francs each.

La Plata and Brazil purchased a number of half-bred stallions.

It was noted that though the total of prices was 31 million francs, the American demand was on the increase though now it has practically ceased; the breeds imported having been largely developed throughout America.

The causes of death and casting of haras stallions in 1887, were—

Deaths.

Lung disease	2
Abdominal	9
Hernial	3
Heart rupture	1
Apoplexy	1
Nervous affections	1
Arthritis	1
Melanosis	1
Farcy	1
Fractures	5
Total	25

Casting.

Roarers	73
Broken wind	24
Heart disease	1
Result of typhoid disease.. ..	5
Worn out, exhaustion, vice ..	59
Blemishes	19
Constitutional ophthalmia.. ..	2
Immobility	2
Rheumatism and paralysis .	3
Chronic lameness	8
Results of severe wounds.. ..	1
Sterility	15
Bad crib biters	10
Dangerous	5
Chronic laminitis	7
Hernia	1
Softening of spinal chord.. ..	1
Melanotic tumours	1
Total	237

Colours.

Of the stallions, 943 were bay; 233 bay-brown; 705 chestnut; 176 blacks; 380 greys; 60 roans; and the rest odd colours—piebald, white, &c.

The age of stallions on 31st December, 1887, was as follows:—

Age.	Number.
3-year olds..	17
4 "	200
5 "	241
6 "	244
7 "	188
8 "	157
9 "	164
10 "	173
11 "	228
12 "	180
13 "	161
14 "	139
15 years and over ..	433
Total	2,525

It is stated in "Le Monde Economique," 7th January, 1893, that about 7 million francs are expended annually in the maintenance of the haras and for the encouragement of horse breeding.

The annexed table shows the distribution of mares covered by national stallions, in the general circuits of inspection.*

Circuits of General Inspection.	Stallion Depôts.	Number.		Average.
		Stallions.	Mares covered.	
1st	Le Pin and Saint-Lo..	450	24,331	54
2nd	Augers, Blois, Cluny and Pompadour	404	19,426	48
3rd	Hennebout, Lamballe, La Roche-sur-Yon and Saintes	581	29,816	51
4th	Libourne, Pau, Tarbes, Gesse, and Villeneuve-sur-Lot..	364	15,895	44
5th	Annecy, Aurillac, Perpignan, Pyrenees (including Corsica), and Rodez	307	11,609	38
6th	Besançon, Compiègne, Rosieres and Montierender	354	17,267	49
		2,460	118,344	48·09

* *Vide* map at end.

181,119 mares were covered altogether by—

Total number of mares covered.

National stallions ..	118,344
Approved " ..	58,963
Authorized " ..	3,812

Approved stallions are those passed sound.

Authorized stallions are usefully so, but all must be free from roaring and ophthalmia.

In 1892 the effective of national stallions was 2,500, and a proposition was made and has since become law, that it should be increased to 3,000. The losses from death during the preceding year were 41, and by casting 256. Average 11·88 per cent.

307 stallions were purchased—

Thoroughbred English ..	18
" Arab ..	5
Anglo-Arab ..	19
Half-bred ..	198
Draught..	67

The totals of premiums awarded to stallions were—

Thoroughbred ..	800 at 2,000 francs.
Half-bred ..	500 " 1,000 "
Draught ..	300 " 500 "

Number of stallions examined.

The number of entire horses examined under the law for the surveillance of stallions, 1885, was 6,316. 6,106 were awarded diplomas, and 210 with ophthalmia or roarers were rejected.

Amount of premiums at

The amount of money given to encourage horse breeding at concours was 1,215,539 francs (48,621*l.*), of which the State gave 747,850 francs, and the departments 467,689 francs.

Percentage of Pari-mutuels.

A percentage is levied by the State on the Pari-mutuels at race meetings, and devoted to the amelioration of horse breeding.

The number of mares covered in 1891 by national stallions was 142,292, the amount of fees for service being 981,933 francs.

The "approved" stallions numbered 1,225, covering 66,330 mares.

Of authorized stallions there were 144 covering 6,767, mares.

The product of service being 126,536 foals.

Stud book for half-breds.

The French stud book for half-breds, decreed by law, 30th April, 1887, is divided into six sections, viz:—

Section Normande.
" Bretonne.
" Vendienne et Charentaise.
" du Midi.
" du Centre.
" du Nord et de l'Est.

Sections published.

The first two sections have been published, and the third (Vendienne and Charentaise) will appear this year.

Number of horses in France.

The equine population of France is estimated at 3,000,000, which gives approximately 90 horses for every 1,000 inhabitants.

In 1871	a census showed	3,170,841	horses.
„ 1878	„	2,919,342	„
„ 1879	„	3,096,241	„

Horse-districts of France.

The parts of the country which produce most horses are Normandy, the Pyrenees, Brittany, La Perche, and the centre (Auvergne and Limousin).

The Norman horses are good, but mature late, between six and seven years, and often blemish if put to hard work before that age.

The horses bred around Tarbes are light, good looking, and hardy.

Those of Auvergne and Limousin do well for light cavalry, but their legs are not tough.

For draught, L'Ardennais, Vosges, Meuse, and Haute Marne are hardy and active, while Le Perche produces the Percheron horse, of world-wide reputation.

Concours de dressage, Caen, 1893.

At the concours de dressage held at Caen, 15th and 16th February last, there was an excellent show of four-year olds, broken to harness, and representative of the highest class of general purpose horse produced in the district. They all had good travelling action, flexing knees, and hocks well. At least two first-class "Park" teams might have been obtained at prices ranging from 90*l.* to 125*l.* each. Mostly brown and dark bays, and standing from 15·3 to 16·1.

Horse fair, Caen, 1893.

The horse fair, in February, at Caen, gave a fair idea of the class of horse which comes into the public market, and brisk business was done. It was largely attended by foreign buyers, especially Italians, who seemed least exacting in their requirements, and they have, I am told, a theory that the Italian climate is beneficial for roaring, if true this should be welcome information to the owners of valuable horses, in all countries, thus affected.

Visit to Pin.

By the authorization of the Minister of Agriculture I was permitted to visit the ancient haras of Pin, where, in the school, pupils are trained to become officers of the haras. M. Ollivier, Director, very kindly allowed me the fullest opportunity of studying its constitution, and I am indebted to M. d'Agnel de Bourbon, Sous Directeur, for most courteously and fully instructing me in the system of the management of its school, and the general working arrangements of the haras.

St. Lo.

At the large haras depôt of St. Lo, in La Manche, M. Vambéry, Director, gave me similar facilities, and under the personal guidance of M. Bruneton, I became acquainted with the stallions used in that district, and acquired much information of the horse resources of the neighbourhood.

A magnificent range of stabling, with every improvement that modern sanitary science has devised, has just been completed to replace the old ones in the ancient Abbaye. I was not a little interested to find one of the most valued stallions in its class was out of a mare "Mon Étoile," which I had often ridden

as a small boy. Also to see Lance à Mort by Golba, out of Qui Vive, whose trotting record, 1 kilometre in 1 minute 26 seconds, is, I believe, unbeaten in France.

Rouen Bacqueville.

I visited the covering stations of Rouen and Bacqueville, in Seine-Inférieure, the same order and exactitude prevailed as at the haras depôt. At Bacqueville I was much impressed with the thorough knowledge possessed, and interest taken, by the townsmen in the pedigrees and performances of the national stallions.

I was shown some of the young horses already premiumed and others to be presented at the next concours. This interest clearly shows, I think, the powerful impetus State aid gives to local endeavours.

There is a difficulty in the cultivation of breed for required purposes, especially of the lighter class, in France, as there is in all countries, that is the mating of mares to suitable stallions. The State controls one, the owner the other, and though it is an especial duty of the haras and remount officers to educate and direct the breeder, I suspect that when dollars are in question argument is often vain. Yet the numerous and remunerative premiums for young stock, guide and lead where more arbitrary measures would fail, as they would drive the breeder to the, at least as profitable, pursuit of raising cattle or mules, and as much of the agricultural work is done with the former it vastly increases their utility.

In the management of national stallions great importance is attached to regular exercise, which is found to increase their fecundity and prolong their usefulness, as opposed to the old system of idleness.

The owners of mares covered are given a certificate of service, copy appended, and advertisement bill posted at all haras stations of the stallions employed, sets forth the conditions of service, copy also appended, with la consigne des palefreniers.

MINISTERE
DE
L'AGRICULTURE.

DIRECTION
DES HARAS.

CERTIFICAT
DE NAISSANCE
DE PRODUIT
D'ÉTALON NATIONAL

(Soumis à un droit de timbre de 60 centimes).

(Article 58 du règlement).

Modèle No. 26.

RÉPUBLIQUE FRANCAISE.

HARAS NATIONAUX.

Je soussigné, Directeur du
certifie qu'il résulte du certificat de saillie et de la déclaration en forme qui ont été déposés en mes mains que la jument nommée (*)

d'espèce de née en 18 , à , taille d'un mètre centimètres, robe tête jambes appartenant à domicilié à départe-ment d a été saillie en 18 par l'étalon national nommé

(*) Si c'est une Jument de pur sang, on en fera mention.

SIGNALEMENT.

Nom
Robe
Tête
Jambes

n° d'espèce , ne en 18 , à taille d'un mètre centimètres, robe tête jambes , appartenant au dépôt d'étalons d et qu'il en est résulté l poul dont le signalement est ci-contre, l quel poul est né à le

En foi de quoi j'ai signé et délivré le présent certificat.

A , le 189

DÉPÔT NATIONAL D'ÉTALONS DU PIN.

MONTE
DE 1893.

STATION DE ROUEN
(SEINE-INFÉRIEURE).

Les Éleveurs sont prévenus que la Station de Rouen sera composée comme il suit

Pour la Monte de 1893.

Noms des Étalons.	Espèces.	Origine.		Prix du saut.
		Père.	Mère.	
Sucre-D'orge	Pur-sang ..	Plutus ..	Virginie II.	30 fr. J^{ts} de P.-S.
Galant II. ..	Demi-sang..	Uriel ..	Faust ..	8 fr. J^{ts} de P.-S.
Jaguar III. ..	" ..	Lavater ..	Ministère ..	20 fr.
Tally Ho.. ..	" ..	Norfolk		20 fr.
Kaback	" ..	Dictateur ..	Centaure ..	10 fr.
Louvain	" ..	Follet ..	Dagobert ..	10 fr.
Picquigny ..	Trait ..	..	..	10 fr.
Pasteur	" ..	..	..	10 fr.
Gorom	" ..	..	..	10 fr.

NOTA.—La Revues réglementaires sont gratuites.

La Monte commencera le 10 février.
Elle sera terminée le 11 juillet (au soir).
La saillie aura lieu à 8 heures du matin et à 4 heures de l'après-midi.

AVIS IMPORTANT.

On rappelle aux Éleveurs qu'il ne sera plus délivré de Carte de Saillie par duplicata, et que toutes les Cartes relatant régulièrement la naissance d'un poulain devront être changées contre un Certificat d'origine dans l'année de la mise bas, c'est-à-dire avant 1er janvier de l'année qui suivra la naissance. Ils sont, en outre, prévenus que les palefreniers ont l'ordre formel de ne faire saillir leurs Étalons que deux fois par jour au plus, et même, conformément aux instructions ministérielles, plusieurs jeunes Étalons de la nouvelle Remonte ne seront donnés aux Juments qu'une fois par jour. Il en sera de même à l'égard de quelques autres Étalons pour lesquels cette mesure aura été reconnue nécessaire. Tout gagiste qui se permettrait d'enfreindre cette consigne serait renvoyé. MM. les Éleveurs sont priés de ne voir dans cette décision qu'une mesure prise complètement dans leur propre intérêt, puisque, si elle a pour but de préserver les Étalons d'une fatigue trop grande, elle aura pour résultat d'assurer leur fécondité.

Le Directeur,
A. OLLIVIER.

Prière est faite à M. le Maire de faire placarder immédiatement la présente affiche.

MINISTÈRE DE L'AGRICULTURE.

DÉPÔT NATIONAL D'ÉTALONS DU PIN.

CONSIGNE

DES

PALEFRENIERS EN MONTE.

DISPOSITIONS GÉNÉRALES.

Article Premier.

Le service des palefreniers chefs de station est, pendant la monte, un service de confiance.

Ils doivent redoubler de zèle et d'intelligence pour s'acquitter de leur fonctions.

Leur mission ne se borne pas seulement à veiller à la conservation et au bon entretien des étalons qui leur sont confiés ; ils ont aussi pour devoir de bien diriger les accouplements et les croisements, d'engager les éleveurs à mieux nourrir leurs produits et à les élever d'une manière plus rationnelle. Ils feront tous leurs efforts pour que les étalons soient employés avec discernement, tant sous le rapport de la quantité de juments à leur donner, que relativement aux diverses circonstances qui peuvent assurer la réussite des saillies. S'il arrivait que des étalons ne fussent pas suffisamment utilisés, ils en rechercheraient la cause afin d'en rendre compte au Directeur.

Article 2.

Les palefreniers devront avoir une conduite exemplaire dans leur station. Toute infraction à cette recommandation expresse serait sévèrement punie.

Ils n'oublieront pas qu'ils ont l'honneur de représenter l'administration des haras et qu'ils doivent, en toute circonstance, sauvegarder sa dignité.

Ils seront tenus de rapporter au dépôt un certificat de l'autorité locale, attestant leur bonne conduite.

Article 3.

Tout palefrenier qui se permettra de blâmer les étalons qui lui sont confiés ou ceux de toute autre station, encourra la punition la plus sévère.

Article 4.

Les palefreniers auront toujours en monte la même tenue qu'au haras. Ils ne porteront la blouse que pour les corvées et ne sortiront de leur station qu'en uniforme réglementaire et absolument complet.

Article 5.

Ils useront envers les éleveurs de toute le complaisance compatible avec le bien du service. La plus grande politesse leur est recommandée en toute circonstance.

Article 6.

Il y a dans chaque station un registre sur lequel les propriétaires peuvent consigner les plaintes qu'ils ont à formuler contre les gagistes.

Article 7.

Il est défendu aux palefreniers d'entretenir dans les stations, des poulets ou autres animaux de basse-cour.

Article 8.

Les palefreniers recevront à leur départ des affiches imprimées qui devront être collées et non clouées, dans l'endroit le plus apparent de l'écurie.

Article 9.

Les écuries de monte seront ouvertes au public, de 8 heures du matin à 5 heures du soir, excepté pendant les heures de pansage et de promenade. Il est interdit d'y fumer.

Article 10.

La plus stricte économie est recommandée pour toutes les parties du service.

Les dépenses pour ferrure, médicaments, soins aux hommes et aux chevaux et réparations d'objets de sellerie, seront seules admises et remboursées aux gagistes.

Dans les cas où elles seraient présentées dans des proportions inusitées, elles resteront à la charge du chef de station.

Article 11.

Les factures des fournisseurs devront être établies en double expédition. L'une d'elles libellée sur une feuille de papier timbré de 0 fr. 60, si la dépense dépasse 10 fr., sera acquittée.

D'après les lois des 13 brumaire an VII., et 23 août, 1871, tous les droits de timbre demeurent à la charge du fournisseur.

Article 12.

Les dépenses de même nature devront faire l'objet de mémoires séparés. Savoir :—

1° Soins et médicaments aux hommes.
2° Soins et médicaments aux chevaux.
3° Ferrure des étalons.
4° Réparations d'objets de sellerie.
5° Conduite des étalons.

Article 13.

Les palefreniers son responsables des effets de sellerie et de monte qu'ils emportent avec eux ; ils ne feront faire que les réparations absolument indispensables. Si un effet quelconque était confectionné sans autorisation, il resterait pour compte ; les gagistes paieraient aussi ceux que seraient perdus ou détériorés par leur faute.

Article 14.

Il est spécialement recommandé de ne pas laisser dans les cours de monte les colliers et entraves ; après la saillie, ces effets doivent être placés dans un endroit couvert.

Article 15.

Les couvertures et surfaix seront rangés et pliés avec soin lorsqu'ils ne seront pas en service. Ces objets ne sauraient être, dans aucun cas, detournés de leur destination spéciale. Les licols, selles et bridons seront astiqués avec soin et les aciers, tels que mors de bridons, étriers, etc., devront être passés à la gourmette.

Article 16.

Les chefs de station ont la franchise télégraphique pour les affaires de service avec le Directeur de la circonscription. (Circulaire sur le service des haras, de 1er juillet, 1875, à tous les directeurs de bureaux télégraphiques.)

SERVICE DE LA MONTE.

Article 17.

La monte aura lieu aux heures ci-après :—

Le matin à 8 heures.
Le soir à 4 heures.

Article 18.

Avant de faire saillir une jument, les palefreniers devront s'assurer qu'elle n'a aucune maladie contagieuse.

Article 19.

Sous aucun prétexte les pouliches de deux ans ne seront admises à la saillie.

Article 20.

Les palefreniers engageront les éleveurs à employer l'étalon le plus approprié à la jument, en lui indiquant les qualités à obtenir et les défauts à corriger.

Article 21.

Ils se serviront d'un bridon, à l'exclusion de tout mors cannelé or tordu, pour conduire l'étalon à la saillie, et ne négligeront aucune précaution pour ménager les jarrets de celui-ci, qui ne devra jamais reculer pour descendre de dessus la jument ; c'est cette dernière que l'on fera avancer quand le saut sera terminé.

Il est défendu d'employer, dans les stations, pour faire saillir les juments, d'autres moyens que ceux habituellement mis en usage au haras. Rentré à l'écurie, l'étalon qui vient de saillir, sera bouchonné et pansé.

Article 22.

Les juments seront présentées à l'étalon tous les 9 jours.

Article 23.

Il est expressément défendu aux palefreniers de réclamer une rétribution personnelle ou un pourboire quelconque pour la saillie, les revues ou les essais de juments conduites à la station.

Ils devront rester absolument étrangers à tout ce qui concerne la conduite, le logement, la nourriture et le pansage des juments qui sont présentées aux reproducteurs de l'État, ainsi qu'à toute entreprise particulière concernant le service de la monte.

ARTICLE 24.

Le prix de la saillie est exigible au premier saut, et la carte de saillie ne sera délivrée qu'après le paiement.

ARTICLE 25.

Tout palefrenier chef de station est responsable du prix des saillies. Il sera tenu d'en verser intégralement le montant dans la caisse du Receveur des Domaines à la fin de chaque mois, en lui présentant, à l'appui, les talons des cartes de saillies de chaque étalon, que ne seront jamais détachés de leurs couvertures.

Le récépissé qui lui sera délivré par cet agent n'est pas soumis au droit de timbre, en vertu de l'article 16 de la loi du 13 brumaire an VII. Conformément aux instructions contenues dans les circulaires ministérelles en date des 11 avril et 6 mai, 1862, les palefreniers chefs de station sont autorisés à conserver, sur l'argent reçu pour prix des saillies effectuées, une somme d'argent suffisante pour le paiement de leurs gages et des diverses dépenses faites pour le service de l'administration.

ARTICLE 26.

Les saillies seront jour par jour portées sans rature, grattage ni surcharge sur les talons. Les revues seront exactement mentionnées sur les talons ainsi que sur la carte. En sus de ces renseignements, les chefs de station indiqueront, aussi bien que possible, au verso de chaque talon de carte, la conformation, les antécédents et les allures des juments présentées à la saillie. Ils devront consigner avec une attention spéciale les origines qui ne seront inscrites que sur la présentation du certificat de naissance.

ARTICLE 27.

Une jument saillie par un étalon de Pur-Sang ne pourra être revue par un étalon de Demi-Sang, et *vice versa*.

ARTICLE 28.

Les jeunes et les vieux étalons ne sailliront qu'une fois par jour. Dans aucun cas ils ne pourront donner de revues.

Il est également interdit de faire donner des revues par d'autres étalons que par ceux désignés pas le Directeur.

ARTICLE 29.

MM. les éleveurs sont prévenus que les palefreniers ont l'ordre formel de ne faire saillir leurs étalons que deux fois par

jour au plus. Tout gagiste qui se permettrait d'enfreindre cette consigne serait renvoyé.

Le directeur ne croit pas devoir insister sur l'utilité de cette mesure qui a pour but de préserver les étalons d'une trop grande fatigue et surtout d'assurer leur fécondité.

ARTICLE 30.

Sous aucun prétexte les chefs de station ne pourront dépasser le nombre de juments assigné à chaque cheval.

Toute infraction à ces dispositions entraînera le renvoi du palefrenier.

ARTICLE 31.

Les palefreniers devront apporter des renseignements complets et exacts sur les résultats de la monte précédente.

ARTICLE 32.

Les chefs de station tiendront leurs écritures constamment à jour et en règle ; ils indiqueront, sur un registre ouvert à cet effet, la date assignée à chaque propriétaire.

ARTICLE 33.

Lorsqu'une jument placée en dépôt par le ministre de la guerre chez un cultivateur sera amenée à la saillie, les palefreniers chefs de station devront exiger du détenteur le procès-verbal de livraison et insérer sur la carte de saillie le numéro matricule de la jument ainsi que l'arme d'où elle sort.

RÉGIME DES ÉTALONS.

ARTICLE 34.

Le soins à donner aux étalons attireront d'une manière spéciale l'attention des palefreniers.

Le service intérieur de la station devra se faire avec la même exactitude qu'au dépôt et conformement au règlement affiché dans chaque écurie de monte.

ARTICLE 35.

Dans les stations où le service est fait par plusieurs gagistes, il y aura jour et nuit l'un d'eux pour faire la garde. Il ne pourra, sous aucun prétexte, s'abstener de l'écurie et y prendra ses repas. Dans les autres stations, le palefrenier couchera toujours dans l'écurie. Il ne s'absentera pendant le jour que pour les affaires du service et pour peu de temps.

ARTICLE 36.

Les palefreniers veilleront à ce que écuries soient entretenues dans le plus grand état de propreté ; les fumiers ne devront pas y séjourner. La litière sera constamment sous les chevaux et l'ordre le plus parfait sera observé dans le placement des ustensiles d'écurie, ainsi que dans celui des effets de sellerie.

Une tresse bordera pendant le jour la paille des stalles.

Article 37.

Les étalons seront promenés chaque jour aussi longtemps que possible et à une allure modérée, sur les routes les moins fréquentées et en dehors des heures de grande chaleur. Les terrains doux devront être choisis de préférence.

Sous aucun prétexte les palefreniers ne devront laisser monter leurs chevaux par des étrangers,

Article 38.

La saillie aura toujours lieu avant les repas ou deux heures après; on pourrait craindre de graves accidents si l'on menait les étalons à la saillie peu de temps après qu'ils on bu. Une heure et demie avant la monte l'avoine ou les mâches qui n'auraient pas été consommées seront enlevées des mangeoires.

Article 39.

Les étalons seront ferrés toutes les fois qu'ils en auront besoin. La ferrure étant neuve au moment du départ, il sera fait des relevés autant pue les fers le permettront; une économie bien comprise est spécialement recommandée sous ce rapport.

Article 40.

En cas de maladie ou d'accident d'un étalon, celui-ci sera mis à la diète et toute saillie sera suspendue. Le palefrenier appellera un vétérinaire et le Directeur sera informe immédiatement afin qu'il puisse prendre les mesures nécessaires.

Article 41.

L'eau destinée aux étalons devra toujours être puisée quelques heures avant de la donner.

Article 42.

Les palefreniers chefs de station sont responsables de la qualité des fourrages qu'ils reçoivent.

D'après les clauses du cahier des charges, le foin, la paille et l'avoine doivent être de la première qualité du département.

L'avoine sera livrée bien vannée, exempte de poussière et de corps étrangers et pèsera au moins 50 kilog. par hectolitre. Ils refuseront toutes les denrées qui ne seraient pas dans les

conditions voulues et en rendront compte au Directeur qui, en cas d'urgence, assurera la nourriture des étalons aux risques et périls de l'adjudicataire.

La prise de fourrages aura lieu à jours fixes et conformément à l'extrait de la feuille de consommation remise aux palefreniers.

Les chefs de station sont autorisés à modifier les rations assignées à leurs chevaux suivant la santé de ceux-ci et leurs besoins; mais ils ne peuvent, dans aucun cas, dépasser le maximum des rations déterminées pour chaque jour.

Les fourrages non consommée seront portés en économie et il en sera fait mention dans les lettres que la palefrenier est tenu d'adresser au Directeur le 1er et le 16 de chaque mois.

Article 43.

Les fumiers appartiennent aux propriétaires des écuries. Les palefreniers n'y ont aucun droit.

Le Directeur,
A. OLLIVIER.

Remounts

The system of remounting the French Army has varied according to circumstances during the last 100 years in the manner shown hereafter. Many of the facts and dates are quoted from its history, written by a distinguished French general, who truly says the actual result of any system can only be tested by war. The conclusion that he arrives at, viz., that the horse resources of the country were equal to the demands of the last war, is indeed strong evidence of their fertility, for it is estimated that as a result, with the changes that attended it, the horses in the country became reduced by a million; yet the census of 1879 showed this loss had been replenished, and the total number of horses in the country then exceeded 3,000,000.

Systems of procuring remounts.

Till the reign of Louis XIII. captains of troops (companies) provided the horses when the king undertook the cost, giving the regiments the money, and they bought as opportunity offered, either at home or abroad. Some regiments bought at two or three years, keeping them till fit for work.

During the revolution (1789) the production of horses was much lessened, and requirements increasing, they were provided as follows:—

1790. Regiments remounted themselves.

1791. Government supplied them through contractors and by requisitions.

1792 to 1795. With "France a vast camp" horses were absolutely necessary at any price, and were levied in all parts of the country, as foreign buying was impossible. The wholesale appropriation that resulted, inflicted a heavy blow on horse breeding.

Another striking proof of the excellence of their resources was their being able to supply unaided all demands till 1795, when recourse was had to general purchase abroad.

1800. These measures being abandoned the regiments again remounted themselves, by direct or general purchase.

1808. Government undertook the supply by general purchase.

1811. Regiments bought their own horses.

1812. Requisitions became necessary.

1816. Government resumed the supply.

1819. Establishment of first remount depôt, Caen.

1823. Regiments bought their own horses,

1825. Uniform system of purchase by remount department was adopted, this service being further organized and completed by Marshal Soult in 1831.

1840. Extensive purchases abroad in view of possible war.

1854. Crimean war. Institution of purchasing commissions, called "commissions éventuelles," for purchase from all vendors.

1859. Italian war. Adoption of same system, and subsequent establishment of a reserve of artillery horses, which were placed with the farmers.

1862. Division of remount depôts in three large circumscriptions.

1867. Large purchases of Hungarian horses.

1870. Purchase in France by commissions éventuelles and requisitions.

1872. Large purchase in England, America, and Austria.

1874. Modification of constitution of circumscriptions.

Commissions éventuelles.

1879. Institution of commissions éventuelles in army corps, where remount depôts did not exist.

1881. New distribution of remount depôts, and suppression of comités éventuelles.

Depôts of transition.

1882. Creation of depôts of transition where young horses are kept till old enough for work.

It is noted that during the years 1812, 1813, and 1814. France supplied her army with 60,000 horses, and 30,000 in 1815.

Defects of various systems of purchase.

The defects attributed to the system of supply by contractors, were the inferiority in class of the animal supplied

and the injury done to breeding, as they were purchased in the cheapest market at home or abroad.

The regimental purchase failed from the want of knowledge displayed by the buyers of the resources of the locality in which purchases were made, from want of uniformity in class of horses bought, some regiments being well, others badly mounted, according to the kind of horse in the district to which they had been assigned; and from the increase in market price, caused by several purchasers buying at the same place at the same time.

The system of purchasing very young horses failed from the losses that were caused by epizootic disease, and the difficulty of finding open spaces to provide them with sufficient range to ensure healthy growth and development. In 1833 horses were broken in at the depôts before being delivered to regiments, but the system was soon abandoned.

Remount department.

The remount department, which bought in 15 districts only, in 1831, had so increased in 1840 that it was buying in 56. Horses were bought only from the breeder, from the age of four to seven years, but this resulted in the unavoidable necessity of purchasing several thousand horses abroad to supply the demand of 1840. Many years later (1862) the system at present in force was authorized, viz., giving preference to the breeder, but also buying as necessity arose from all vendors. It may be noted that some breeders sought the assistance of the dealers in their transactions with Government. In 1879 the purchase of horses at 3½ years was ordered, and in 1882 animals bought at this age were kept in depôts of transition till 4½ years old, when they were sent to regiments, but not taken into hard work, *i.e.*, that of the more severe exercises, till six years old.

Supply of riding horses.

The supply of a sufficient number of suitable riding horses for the army has always been a serious difficulty in France, though at all times the supply of horses for draught has exceeded the demand, for it is more closely allied to the ordinary ones of commerce, including the requirements of the foreign buyers.

Cavalry squadrons always at war strength.

It is partly to overcome this difficulty that cavalry squadrons are during peace kept up to their war effective.

Hungarian cavalry reserve.

Baron Vaux, writing in 1887, says, "Hungary is the only country that has a reserve of trained cavalry horses distributed amongst the farmers, who have to give them up for manœuvres or war. After seven years, if they have been well cared for, they become their own property." He adds, "This system entails the maintenance of three horses for one used." Similar experience was gained in France with the artillery horse reserve, formed after the Italian war, the animals being found to lose their training for military work, and many were overworked, while their lessees employed their own mares for breeding.

Horses of gendarmerie as a reserve for war.

It was ordered at one period to mount the gendarmerie by requisition during war, and thus acquire a reserve of from 8,000 to 10,000 trained riding horses to replace losses in the field. But a more recent Decree appoints this force shall be be largely mounted on horses drafted from cavalry over 10 years of age, and unfit for fast work, which considerably nullifies the former intentions.

Condition of horse-breeding in Europe in 1887 (Baron Vaux.)

Baron Vaux thus describes the state of horse breeding in Europe in 1887:—

"There has been great progress in horse breeding during the last 20 years.

"Holland has created 'Le poney double ou grand cob," a marvellous creation considering the sloping quarters and drawn flanks of their breed. Hanover and Mecklembourg have produced carriage horses (carrossiers) more perfect in formation than the greater part of the English.

Prussian troop horse.

"At length Pomerania and Silesia have a hardy, well-formed breed, suitable for harness or saddle, a veritable war horse—this is the Prussian troop horse. Austro-Hungary, Russia, Italy, and Spain retain their primitive types, excellent for the most part, but with them breeding has never ceased to progress; it has quadrupled itself in Russia, tripled in Austro-Hungary, and doubled in Spain and Italy. England has remained stationary; and France has altered its best types and reduced its production." He writes:—"The old Duke of Wellington always kept ready signed two or three cheques for 2,000*l*., to aid newly-formed companies for the promotion of sport. For, he said, it is the school of the perfect sabreur; nothing should be saved on this score. Without hunting there will be no horse breeding; without hunting and breeding, no war-horse; without war-horse, no army."

Age at purchase.

Baron Vaux says "the horse resources of France are ample, provided purchases are made between three and four years of age." Clearly inferring that otherwise they will be absorbed by the other demands of the market. This is the same in all countries, as breeders decline to maintain at a loss for any special demand, that which has become marketable at its normal value. He adds "our remount department is the masterpiece of our generals for the last 60 years. Accepted by the military world as complete, the same system operates successfully in Russia, in Italy, in Spain, and in Germany, it has regenerated the breed of horses, and to it the Prussians owe the efficiency of their mounted branches to-day."

For the general service of remounts, continental France is divided into two regional circumscriptions, and one permanent inspection, sub-divided into 17 depôts as follows:—

Circumscription.	Depôts de Remontes.	Departments Explored.
First Circumscription (Caen.)	Caen	Calvados.
	St. Lô	La Manche.
	Alençon	Orne. Eure et Loire. Mayenne. Sarthe.
	Le Bec Hellouin and Annexe d'Eu	Eure (less the arrondisement of Senlis). Seine-Inférieure. Somme.
	Paris. Annexe — St. Cyr (Oise.)	Seine Loiret. Oise (Arrond. de Senlis). Seine et Marne. Seine et Oise. Yonne.
	Angers. Annexes—Beauvel, Montoire.	Loire-Inférieure. Maine et Loire. Indre et Loire. Loire et Cher.
	Guingamp. Annexe—Lesnevar.	Cotes du Nord. Finistère. Ille et Villaine. Morbihan.
Third Circumscription (Tarbes.) The second is suppressed.	Tarbes. Annexes—Bazet, Le Garros, Sarriac.	Hautes Pyrénеés. Ariège. Haute Garonne (Arrond. de St. Gaudens. Gers. Basses Pyrénеés.
	Agen. Annexes—Lastours, Lavergne, Eymet.	Pyrénées Orientales. Tarn. Tarn et Garonne. Lot et Goronne. Aude. Haute Garonne (less Arrond. de St. Gaudens).
	Mérignac. Annexes—Le Gibaud.	Gironde. Dordogne. Landes.
	Guéret. Annexes—Bellac Bonnavois, St. Junien.	Creuse. Cher. Indre. Haute Vienne.
	Aurillac..	Cantal. Aveyron. Corrèze. Loire. Haute Loire. Lot. Lozère. Puys de Dôme.

Circumscription.	Depôts de Remontes.	Departments Explored.
Permanent Inspection ..	Macon. Annexe—Romanèche.	Ain. Allier. Côte d'Or. Doubs. Jura. Nièvre. Rhone. Saone et Loire. Savoie. Haute Savoie.
	Fontenay le Comte ..	Vendée. Deux Sèvres. Vienne.
	Arles	Herault. Ardèche. Garde. Bouches du Rhône. Var. Alpes Maritimes. Basses Alpes. Vaucluse. Drôme. Isère.
	La Capelle. Annexe—Faverney.	Ardennes. Aube. Belfort. Marne. Haut Marne. Meuse. Meurthe et Moselle. Haute Saone. Vosges. Aisne. Nord. Pas de Calais.
	St. Jean d'Angély ..	Charente-Inférieure. Charente.

Many of the horses bought too young for work are placed with farmers till of the required age. The following is a list of the principal places which are termed

Annexes des Particuliers.

Annexes des particuliers.

St. Cyr.
Lys.
Le Busson.
La Brosse.
St. Ouenne.
Favarnay.
Beauval.
Romanèches.
La Vergne.
La Gibaude.
Bellac.

Lesnevar.
Bonnavoir.
St. Junien.
Eymet.
Le Garros.
Lastours.

Of the remount depôts in Normandy, viz., Caen, St. Lô, and Alençon, and the depôts of transition, Le Bec Hellouin, and Eu, which, by the permission of the Minister of War, I was allowed to visit, the most noticeable feature was the excellence of their arrangement, even to the minutest details, and I was much struck with the order that reigned, as well as the scrupulous attention bestowed on sanitation and ventilation, all of which literally fulfilled the official instructions as to the purpose of these depôts, viz.: "To receive horses from the vendors, and bestow on them the necessary care to enable them to pass progressively and without risk to the military régime."

Feeding with straw from rack.

Their system of feeding, as throughout the army, differs only from our own in the fact that they feed with the straw from the rack as well as the hay; that left uneaten becomes bedding.

Construction of stables.

All the Government stables I saw, including those of the 12th Chasseurs, at Rouen, and the 29th Dragoons, at Alençon, give a liberal cubic area to each horse, I should think about 1,400 cubic feet. Throughout their military stable management they are fully alive to the importance of ventilation, and the necessity for the rigid exclusion of draughts from sweating horses. The temperature of the troop stables was between 50 and 60 degrees Fah., when the thermometer was 8 or 10 degrees below freezing in the open.

Plank bails.

The swing planks or bails which are in general use to separate the horses are excellent, and have the great advantage of not blemishing "kickers." Of the 2,800 horses I saw in the military stables none had the enlargements, and few the capped hocks, so prevalent where iron bails are used.

The manes were not rubbed, as the manger wall is flush with its edge, so preventing this unsightly blemish. Their method of fastening horses in the stable, similar to that in use for stall cattle in this country, is noiseless, and is productive of quietude and rest in the stable, whereas one "weaver" will keep a whole stable awake with a log and chain, as one kicker will start half his neighbours where iron bails are used, hence the thick legs and capped hocks so common from this cause.

Clipping.

Clipping is not practised in the army, the only clipped horses I saw were detailed for special work or officers' chargers that are hunted. It may be noted that officers are encouraged in every way to hunt or paper-chase their chargers for the development of equitation.

Purchase by remount committee.

The system of purchase by remount committees is extremely searching, methodical, and absolutely free from argument on the part of the vendor.

The public notification which precedes the sale is given in the Appendix.

The horse submitted is examined for soundness, save for "vice redhibitoires," against which a guarantee is given. If passed it goes before the committee, who see it trot and walk, when each member makes a note on a slip of paper of what he considers its value, the vendor being asked his price, an average is struck, and if necessary the president (usually commandant of depôt) gives a casting vote, and the bargain concluded. Payment is made by an order on the local treasury, negotiable five days later. The horse is classed, then branded with remount number on one fore foot, and taken to a stable allotted to his class, but apart from previous purchases. Days are set apart exclusively for the breeders, or they can show their horses first on any buying day; afterwards the dealers' horses are brought forward. Often the "éleveur" avails himself of the dealers advice in trading.

At the seven buying days that I attended, the selection was on each occasion most careful. Defects of conformation or action being quickly noted and, if of sufficient importance, the horse rejected, and in all cases noted in descriptive sheet for inspection with the horses by the inspector-general, though not, I believe, sent to receiving corps.

I should estimate the purchases at about 40 per cent. of those offered.

The following gives the number bought, and the prices paid in a large depôt for one year:—

Class.	Number.	Average price.
		Francs.
Reserve chargers*	14	1,694
Dragoon "	167	1,236
Legère "	6	1,308
Carrière† "	6	2,121
Reserve troop horses	434	1,254
Dragoon "	632	1,052
Legère "	67	905
Horse Artillery	698	..
Field "	463	934
Total	2,487	1,029

* Cuirassiers. † Cavalry school at Saumur.

In 1890 the general effective of horses and mules was—

	Interior.	Africa.	Total.
Horses	49,542	10,647	60,229
Mares	48,714	172	48,886
Mules*	1,943	4,423	6,366

* Mules average in price, Poitou, 1,400 francs, light from 836 to 1,200.

Loss by death	1,604
Destroyed	573

Casting is materially reduced by drafting horses unfit for fast work, and over 10 years, to the train and gendarmerie.

The annual remount of a regiment having between 700 and 800 horses is from 70 to 80. Annual remount of a cavalry regiment.

The annual demand for the whole of the army varies from 7,000 to 8,000 horses, and has in peace been as high as 12,000.

Average service in the ranks, seven years.

When horses are bought in the district, men are detailed, in the proportion of one man to four horses, from the nearest regiment, to deliver them if of sufficient age to receiving corps, if not to remount depôts or annexes des particuliers.

I was much struck by the good class of Horse Artillery remounts I saw in the depôt at Caen, while the horses of the carrière or 1st class showed both bone and quality, and of these there were some excellent specimens at the remount depôt of St. Lo. As much as 100*l.* is paid for horses of this class, and I believe they average about 80*l.*

The horse shoeing in its general principles is identical with our own, and vastly improved throughout the army since I last saw it in 1879. The shoes are nearly all hand-made, it being fully recognized that the men need constant work to attain and maintain proficiency in their art. Horse shoeing.

Each horse has a set of store shoes fitted and marked, carried in shoe cases on saddle, and from three to five sets similary prepared and stored in magazine for service. Of the latter perhaps $\frac{3}{4}$ are the fer mécanique, or machine-made shoe, but the wear does not equal that of the hand-forged one. The only ancient custom I noticed was that of having two men to nail on instead of one.

The system of roughing for winter is still in the experimental stage in the artillery, where many kinds of screw pegs are being tried, but the cavalry use a square-headed screw peg in each heel. One trooper in five carries a wrench to clear the holes, and fasten them; and the foot bar of stirrup, which is hollowed out, is fitted with a crosspiece to act as a wrench in an emergency. Each trooper carries a few spare pegs. They are not removed on return to stable from work. Winter shoeing.

I have most gratefully to acknowledge the great courtesy and kindness I experienced from all the French officers, even in some cases at inconvenience to themselves, and to their patience and good nature I am indebted for many of the facts contained in the foregoing, and I have to thank Colonel Hon. R. Talbot, C.B., Military Attaché in Paris., for all the trouble he took on my behalf, as well as Mr. O'Neill and Major Leeson, Her Britannic Majesty's Consuls at Rouen and Caen, for the practical assistance they so willingly afforded me. In submitting this report I have endeavoured to make it useful to those who may have to pursue the subject further, and hope it may prove of use for reference, for as far as I know there is no pamphlet which deals with this subject in the English language.

HYDE PARK BARRACKS,
7th June, 1893.

APPENDIX.

MINISTERE DE LA GUERRE.

REMONTE GÉNÉRALE.

DÉPÔT DE CAEN.

Pour exécution des ordres de M. le Ministre de la Guerre, le Comité dudit Depôt se réunira pendant le mois de janvier 1893 :—

Le Mercredi 4	Bayeux	8 h. ½
Le Jeudi 5	Evrecy	midi ½
Le Samedi 7	Langannerie	9 h. ½
Le Mardi 10..	Tilly-sur-Seulles	9 h. ½
Le Jeudi 12..	Creully	midi ½
Le Samedi 14..	Mézidon	8 h.
	St. Pierre-sur-Dives	2 h. ½
Le Mardi 17..	Troarn	midi ½
Le Jeudi 19..	Villers-Bocage	9 h. ½
Le Samedi 21..	Trévières	9 h. ½
Le Mardi 24..	Douvres	midi ½
Le Jeudi 26..	Pont-L'évêque	2 h.

A CAEN,

Les 6, 9, 13, 16, 20, 23 et 27 janvier 1893,

A 8 heures du matin et à 1 heure du soir,

Pour procéder aux achats de chevaux ci-après :—

Chevaux de carrière .. .. Chevaux de tête de toutes armes Chevaux de réserve .. .. Chevaux de ligne .. .. Chevaux de légère .. .. Chevaux de batterie .. .. Chevaux de trait léger .. .. Chevaux de trait	de 4 ans	et de préférence de robe foncée.	Les Chevaux de trait devront être des animaux puissants, étoffés et pas trop lourds.

AVIS.

L'achat n'est définitif qu'après la visite à l'écurie du Dépôt.

En outre, indépendamment des vices rédhibitoires prévus par la loi du 2 août, 1884, tout vendeur qui livre un cheval au Comité du Dépôt de Caen, le garantit pour les cas spéciaux énoncés ci-dessous :

Affections des yeux ;
Cryptorchidie.

AVIS.

Pour les chevaux de 5 à 8 ans, présentés dans un bon état de conservation, et qui seront acceptés, le Comité tiendra compte, dans la fixation des prix, des qualités de résistance acquises par l'avoine, et du degré de préparation à la mise en service immédiate de l'animal,

Messieurs les vendeurs sont prévenus qu'ils auront à rembourser entre les mains du Président du Comité d'achat la valeur du timbre de dimension dont les facteures sont revêtues d'avance, et qu'ils devront se munir des timbres d'acquit de 0 fr. 10 centimes qui doivont être apposés sur les mêmes factures au moment de la vente.

En conformité des instructions de M. le Ministre de la Guerre, MM. les Maires sont priés de faire apposer ces affiches dans des lieux apparents et dans les gares, et de les porter à la connaissance des habitants des communes par des publications à son de caisse, les jours de foire et de marché.

A titre de renseignement pour MM. les Éleveurs, les localités suivantes seront visitées pendant le mois de février, 1893 :— Varaville, Vire, Lisieux, Caumont, Dozulé, Bretteville-sur-Laize, Falaise, Bretteville-l'Orgueilleuse, Thury-Harcourt, La Mine, La Cambe.

Les tournées étant plus particulièrement réservées aux Éleveurs du Calvados, ces derniers sont invités à présenter directement leurs produits à la Remonte.

Les achats au Dépôt et aux foires se font de toutes mains, sauf le vendredi, jour réservé aux Éleveurs.

MM. les Vendeurs sont invités à informer, par lettre, le Commandant du dépôt de l'importance des présentations qu'ils se proposent de faire.

Il n'est acheté, pour la Remonte de l'armée, que des chevaux hongres, entièrement guéris de la castration, et des juments, à l'exception de celles reconnues pleines.

Les chevaux sont pourvus, par les soins du vendeur lui-même, d'une ferrure et d'un licol en bon état.

Le vendeur aura à payer 2 francs par cheval acheté pour la renouvellement de la ferrure.

MM. les Vendeurs sont invités à présenter les Cartes d'origine

Caen, le 15 *decembre*, 1892.

Le Capitaine Commandant le Dépôt,
BAROUX.

Approvė :

Le Colonel Commandant la Circonscription,
BONN.

[350—10 | 93—H&S—(#264)—362wo]

SKETCH MAP OF FRANCE

Showing 6 General Inspections of Haras & 22 Stallion Depôts

Intell. Div. W.O. No. 1006.

Aug. 1893

With the Author's Compliments
For Library Table, Netley,
T. Longmore

SOME JOINT DISEASES

OF

THE HORSE

BY

VET.-CAPTAIN F. SMITH, F.R.C.V.S., F.I.C., Aldershot.

(*Reprinted from the Journal of Comparative Pathology and Therapeutics.*)

SOME JOINT DISEASES OF THE HORSE.

In the present article I purpose describing certain diseases of the joints of the horse of considerable practical interest.

Joint diseases may be divided into—1. Suppurative; 2. Non-suppurative. It is true that in places these at times overlap, that a non-suppurative in the first instance may later prove of a suppurative character, but though no hard and fast rule can be drawn, yet for practical purposes the division holds good. There is one rule, however, to which I know no exception—what may be described as specific joint diseases, viz., phalangeal and tarsal exostosis, and navicular disease, never under any circumstances take on a suppurative action, though why they do not when the articular ends of the bones are affected is difficult of explanation.

Suppurative Diseases.—Injuries which at the time or shortly afterwards open the joint.

Non-Suppurative Diseases.—Sprains, fractures within the joint, calcareous degeneration of the cartilage, absorption of cartilage, and specific joint diseases.

We may speak of these joint injuries as synovitis, arthritis, osteitis, or caries, but I think we are bound to recognise the fact that all the tissues of the joint are implicated more or less in the diseased action, of which perhaps the synovial membrane plays, in the first instance, the most important part; it would be better I think to speak of these cases as arthritis.

I propose to deal, in the first instance, with suppurative diseases of the joints. These are almost invariably due to injury, such as broken knees, brushing, punctured and contused wounds, etc. The great distinction between the causes mentioned is, that in the one case the joint is opened at once, and in the other case in the course of a few days; once opening has occurred, the ultimate issue is not affected thereby.

The constitutional and local disturbance is considerable, irritative fever runs high, the part is greatly swollen, and the patient suffers intense pain; the material which comes from the joint is in the first instance synovia, later synovia and pus, or turbid coagulated synovia, blood stained or not; the blood staining of the discharge is not, as a rule, present until near the termination of the case, and generally indicates that the bones are exposed and involved.

In cases where the wound over the joint does not immediately open the synovial sac, we have no discharge of importance for a few days, but during the whole of this time the joint is in a state of extreme distension due to the formation of pus or inflammatory fluid within it, and pointing may occur, either near the seat of the original injury or on the opposite side of the joint; we see this latter frequently in the fetlock, but rarely in other parts.

The most pressing features in the case are the irritative fever, the suffering, and the rapid loss of condition; when two joints are affected, as in the knees, the case may generally be regarded as nearly hopeless, and if the irritative fever does not kill, the animal is left with important joints so anchylosed as to be useless; where one joint is affected treatment may offer some prospect of success, though I must confess that in my experience such cases do not make useful recoveries, and commonly—and it is a point of considerable practical importance—changes take place in the opposite sound leg such as to render the animal of little value even should he recover from the original injury.

A horse from continual brushing was at last laid up with arthritis of the fetlock joint; shortly abscesses formed around the part, the usual suffering and loss of condition were undergone, the patient rested on the toe, and a high heeled shoe was given him for support. He was destroyed; the effect of the high heeled shoe was apparent; it had partly dislocated the metacarpal bone forwards; there was considerable thickening of the skin and subcutaneous tissues around the joint, the lymphatics of the limb were considerably enlarged, openings existed in the joint at the inner and outer lateral ligaments, communicating with external abscesses; the cavity of the joint contained blood-coloured synovia and pus, and the synovial membrane hung in large pulpy, scarlet fringes. Owing to the metacarpal bone being displaced forwards, the posterior synovial membrane had grown completely over the sesamoids so as to hide them from view; it was scarlet, pulpy and in fringes. On removing this synovial covering the bones were found bare and their articular cartilage absorbed; the cartilage covering the metacarpal bone was free from disease, though discoloured through being in contact with blood-stained pus. The tissues around the joint were rigid, and bone was becoming deposited in them.

The point of importance in this case is the covering over of the articular surface of the sesamoids by a proliferation of the synovial membrane, and this was assisted by the displacement forwards of the metacarpal bone. So far as my experience goes, it is the sesamoids which suffer in brushing; I have known the internal plantar nerve flattened and dissected into fibres, and have seen the blood-vessels obliterated by plugs; in the above case the vessels were found healthy, though the nerve was considerably swollen.

A mare received an injury to the inside of the near hock which opened the articulation between the os magnum and the astragalus; the discharge from it for a day or two was principally synovia, later pus and synovia; the limb became swollen, and on the fifth day after the injury the patient had a severe rigor, and broke out at once into a profuse perspiration. The discharge from the joint now became blood-coloured, the swelling extended as high as the thigh, and the usual symptoms of surgical fever were present. On the seventh day the patient was found to be bearing weight on the near or injured limb,

and holding up its fellow in the air. I at once suspected laminitis, but this did not exist; the off hind leg was swollen over the fetlock and up the back of the limb, and so painful that she could not bear it being handled. The hock at this time was discharging very little. She now commenced to show a symptom which in my experience is invariably a fatal one in joint trouble, viz., the whole weight being thrown into the sling, the horse lying "all of a heap;" it indicates complete nervous exhaustion and a desire for death. She was removed from slings and shortly died. The heart contained on the left side a firm clot, which filled auricle and ventricle, and extended into the coronary arteries and aorta; this was doubtless the immediate cause of death. The joint presented considerable subcutaneous effusion and enlargement of the lymphatics; many of the lymph vessels contained yellow clots, while others poured out their fluid contents; one large lymphatic vessel accompanying the saphena vein was filled with pus, and its lining membrane roughened and inflamed. The capsule of the hock joint was scarlet in colour and covered with lymph, giving it a roughened appearance such as is seen in pleurisy; the joint contained a dirty grey fluid; the articular cartilage on the astragalus was swollen and pulpy, and the ligaments and tendons surrounding the joint were softened and readily removed. The off hind limb, which for the last two days of life had exhibited such extreme pain, was found to contain in its sesamoid sheath a quantity of dirty coffee-coloured pus, the synovial membrane being scarlet and covered with shreds of lymph; the covering of the flexor tendons was highly injected, and the tendons themselves softened. The skin of the limb was acutely œdematous, and the lymphatics enlarged.

In the above case we have the progress of the disease complicated by pyæmia; we note the saphena lymphatic of the diseased hock as containing pus; doubtless by the lymphatic system putrid products found their way into the circulation, and the period at which infection was produced was when the rigor and sweating occurred.

A horse received a punctured wound over the capsule of the hock joint on the outer side of the limb. The patient was allowed to live six weeks, a special effort being made to save life as he was a favourite. The discharge from the joint was apparently never distinctly purulent, but only thick semi-coagulated synovia; secondary abscesses threatened, the skin around the joint became boggy from collections of pus, and the animal was destroyed. The subcutaneous tissue was found œdematous, and contained two large abscesses with coffee-coloured pus, which had burst into it from the capsule of the joint; the reason of this was that the wound in the capsule of the joint was high up, and it appeared easier for the inflammatory material from the joint to find its way into the tissues than to escape in an upward direction. The presence of these abscesses is somewhat remarkable when we remember that no pus came from the joint during life. The ligaments surrounding the joint were soft, pulpy, and yellow; the joint contained principally blood clots, though no blood-stained discharge occurred during life; the blood clots were adherent to the synovial membrane, and the latter was villous, swollen, pulpy, bright scarlet and yellow in colour, and blood-stained in patches. The articular cartilage on the astragalus was purplish in colour, thin, in fact so worn in parts that the bone was exposed though not here ulcerated. The sulcus on the astragalus and ridge of the tibia (viz., the part where normally no articular cartilage is found) was filled in with red granulations, which appeared to spread into and grow over the articular surface. In two or three places on the astragalus there were ulceration of the cartilage and caries of the bone, the latter being filled in with pink granulation-like material, which deceived one as to the depth of the destruction effected; on the articular surface of the tibia was a peculiar patch of ulceration which was limited to a narrow circle. The bones on boiling showed that the joint between the calcis and astragalus was destroyed, the articular surface being largely removed and the bone exposed; on the surface of the joint were considerable bony deposits affecting all the bones of the hock; the internal sulci on the astragalus and tibia were considerably enlarged, and the bones beneath porous; at that part of the tibia and astragalus which had been most in contact the bones were exposed and eburnated as the result of friction.

In another case of hock injury, caused by a kick on the outside of the joint, synovia at once ran from the wound. The case took the usual course—high fever, muscular wasting in spite of the fact that the horse had an excellent appetite, which he preserved throughout; later, the discharge became blood-coloured, abscesses formed, and the case became hopeless. On dissecting the joint the surrounding tissues were found fibrous and gritty from the deposition of bone in their substance, or as an outgrowth from the bones of the joint. The wound in the joint was readily found; the cavity contained a quantity of viscid maroon-coloured synovia, and the synovial membrane was purple, thickened, pulpy, and in large fringes. At the edges of the tibia it was commencing to invade the articular cartilage, and from the fossa or sulcus on the ridge of the tibia, and between the ridges of the astragalus, the synovial membrane was invading what was left of the cartilage at these places. The astragalus, excepting at its inferior extremity, was as devoid of articular cartilage as if it had been scraped, and the cartilage which was left was of a maroon-colour owing to contact with the blood-coloured synovia. Deposits of bone were forming on the os calcis where the injury was inflicted, and the bones on section were of a deep yellow colour, and the blood-vessels clearly seen. On the articular surface where the bones were bare they showed up as a yellowish dull brown body.

Where joints are opened by an injury which inflicts a severe contusion as well as penetrates the joint, the injury is, if possible, even more severe. We meet with this class of case in broken knees; the pain suffered is intense, the animal stands with the knee bent, resting on the toe, painful startings of the limb are frequent, the discharge becomes profuse, and the joint assumes a considerable size. On dissection it will be found that the tendon of the extensor metacarpi magnus is ground away and in shreds, the other synovial sheaths in front of the joint are inflamed, the tendons being of a yellow ochre colour; the synovial membrane of the joint is swollen, pulpy, and scarlet; the cartilage covering the bones is thin, dusky, perhaps entirely absorbed, and even caries of the bone present. The bones on section may or may not present any great change in colour. If the joint be examined shortly after the injury, the extravasation of blood both up and down the limb is often remarkable. Where the

injury is very severe the extensor pedis tendon may also be involved, but the joint which is opened in all cases is the middle one of the knee, and the bone which suffers most is the os magnum, though the scaphoid and head of the metacarpal by no means escape; if the injury has been very severe the interosseous ligaments are ruptured.

In all the injuries here recorded some wound has directly or indirectly affected the joint; we may have a wound over a joint like the hock, which for the first few days does not communicate with the joint, but later the tense condition of the interior, due to inflammation of the synovial membrane, causes the capsule to bulge, and eventually give way, constituting an open joint. It is these cases of all others which require from us the greatest possible care in treatment, and, until the final rupture of the capsule occurs, are the only cases of the class which offer a reasonable prospect of recovery; once, however, the capsule has been opened, the joint destruction is as certain as if a penetrating wound of the joint had occurred in the first instance.

In the next class of case, injury to a joint without any wound of the skin may be followed by suppurative arthritis; such cases are fortunately rare. The class of injury I have known produce it is a severe strain of the joint, at least, that is, if it is possible to place any reliance on the history of the case as given us. Strain followed by suppuration is a rare surgical condition, though when the strain affects a joint I think I have had undoubted evidence of its occurrence.

Some time ago I was consulted in a case with a history of five weeks intense lameness after hunting; the part affected was the fetlock, but the joint was so swollen that a diagnosis was impossible; I suspected a severe strain of the suspensory ligaments, fracture of one or both sesamoids, and synovitis of the fetlock joint. The lameness was most intense, the animal only resting on the toe of the foot; six weeks after receiving the strain the joint suppurated, two abscesses formed on either side, and the case was now hopeless. On dissecting the limb two large patches of maroon-coloured, disintegrating, offensively-smelling surfaces corresponded to the holes in the skin, and these communicated with the joint somewhere over the lateral ligaments. The tendons and ligaments were quite sound, though a very considerable effusion existed around them; on laying open the joint it was found to contain blood-coloured pus; the synovial membrane was scarlet, pulpy, and swollen; the articular cartilage was absorbed from all the bones entering into the formation of the joint; and the bones could be felt bare, or with only a mere trace of cartilage covering them. The articular surface of the sesamoids was nearly obliterated by a growth from the synovial membrane of a scarlet fringe which spread over both bones, very much like the false membrane of pleurisy, only of a scarlet colour.

In the first case related in this article, I have drawn attention to this overgrowth of the synovial membrane, and hinted that the high heeled shoe assisted it; this horse wore no high heeled shoe, but he stood persistently on the toe, thus throwing his weight directly on to the os suffraginis, instead of allowing the sesamoids to take their share. There was no ulceration of the articular cartilage of the joint, but on the surface of the bones forming the articulation considerable bony deposits existed.

An animal received a severe injury to the fetlock caused by being tied up by one fore leg; the joint was found greatly swollen, the knee bent, and the foot resting on the toe. I considered that the inferior ligaments of the sesamoid bones were strained, but nothing definite could be ascertained owing to the swelling. The horse was under treatment for three months, during which time abscesses formed around the fetlock joint, the lameness remained intense, and a fracture was suspected; the case was eventually destroyed. The leg at the fetlock measured 17 inches in circumference, and 12 inches around the pastern; there was considerable subcutaneous effusion of serum, causing the skin at parts to be from 1½ inches to 2 inches in thickness, and serum flowed from it in abundance. The lymphatics of the limb were enlarged, and contained coagulated lymph in the vessels; the tendon of the extensor pedis was gritty from bone deposits in its substance, the head of the suffraginis around the fetlock joint was found to be nodular from bony deposits; the joint when opened contained blood, pus, and air bubbles; the articular cartilage was nearly absorbed, faintly red in colour, the inflamed bone beneath showing through dark; there were several points of ulceration which extended deeply into the substance of the bone, the ulcerated surfaces being scarlet and black in colour; they varied from the size of a sixpence to a pin's point, their margins being irregular; there was extensive porcellaneous deposits on the bone; the synovial membrane was scarlet, and between the sesamoids and suffraginis was an abscess which communicated with the sesamoid bursa. The sesamoids were dark but not ulcerated, and the articular surface was invaded by an outgrowth of the synovial membrane; the inferior extremity of the metacarpal bone was in the same diseased condition as the suffraginis; in fact, it will generally be found in joint disease, that the articular surfaces partake of the same amount of destruction, one generally being a perfect counterpart of the other. The tendons and ligaments were matted together, and those around the joint much softer than usual. I could discover no strain of the inferior sesamoidean ligaments, but owing to the disorganised state of the parts it is doubtful if it could be found. The perforans and perforatus were glued together in the sesamoideal sheath, and the perforans was firmly adherent to the fibro-cartilage covering the sesamoids.

Section of the bones forming the joint, especially the os suffraginis, showed acute osteitis, the marrow very yellow, the compact tissue red, with minute dots of a deeper tint indicative of cut blood-vessels.

In the above case we have another example of suppurative disease of the joint, following an injury which did not produce any wound of the skin, and caused by straining violently on the foot shackle with which the animal was secured.

A very brilliant hunter in the hunting field received an injury to the fetlock which was thought at the time to be due to a thorn; the joint in course of time suppurated, and I saw the case nine months after the accident; the sinuses leading to the joint had closed, but the leg was very large and the horse lame. Whatever repair could take place must by this time have been effected, and being a very valuable animal a special effort was made to restore him to usefulness. I directed exercise in a supporting bandage—at first walking and then trotting; the case made such improvement that the owner, an

impetuous sportsman, could not be persuaded to give the horse further steady work, and the animal carried him for the tail end of a season in its usual brilliant style; unfortunately, he broke down and had to be destroyed, and the bones after boiling were sent to me for inspection. I found a complete hole in the head of the os suffraginis, large enough to admit the little finger, and communicating with a channel which ran obliquely through the bone and opened on its surface. It is greatly to be deplored that I had no opportunity of dissecting this remarkable limb.

All the cases I have described are characterised by suppuration of the joint, and I propose now to consider what methods of treatment should be adopted for this class of case, before proceeding to examine other diseases of a non-suppurative kind to which joints are liable. We must clearly, however, distinguish between those cases where the joint is actually opened, and those where it opens in the course of a day or two; with this latter class I will first deal.

Any wound over a joint may slough into it, or, as the result of the tension of fluid in the capsule, may cause the latter to give way. I believe, but it may only be bias, that where we treat these cases by fomentations we assist the perforation which is eventually so fatal; this, at least, is my experience, and I have not for years fomented wounds over joints, and have seen no reason to regret it. The continual application of hot water or poultices renders the skin sodden like the hands of a washerwoman, and I believe renders it less resisting; it also encourages the pouring out of inflammatory products, which is a result to be guarded against rather than encouraged. My experience of joint trouble leads me to the adoption of cold water, preferably in the form of continuous irrigation, though I am bound to confess that even this has not always met with that success which I could have wished. Perfect rest to the joint, so far as it is possible to obtain it in our patients, is an essential; the use of slings is desirable and often necessary, and the system may be treated according to the state of the patient and the nature of the case; doubtless the most important treatment is the local.

We may suspect approaching perforation when we find the swelling of the joint is increasing, the fever running higher, and painful startings occurring in the limb; the latter are usually indicative of suppuration. We are not at this stage of the case warranted in adopting any more active surgical interference, and the less the joint is interfered with the better; any probing or examination of the part cannot, in my opinion, be too severely deprecated; the thickness of a piece of tissue paper probably lies between recovery and almost certain death. Once, however, the joint has opened, and a turbid synovial discharge has declared itself, the period of expectant treatment has passed. The influence of a blister on an open joint is sometimes very remarkable, and Professor Williams, who, I believe, was the first to advocate this active method of treatment, is certainly to be congratulated on his boldness. I cannot say what proportion of cases are thus cured, but the value of the practice is undoubted. Should this method of treatment fail, we are perhaps inclined to fall back on what might be termed the "plugging up" treatment, viz., the application of agents which coagulate the synovia and form a plug. Such treatment in my experience has proved absolutely worthless. I have never known it leave a fairly sound joint behind it, and have seen it do harm from the accumulation of putrid products in the cavity of the articulation. I think we may do well here to take a hint from the human surgeon, and treat these cases on proper surgical principles, viz., by opening at the most dependent part, draining, and washing out the cavity with antiseptics. I cannot from my own experience speak of the advantages of this system, but what is correct for the human joint is equally correct for that of the animal if it can be applied. This treatment can be applied, it is rational, and may save in some cases these destructive lesions occurring which I have described ; one thing is certain, and that is, our present practice of non-interference with the cavity of the joint is capable of improvement. Looking back to a not inconsiderable experience in joint trouble, I cannot charge my memory with a single case of open joint which, treated on this plan, has left the animal with a satisfactory limb.

Where joints are opened by clean cut wounds, a case of which I have never seen, the correct surgical procedure is to bring the edges of the skin together after disinfecting the joint and removing from the cavity any of the agents used for this purpose, and to endeavour to seal up the cavity by collodion or other impermeable application. Most joints which are opened are contused wounds, and the bruising which is present is sufficient to destroy the process of union by the first intention, though no harm can be done by attempting it. In this class of case I am very fond of continuous irrigation, and an attempt should be made to carry this out as perfectly as possible for the first few days; should the discharge still continue and the patient be unrelieved, the blister treatment ought I think to have an opportunity, and should this fail the cavity of the joint should certainly be treated antiseptically.

It is the synovial membrane which is primarily responsible for much of our trouble. I have shown how it becomes pulpy, swollen, in large fringes, and the manner in which it involves the articular surface of the joint ; it is this membrane which furnishes the discharge, and it is the discharge which helps in no inconsiderable degree to destroy the integrity of the cartilage ; that the latter, however, is also assisted by inflammation in the heads of the bones is equally undoubted ; the manufacture of cartilage, *which is constantly occurring*, ceases ; what is left is removed by friction, pressure, and the influence of the inflammatory fluid in the joint, and I conceive that our only hope of saving the limb at this stage of the disease lies in treating the interior of the joint as an open wound, and thus reducing the inflammatory action within. No matter what view we take of the treatment, we cannot disguise from ourselves or our clients that these cases are severe surgical conditions involving life, and offering only a small prospect of recovery.

NON-SUPPURATIVE DISEASES OF JOINTS.

I have previously said that it is impossible to draw a hard and fast line between the causes leading to a suppurative and non-suppurative joint disease, and I must here at the risk of repetition reiterate the statement ; a horse, for example, receives a kick over the ulna which fractures the bone, and this may or may not suppurate ; for the purpose of this paper I will regard it as a non-suppurative form of injury.

Kicks and injuries to joints are exceedingly common in army practice, and the consequences may be so serious that I have made it a

rule for years to regard such injuries as dangerous, until they have proved themselves to be the contrary.

A horse received an injury to the knee, by repeated blows against a stone wall opposite to which he was standing whilst in a foot bath for lameness; the knee in course of time became considerably enlarged, and this was aggravated by daily marches of twenty miles, which at the time were unavoidable. In due course it was evident that anchylosis was occurring, judging from the enlargement of the part and the stiffness of the knee ; in trotting the animal could barely carry the toe clear of the ground, and on bending the limb the foot could not be brought nearer than twelve inches to the elbow. Under chloroform the leg was flexed until the foot touched the elbow, and the adhesions which I expected to exist were broken down ; for a short time I fancied I saw some improvement, and the operation was repeated a few weeks later. The case, however, made no satisfactory progress, and the animal was destroyed. *Post-mortem* examination showed that the cuneiform was anchylosed to the semilunar, the deposit being considerable; the scaphoid had deposits on its external surface, and the inferior extremity of the radius was in a similar condition. Bony deposits were not only on the front of the knee but also on its posterior face. There was no disease of the articulation. This case helps to demonstrate the physiology of the knee joint, namely the almost total inability to flex the knee owing to anchylosis of the semi-lunar and cuneiform, with entire absence of articular disease.

Such a condition in the hock would have been of no great importance, and this and similar cases have impressed upon me the necessity of being especially careful in dealing with knee trouble, where the slightest amount of rigidity represents a hopeless condition ; had the lower instead of the upper row of bones been affected, the treatment by forcible extension would probably have been satisfactory, for the reason that the lower row of bones have comparatively little movement.

A mare received an injury to the shoulder joint caused by coming into collision at rather a fast pace. She was knocked completely over, rose with difficulty, and the leg dangled about like a broken one, the elbow being turned outwards and the limb thrown across its fellow ; when made to move she advanced the leg fairly well, but was unable to support any weight on it, the entire shoulder joint being forced out laterally as if all the external supporting structures had been destroyed ; so marked was this that I expected her to fall on her side at every step. There was evident pain on pressure over the shoulder joint, but the leg could be flexed and extended without producing much inconvenience. I considered that the structures on the outside of the joint had been destroyed, with probably fracture of the external condyle of the humerus. I experimentally divided the external structures of the shoulder joint on a dead limb, and produced the above-described deformity, which strengthened my diagnosis. During the time the animal was in slings the shoulder kept constantly shooting outwards, and the patient was always crossing the injured leg over its fellow. Owing to her uneasiness she got galled by the slings, and died from tetanus. On *post-mortem* examination the muscles surrounding the joint were paler than usual, there was a small bruise on the flexor brachii tendon, *but no destruction whatever of the external structures of* *the joint*, nor fracture of the bone. The subscapularis muscle was ecchymosed and bruised, but its fibres and insertions were intact.

On opening the joint the synovia was found in excess and blood-coloured, the synovial membrane appeared thicker than usual but not inflamed, and there was no disease of the articular cartilage. Up to this point there was nothing to account for the symptoms shown. I now made a longitudinal section of the head of the humerus; the cancellated structure was found scarlet, and towards the medulla of a deep maroon tint; the periosteum was thickened and easily removed.

The case was one of inflammation of the humerus, there being true osteitis; probably had the animal lived bony growths would have resulted. The case presents features of unusual interest, the phantom dislocation being explained by the inability of the animal to bear weight on the humerus. Severe injuries involving bones, without serious injury to the neighbouring joint, are no doubt rare, excepting when arising from such specific causes as ringbone.

Fractures extending into joints are very serious complications, of which we may take as examples fracture of the ulna extending into the elbow joint, fracture of the humerus into the shoulder joint, fracture of the suffraginis extending into either the fetlock joint or into both fetlock and pastern joints; we may regard either of the two first injuries as incurable, owing to the fact that it is next to impossible to immobilise the joints; the ulna would stand a chance of recovery were it not that the triceps muscle is constantly pulling it out of its place. Simple fractures of the pastern, on the other hand, are capable of recovery owing to the comparative ease with which the part can be treated, the anatomical formation of which assists, instead of offering resistance. Compound fracture into joints leads to suppurative disease, with which we have already dealt.

Our great difficulty in these cases is exact diagnosis in the early stages; if we can obtain crepitus the question is one of simplicity, but if the case is seen after swelling of the limb has occurred it is surrounded by considerable difficulty; the intense pain, the persistent lameness, with no change from week to week, are symptoms which in my experience point to fracture into joints.

The distance which a horse may walk after a fracture into a joint, providing it be obliquely placed to the long axis of the bone, is very remarkable. A case occurred of an injury to the shoulder, in which distinct crepitus could be ascertained as affecting the head of the humerus—I saw the case in consultation, the horse having walked about 2 miles to the infirmary. A dull crepitus could be made out, but the animal placed so much weight on the limb that I could not make up my mind that the fracture extended into the joint. I advised treatment, but the horse was destroyed, and the *post-mortem* examination revealed the fact that the humerus was split through the head, and for some distance obliquely down the shaft; the reason why the horse had walked and stood so well on the limb was that the articular surface of the scapula, being much smaller than that of the humerus, did not bear to any extent on the fissure into the joint, and hence the animal was able to support weight on the part.

In fracture of the pastern it is certain that good recoveries are made where the fracture is oblique, namely only affecting one articular surface; where, on the other hand, the fracture affects both articulations, the process of repair is considerably retarded and often prevented, by the fact that the least weight of the body on the part seems to separate the fractured surfaces. The treatment of such cases according to ordinary surgical principles should nevertheless be attempted. A comminuted fracture of the pastern, on the other hand, is hopeless.

Fractures within joints and confined to an area surrounded by the capsular ligament are very rare; I have met with such a case, where a portion of the condyle of the femur had been detached owing to a sudden strain to one insertion of the crucial ligaments; the case was under treatment for months, the lameness in the first instance being intense, but later the animal was able to trot with a fair amount of comfort. I localised the lameness not from any external indications, which were absent, nor from the gait, which presented nothing characteristic, but by the presence of a symptom which, rightly or wrongly, I connect with stifle joint lameness, viz. holding the leg persistently in the air, the joint being flexed. I believe that, where this symptom is persistent, in the absence of other indications it points to an injury in the stifle joint between the tibia and femur; lesions of this part are distinctly rare, and I have only had two opportunities of verifying by *post-mortem* examination, but in both of these the prominent feature during life was holding up the limb in the manner I have indicated. Two cases cannot establish a law, but personal bias is a difficult thing to overcome.

As fracture of the navicular bone belongs to the class of specific joint disease no further mention will be made of it.

Sprains of joints both large and small must occur. I say must, for the reason that with one or two exceptions I have never been able to clearly make up my mind on the subject, and yet I have met with cases where nothing but a sprain would satisfactorily account for the damage produced.

First let us consider what we understand by a sprain of a joint. The opinion I hold is that to obtain a sprain we must have some laceration of the ligaments or other structures around or in connection with the joint, such for instance as a laceration of the lateral ligaments of the fetlock, or of the ligamentum teres of the hip, or the capsular ligament of the shoulder, or tendon of the flexor brachi at its insertion into the scapula, or of the lateral ligaments of the hock. Now do we meet with many of these cases in actual practice? are they sufficiently common to warrant us, excepting for the purpose of practice, in speaking of sprained joints?

I fully agree in saying that such cases do occur. I have met with the head of the femur out of the cotyloid cavity, and this could only have happened through rupture of the ligaments inserted into the head of the bone, I have known the straight ligaments of the patella to be torn from their tibial attachment, and I have known the crucial ligaments to be torn from their insertion into the femur; but these are not everyday cases, nor do they happen with sufficient frequency to establish a law—they are rather exceptions.

All I am now urging for is greater accuracy in diagnosis. How commonly do we speak of a sprained fetlock joint when we mean a sprain of the suspensory ligament or a sprain of the flexors; a sprained fetlock joint should mean a sprain of the lateral ligaments, and such cases, I take it, are very rare.

We have, I think, distinct evidence that a sprain of a joint may occur, and we have equally strong evidence that a sprain of a joint is a rare surgical complication.

An injury which is sufficient to sprain the structures surrounding a joint is generally sufficient to set up a certain amount of arthritis. In this way we may account for certain lesions affecting such joints as the shoulder and elbow, which lead to deposits around the joint and every appearance of arthritis.

Let me take what at present I am inclined to regard as a typical case of such a lesion. A horse is found with the elbow joint surrounded by a considerable swelling, and the patient intensely lame. The most careful inquiry fails to elicit any history of an accident or injury. The case in course of time improves, the swelling subsides, but considerable enlargement of the joint still exists, and on *post-mortem* examination the part is found surrounded by bony deposits. The cause of this condition is in my own mind open to serious question. I class it as one of sprain of the ligaments of the joint, giving rise to arthritis and exostoses.

I have met with very few cases of this description, and an inspection of the joints *post-mortem* throws no light on the cause of the condition, excepting perhaps that articular disease is not, I think, present, or not to the same extent as it would be if the joint had been opened by an injury; in other respects these two opposite cases present practically identical joint lesions.

It is certain, and this I believe to be a most important statement, that lesions of ligamentous structures near to their insertion into bones may give rise to sufficient disturbance to produce inflammation of the bone itself. We see this, I think, clearly demonstrated in those cases where sprains of the suspensory ligament are associated with inflammation of the sesamoid bones. In a case which came under my observation of laceration of the insertion of the straight ligaments of the patella, the head of the tibia was found affected with acute osteitis; though this may have been caused by a splintering of the tibia, which occurred at the same time as the ligaments were torn away.

I wish I could have spoken of sprains of joints in a more definite and decided manner. The subject is one on which my mind is far from being made up, and we require for its thorough elucidation greater clinical accuracy, and exact *post-mortem* observation.

To determine a sprained condition of a joint we must both be able to feel and to see the part; a diagnosed sprain of the ligaments of the hip joint I take to be as difficult, and during life as unsatisfactory from the point of exactitude, as a diagnosed sprain of the round ligament of the liver, or of the ligaments of the navicular bone.

Certain changes occur in joints the result of fixity of position. If for example an animal meets with a severe sprain of the flexors of the off fore, it is clear that the near fore limb has to perform nearly double duty as a prop, but, and this is the important point, it performs *continuous* double duty, owing to the inability of the animal for even a short time to bear weight upon the diseased leg.

From long continued *post-mortem* observation, I am satisfied that the

most extensive changes occur in the originally sound limb, the result of continuous pressure; tendons, joints, and foot, suffering in consequence. I have seen the structures behind the knee give way, the flexor tendons to partially rupture, and laminitis with depression of the pedal bone to occur to the originally sound limb, and in addition, as I showed some years ago, have known navicular disease to become developed. So impressed am I with the importance of these changes, that in long continued acute lameness of one leg, I feel just as much, if not more, anxiety for its fellow.

I do not propose dwelling upon the changes resulting from fixity of position excepting as they affect joints.

We will take a case of an open knee joint for the purpose of illustration; the animal having been allowed to live for a month, what changes will we find in the opposite sound limb? So definite and regular are these that they may be foretold with almost positive accuracy before the limb is dissected; it will be found that the fetlock joint possesses the most extensive changes as a rule, next the navicular bursa, then the knee. The changes consist of dryness of the joints; little or no synovia is secreted, and what is there is often thick, yellow, and coagulated. This may be especially well seen in the sesamoid bursa, where the flexors pass over the bones. The articular cartilage, say of the true fetlock joint, is partially absorbed, the bone being bare or nearly so; the uncovered bone gives a peculiar dark reddish or violet appearance to the part, being most marked where the greatest pressure was exerted, for example, on the posterior part of the metacarpal articulation, and on the sesamoids, the latter bones leaving a complete and perfect imprint of their shape on the metacarpal. Where some of the cartilage is left it may be seen to be finely grooved in the direction in which the bones move on one another. Where there is no pressure the cartilage is left, and owing to the absorption of the other portion, the cartilage of no pressure stands out prominent and of its bluish-white tint; this is perfectly seen in the fetlock, where a prominent white ridge will always be found transversely across the metacarpal, produced by the absence of pressure resulting from the space between the sesamoids and the suffraginis. Turning to the navicular bursa, we find the parts dry, the flexor tendon slightly eroded, and the central ridge of the navicular bone with part of its fibro-cartilage removed, the result of dead continuous pressure; we may even find blood spots on the bone, showing the depth to which the part is exposed. In the knee much the same appearance will be produced as in the fetlock, the regions of greatest pressure, viz., the anterior half of the carpal bones, especially of the upper row, showing absorption of their investing cartilage.

Absolute caries in these joints (excepting the navicular) I have never seen, and I therefore think it more than likely that the cartilage gets restored in course of time when the animal is capable of bearing weight on the opposite limb. That this is an important factor in the production of navicular disease I have no shadow of doubt, as I have repeatedly verified it by *post-mortem* examination.

We learn, however, the practical lesson of the value of slings, the necessity of allowing animals to lie down as early as the case admits of it, and on being restored to soundness the necessity of taking them into work very gradually.

There are other changes taking place in joints, due to the deposition in the articular cartilage of salts of lime, giving rise to white nodules which may or may not cause lameness. In the pages of this Journal I have dealt with the clinical aspect of calcareous degeneration, and any further mention of the subject would be needless repetition.

Granular degeneration of the articular cartilage is a curious affection which is comparatively common, yet I cannot make up my mind that its practical significance is of any importance; it is common in the shoulder (a seat of lameness which is distinctly rare), it is not uncommon in the knee, and it is fairly common in the fetlock.

The joint affected with granular degeneration has its cartilage here and there eroded, the cartilage surrounding the eroded patch, which may be no larger than a pin's head, being opaque, loose, ragged, and fringey; the fringes can readily be raised, and the bone beneath is found bare. Microscopically the fringes are found to be granular, and to have lost their normal cartilage cells. Beyond this description we find nothing more; there is no caries, no inflammation, and so far as I am aware no lameness, and yet we cannot regard the alterations as normal. A systematic *post-mortem* inspection of the joints of healthy horses will reveal the comparative frequency with which this change may be observed.

I have observed that loose pieces of cartilage may commonly be found on the anterior edge of the suffraginis at the fetlock articulation. The cartilage or nodule is not absolutely loose, but is very freely movable. I know nothing of the significance of this change.

SPECIFIC JOINT DISEASES.

Hitherto the joint diseases of which I have spoken are, as a rule, clearly traceable to a distinct cause, and there is nothing in their character which can be looked upon as hereditary or capable of transmission; moreover, though by no means infrequent, yet they do not occur with that persistent regularity which marks another class of joint disease which, for want of a better term, we may call "specific."

By a specific joint disease I mean such affections as spavin, ringbone, and navicular disease, affections which are characterised by their extreme frequency, by their causing more or less prolonged lameness, by not uncommonly being of a perfectly incurable nature, and further, from the fact, of which considerable evidence exists, that these diseases are transmissible.

There are certain features connected with these specific forms of joint disease which are worthy of attention—speaking generally, two of them occur in the fore leg and one in the hind; two are situated close together at the lower extremity of the limb, close to the ground; the other is situated about one-third up the limb and some distance from the ground.

There is nothing in common in the joints[1] affected; they are all

[1] It is permissible for clinical purposes to regard the navicular bursa as a joint.

distinct types, but there is a something in common in the nature of the lesions produced, which would lead one to suspect that the changes occurring in each are closely allied.

There is a greater weight carried by the fore legs than by the hind; in comparing the joint of the fore leg with that of the hind we observe that only in one joint is there any considerable difference in the way in which that weight is carried. As high as the knee and hock we may say that there is no practical difference in the anatomical arrangements of the limb, and yet we know how commonly the foot and coronet of the fore leg are affected with specific lameness, and how rarely in comparison the hind one. In comparing the knee and hock great differences are observed; it is true that in both a number of pieces of bone enter into their formation, but here the likeness ends; the small bones of the knee have considerable movement, the small bones of the hock only a trifling amount; the lower row of knee bones, so far as movement is concerned, are the nearest approach to the movement of the small bones of the hock, yet the latter are frequently diseased, the former rarely affected; evidently, then, the presence of small and comparatively immobile bones in the hock cannot constitute an explanation of the frequency of hock disease. Does the manner in which the joints are flexed throw any light on the acknowleged fact that knee disease is rare and hock disease frequent? It will be observed that these two joints bend in opposite directions; the knee opens in the front when flexed, the hock opens at the back; later on I will have to show that there is reason for believing that some injury may be inflicted on the hock joint by this method of opening and closing.

Continuing this comparison of the fore and hind leg, we would remark that the stifle corresponds to the elbow, the patella to the ulna, and that during flexion of these joints the elbow opens at the back whilst the stifle opens in front; in other words, though corresponding joints—the elbow and the stifle, the hock and the knee—yet they do not agree in the direction in which their movement is made.

The hip joint corresponds to the shoulder joint, and though in the hip all the movement is done by one bone instead of two, yet the to-and-fro movement is practically the same in each.

We have seen reason for believing that with one exception, to be dealt with later, the structure of the fore and hind limbs throws no great light upon the relative frequency and position of the so-called specific forms of lameness. We must now briefly consider what light physiology is capable of throwing on it.

When the fore leg comes to the ground—no matter what the pace may be—the limb must be straight in order that the foot may be placed down flat, or, as in the faster paces, heel first; this straightening of the knee renders the bony column of the leg rigid for the time being; the shock of impact is therefore greatest at that part of the column nearest to the point of impact, and decreases as we pass up the leg.

It would be foreign to our subject to attempt to deal with the various means which exist in the foot to render this shock as little destructive as possible; we can only allude to the weight being supported on the laminæ, to the presence of a foot articulation which is posteriorly yielding, the existence of an elastic movement of the posterior part of the foot, and the presence of an elastic and indiarubber-like frog.

There are, however, two distinct strains imposed on the same limb, viz., the strain or concussion when the leg comes to the ground, and the strain or concussion occasioned when it leaves the ground; one is the concussion of impact, the other the concussion of propulsion.

Look now at the hind leg, and see how it differs from the fore limb in providing for the concussion of impact; here we find that the limb instead of being straight—as the fore leg is from the elbow to the foot—is now bent, and it is bent at the hock, at a point which we will take to be midway between the stifle and the ground. The shock of impact comes, therefore, largely on the hock.

Further, the fore leg in providing for propulsion rotates over the foot, the limb still being straight from the elbow to the ground, and the shock of rotation is confined to the lower end of the bony column. In the hind leg propulsion is obtained not only by the foot remaining fixed on the ground, but also by a straightening or unbending of the hock, which gradually opens until the tibia forms with the metatarsal bone the nearest straight line it is capable of making.

In this way we may say that the hock performs twice as much work as the knee, and such a statement throws some possible light on the frequency with which this joint is affected with disease.

After all, though we have attempted to reason in this imperfect manner on the form and function of the limbs, as throwing light upon its diseases, yet we must confess that when applied to the bulk of the equine race it is extremely unsatisfactory. It does not account for horses suffering from spavins, ringbones, and even navicular disease, which have practically done no work. It increases the mystery of how it is that joints, viz., hocks and coronets, notoriously diseased, yet stand work, and we are therefore compelled to fall back upon even less satisfactory means of explanation than those we have offered above.

The absolute uncertainty attached to the so-called specific joint diseases of the horse is their great terror. Who can say, for instance, what horse may not become suddenly affected without apparently the slightest cause, and who can say when such animal will go sound again, and how long it will remain so?

I purpose now taking each of these specific diseases and considering them separately.

SPAVIN.

I have used this absolutely meaningless term, as it is the accepted designation for tarsal exostosis.

There is no branch of our art over which greater difference of opinion exists than the existence of spavin or not. The more one studies the subject, and the greater their clinical experience, the larger the proportion of hocks they meet with about which they cannot make up their mind. The cause of this is entirely due to the anatomical formation; on this point I am perfectly clear. For years I have examined *post-mortem* all the hocks I could collect; I have made my diagnosis of their condition, committed it to writing, and then made my dissection. I have been shocked to find how often I have been wrong in hocks I have felt positive were not healthy; my only difficulty has been to convey to others who saw the bones and not

the joints how enlarged they appeared to the eye, and what really good grounds existed for the opinion I gave. It was my difficulty in conveying this appearance to others that caused me to look around for some method of permanently recording the shape of the hock I was about to dissect. This I now do by taking a plaster cast of the inner aspect of the joint; the limb is then dissected, and the bones cleaned, and we have at once the apparent and actual condition of the joint presented to the student. I must confess that this exact method of working robs one of that unbounded confidence in their opinion which we so constantly exhibit in the court of law and in the examination of horses for soundness.

It is only by a sound anatomical knowledge of the joint that we can expect our opinion to carry weight; a man should know the regional anatomy of the hock as well as he knows that of the leg, and he should be capable of passing his hands over the joint and naming every structure beneath his fingers; this knowledge helps to restore some of his lost confidence, and places him in a stronger position than before.

Nothing is more deceptive than the arrangement of the hock joint as judged when the part is clothed in its ligaments and skin; it is nearly impossible to believe that the outer ridge of the astragalus stands out prominently on the exterior of the joint and not on its anterior face, that the inner ridge projects prominently on the anterior face and not on the internal, that the cuneiform bones do not extend anything like so far back on the joint as is generally supposed, and further, that the seat of spavin which we can feel is comparatively small compared with that which we cannot touch, and many other examples I might give of the same difficulty in localising the various parts of this complex joint.

I propose, therefore, to deal first with the regional anatomy of the joint before I pass on to consider the subject of spavin.

There are seven prominences more or less large on the inner face of the hock joint, there is one prominence on its anterior face, and six on its external face.

It is extremely difficult to describe these prominences, but I shall attempt to do so by the aid of the annexed illustrations, which are reproduced from photographs.

1 *i.* A large somewhat triangular prominence representing the inner malleolus of the tibia and internal lateral ligament. The part of the prominence to which the line 1 *i* is drawn in Fig. 1 is one inch behind the saphena vein; the portion of the malleolus to which reference is made is seen at 1 *i*, Fig. 2.

2 *i.* This is a small prominence just behind 1 *i*; it is produced by the posterior extremity of the tibia, and part of the inner ridge of the astragalus. At the exact seat marked in Fig. 1 the hock joint would be covered only by a ligament which runs from the calcis to the tibia, and reinforces the inner lateral ligament of the joint. Immediately in front of 2 *i* is found the tendon of the flexor accessorius. In Fig. 2 may be seen the exact part of the true hock joint which lies at 2 *i*.

3 *i.* Above and behind 2 *i* is a prominence due to the head of the calcis; at the place marked in the figure is found the inner lateral ligaments of the cap of the hock.

4 *i.* Below and behind 2 *i* is a prominence due to the calcis, a ridge formed just internal to where the perforans passes over the bone. Covering the part is a dense ligament running the whole length of the postero-internal part of

the hock, in width embracing *2 i* and *4 i*, and then narrowing to *7 i*, below which it is inserted. Posteriorly this ligament is confounded with the posterior annular ligament of the hock. I mention the presence of this ligament as owing to its density it fills up the deep hollow between the calcis and astragalus, and completely obliterates the posterior part of the cuneiform magnum and parvum.

5 *i*. A small prominence below 1 *i* found by following the inner lateral ligament down as far as the astragalus. It is the projection on the inner face of the astragalus, and, as I shall have to show, constitutes a most important landmark. In Fig. 1 the line is drawn to that part of the prominence which touches the joint formed between it and the magnum, *see* Fig. 2. This exact point is immediately above the slip of tendon which the flexor metatarsi sends over the inner face of the joint to be inserted in the parvum. Further, just above the point marked at 5 *i*, Figs. 1 and 2, is the insertion of the inner lateral ligament of the joint, and the origin of a large fan-shaped ligament which runs from the astragalus in an anterior direction, knits together the cuneiform magnum and medium, and becomes inserted into the head of the metatarsal bone. I allude to this ligament as it also has a practical bearing.

6 *i* is below 5 *i*. It is a largish rounded surface running both anteriorly and posteriorly, and is formed by the cuneiform medium and the head of the large metatarsal bone; practically we may speak of it as the seat of spavin, though this is not strictly correct, as we shall endeavour to show. The exact spot where the line 6 *i* is drawn in Fig. 1 is immediately between the medium—close to its posterior extremity—and the large metatarsal bone, *see* Fig. 2; further, the exact spot marked is immediately behind the saphena vein, and about one half of an inch below the slip of the flexor which passes to the parvum.

7 *i*. Posteriorly to 6 *i* but in the same line as it, is the prominence due to the head of the inner splint bone. The exact spot in Fig. 1 is through the posterior extremity of this splint bone, and just below the insertion of the slip of the flexor into the parvum; *see* also Fig. 2. Nearly midway between 6 and 7 is a groove which can often be felt; it is said to be the space between the parvum and the medium. This is not the case, *as such can never be felt*; it is the space between the inner splint bone and the large metatarsal. This space is a very important landmark. Immediately behind 7 *i* runs the accessorius tendon.

1, Fig. 1, is the prominence on the anterior face of the hock due to the inner ridge of the astragalus, *see* also Fig. 2.

1. A marked prominence in the centre of the joint due to the internal ridge of the astragalus. The ridge here is completely covered by the flexor metatarsi; at the spot marked in Fig. 3 the flexor makes its first division; immediately beneath it is the thickened sheath formed for it by its own tendon, the extensor pedis being external to it; then comes the capsule of the joint, and lastly the ridge of the astragalus. Fig. 4 shows the exact part of the astragalus indicated in Fig. 3.

The other prominent points of the hock as seen from the front belong to the external and internal faces and will there be found described.

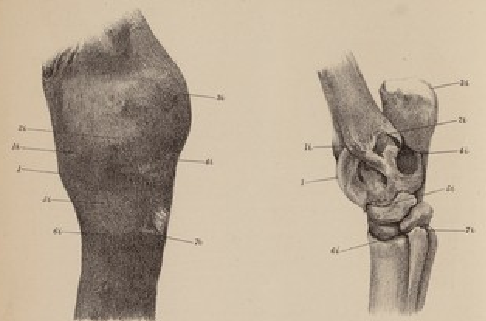
On the external face of the hock we have six distinct prominences.

1 *e*. A prominence due to the external malleolus of the tibia, large and extensive. The place marked in Fig. 5 is through the centre of the peroneus tendon and the groove on the tibia which lodges it.

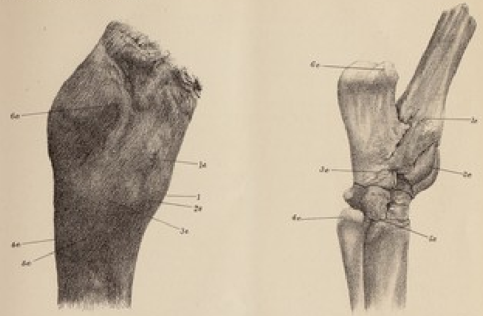
2 *e*. Below 1 *e* and rather anteriorly placed is a prominence due to the external ridge of the astragalus. The exact spot on the astragalus indicated by this mark can be seen in Fig. 6.

3 *e*. On a level with *2 e*, but posterior to it, is a large prominence due to the inferior and outer extremity of the calcis—not to the cuboid as is generally considered; at the part indicated in Figs. 5 and 6 is inserted the outer lateral

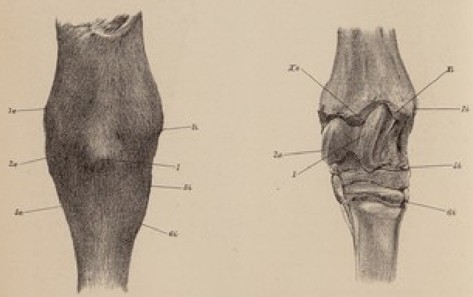
Plate I.—SURFACE ANATOMY OF THE HORSE'S HOCK.



Figs. 1 and 2.—Inner Face of Hock Joint.



Figs. 5 and 6.—External Face of the Hock Joint.



Figs. 3 and 4.—Anterior Face of Joint.

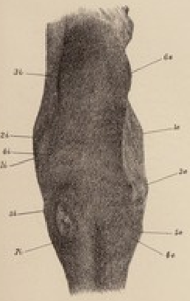


Fig. 7.—Posterior View of the Hock Joint.

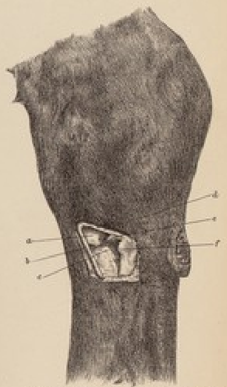


Fig. 8.—A Dissection of the Internal Face of the Hock limited to the "Spavin" Region.

W. & A. K. Johnston, Edinburgh & London.

ligament of the joint. Immediately in front of 3 *e* runs the tendon of the peroneus. Prominences 1 *e* and 3 *e* appear to run into one another, and to be connected by a ridge. This ridge is the external lateral ligament of the joint, which in Fig. 6 is left intact. The drawing shows that slightly below 3 *e* there is still a large swelling. This is the body of the calcis, which is here very large and prominent.

4 *e*. Below and well behind 3 *e* is a prominence due to the extensively developed head of the outer small metatarsal bone; here is inserted the misnamed calcaneo-cuboid ligament. The exact place indicated in Fig. 5 is on the extreme posterior edge of the bone, *see* Fig. 6.

5 *e*. Some short distance in front of 4 *e* is a prominence due to a projecting part of the head of the large metatarsal bone, just where it articulates with the outer splint bone. Immediately in front of this projection is a groove lodging the metatarsal artery. This prominence is put into insignificance owing to the considerable size of the head of the outer splint. The exact spot in Fig. 5 is between the cuboid and outer splint bone, just posterior to the articulation of the two metatarsals, *see* Fig. 6.

6 *e*. A projection at the upper and posterior part of the hock due to the calcis; at the part indicated in Fig. 5 is the lateral ligament of the cap of the hock.

1, Fig. 5, is the prominence on the anterior face of the joint produced by the internal ridge of the astragalus.

Fig. 7.—The figures correspond to the faces already described; the drawing is introduced to show the position of the prominences when viewed from behind.

Reviewing these prominences, which as landmarks are of the greatest possible value, and comparing Fig. 1 with Fig., 2 we are struck by the fact that the postero-internal face of the hock—just behind what for convenience we will term the spavin region—is ligament and not bone; that the division between the large and small metatarsal, instead of being at the back of the joint, is very near the centre, viz., midway between No. 6 *i* and 7 *i*, Fig. 7. No. 6 *i*, Fig. 1 indicates nearly the posterior limit of the cuneiform medium, whereas one would be inclined to think that in the living joint it extended very much farther back; No. 7 *i*, Fig. 7 indicates the posterior limit of the bony region; *see* also Fig. 8.

I shall have to point out later the advantage from a diagnostic point of view of the landmarks afforded by 5 *i*, 6 *i*, and 7 *i* of the internal face of the hock, and the necessity which exists for exact localisation on the living limb. I would indeed speak of them as the cardinal points of the hock, and of the triangle which they enclose, of which 5 *i* is the apex and 6 *i* and 7 *i* the base, as the tarsal triangle.

Turning now to the outside of the limb, the necessity for local landmarks is nothing like so great, though no less interesting. We learn from what has already been described that the posterior part of the base of the external face of the hock is bone, viz., the outer small metatarsal; here then the outer differs considerably from the inner face, which, as before remarked, is ligamentous at the posterior part of the base—in fact, if we compare generally the external and internal faces of the hock it will be found that the external face possesses much more bone than the internal face.

From a point of exactitude it is necessary to bear in mind how very little the cuboid or the cuneiform parvum play in the building up of either the internal or external faces of the joint. It is true that one bone is situated on the outside and the other on the inside of the limb, but if we examine the bones of the joint *in situ*, it will be seen that their position is not on the internal or external face but on the *posterior face* of the joint, which they envelop so completely as to nearly touch each other.

A very important clinical point is a determination of the amount of the cuneiform bones which can be felt in the living animal when examining the internal face of the joint. I have no hesitation in stating that the amount is inconsiderable, and very much less than is usually supposed. This is not apparent on looking simply at the bones forming the joint, where practically half the magnum, half the medium, and the whole of the parvum are in view as in Fig. 2, but we must remember that though in view with the bones exposed they are not *within touch* in the living animal; for instance, the magnum can never be felt, because its face is covered by the slip of tendon from the flexor metatarsi; only a very small piece of the parvum can be felt, for its face is occupied by the slip of tendon from the flexor metatarsi, and by the powerful ligament running down the postero-internal face from 2 *i* and 4 *i* to 7 *i*, Fig. 2. We are therefore left with a small piece of the medium and its ridge, a large piece of the head of the large metatarsal bone, and a little piece of the parvum, as the only portion of the internal face of the hock which is practically covered by skin; see Fig. 8 which shows a dissection of this region without serious interference with the main ligaments. It is not, however, perfectly true to say that the bones here are only covered by skin; as a matter of fact there is only a portion of the head of the metatarsal which simply has skin covering it; all the other portions exposed in Fig. 8 are covered by ligamentous material, dipping down between the bones, and plastering over and cementing the surface in such a way as to give little or no indication to the touch of the irregular surface which actually exists here. This ligamentous material plays a most important part in the formation of spavin, as the greater part of the tissue becomes ossific. In Fig. 8 the superior border of the exposed surface is bounded by the slip of the flexor metatarsi, and the anterior margin by the saphena vein.

FIG. 8.—*a*. A portion of the cuneiform medium and its ridge; *b*. The saphena vein; *c*. Portion of large metatarsal bone; *d*. The extreme lower edge of the slip of the flexor metatarsi tendon which runs to the parvum; *e*. Small portion of the parvum; *f*. Inner small metatarsal bone.

Between *c* and *f* is the groove representing the division between the metatarsals; between *a* and *e* a space representing the division between the medium and parvum.

I have endeavoured to show that the surface of the hock which we can feel and thoroughly examine is inconsiderable; I do not mean by this to say that those parts covered by ligamentous tissue will afford no information to touch, but I wish to impress the important fact that an examination of these parts can only be conducted through ligamentous material more or less dense, and that such examination is more or less imperfect.

The description just given only deals with that region of the hock posterior to the saphena vein, which as we know only contains a portion of the region affected with spavin; I shall now describe that part situated between the tendon of the extensor pedis and the anterior part of the saphena vein. Here we find a considerable quantity of

ligamentous material, such, for example, as the anterior annular ligament of the joint, and beneath this a thick band representing the insertion of the flexor metatarsi into the head of the metatarsal bone; when these are removed we find the dense fan-shaped ligament which runs from the astragalus over the cuneiforms, and beneath this latter is the medium—a dissection carried higher up and involving the slip of the flexor metatarsi, would be necessary to expose the magnum.

To put this in a few words, the medium might *possibly* be felt anterior to the saphena vein, but the magnum could not; this is extremely unfortunate, for a careful examination of this region would be of the greatest value to us in the diagnosis of spavin, as some of the figures I have yet to show will conclusively prove. There is, however, a place anterior to the vein where bone may be distinctly felt; this is the metatarsal bone, though I think often confused with the medium; it is important to map it out carefully, for when we lose the touch of bone we may be sure that a little higher up our finger will be over the medium.

I do not propose to describe any further the anatomy of the hock joint; it will be observed that all I have attempted to do is surface anatomy, such as is required in everyday practice. I must, however, briefly describe some of the movements which occur in this joint, as I believe they affect the production of disease in this region.

The chief movement of the hock occurs between the tibia and astragalus; the latter with its ridges looking outwards forms a perfect hinge joint and one allowing of considerable motion. I have shown elsewhere[1] that these ridges on the astragalus do not turn the hock outwards, but that the leg below the hock is carried forward in a comparatively straight line, the influence of the ridges being to produce that remarkable turning out of the stifle so well seen in the trotting horse.

Though the range of motion between the tibia and the astragalus is so considerable, yet it is not fully exercised in all the paces; it is only in the jump and the gallop that the angle formed between the tibia and metatarsal is closed to any great degree. If, when the joint is completely closed in the dead dissected limb, we look at the posterior part, viz., the now uncovered ridges, we find that when the part is flexed to the utmost the *tibia and astragalus are no longer in apposition*—the tibia has left the astragalus and a space exists between them. To prevent flexion to a dangerous degree two stops are placed on the anterior face of the inferior extremity of the tibia, one outside and one inside, the outside being the larger of the two (Fig. 4, *x e* and *x i*); these stops come into contact with two rests on the astragalus, and in this way, rightly or wrongly, I think that a certain amount of jar may be imparted to the astragalus. As the inside stop comes into contact with the astragalus slightly before the outside stop, I conceive it possible that the inside of the astragalus receives more concussion than the outside. Can this help to offer any explanation of the position of spavin?

Looking at the ridges on the astragalus, one is narrow and one broad; the narrow one is the inside ridge, and it runs completely down to the surface which articulates with the magnum, and sometimes considerably overlaps this surface. This point will be mentioned again, as

[1] A Manual of Veterinary Physiology.

I think that it occasionally bears some relation to articular spavin. The overlapping ridge can be seen in Fig. 4.

The movement in the true hock-joint is very simple as well as extensive, but the movements between the small bones composing the joint are complicated. In the first instance they are very limited; the astragalus moves on the magnum, the magnum on the medium, and the medium on the large metatarsal, but the amount of movement in these is not the same, the astragalus and magnum movement being the greatest. One would consider that the movement in this part was rather of a front to rear, viz., to and fro, character, though the ligamentous attachment between the bones, being situated at the central part, would show that this was probably not the case. Pathology proves the correctness of this latter supposition. An examination of the face of these bones when affected with articular disease exhibits well-marked, sharp, and rather deep grooves, which run obliquely across the face of the bones, and are better seen between the astragalus and magnum than elsewhere. The grooves are the result of friction during the movement of the joint, and they tell us that the motion of these bones on one another is more of the nature of a rotation.

Again, these grooves tell us where the greatest amount of pressure normally comes on the bones; it will always be found that the greatest damage is on the anterior and internal surface, and this rule holds good whether it be the astragalus, magnum, medium, or head of the large metatarsal which we are examining.

If we make a longitudinal section of the leg from the thigh to the fetlock, we observe that the line of weight on the bony column mainly falls through the anterior part of the hock joint.

There can be no doubt that this pressure is removed by resting the leg, viz., flexing the hock, and I conceive this to be the reason why no horse ever stands resting equally on both hind legs.

Defective flexion of the hock is present in spavin, but unless the disease is articular I do not see that the defective flexion is necessarily produced by the pain resulting from the movement of the cuneiform bones on each other, but rather from the fact that the more a horse flexes his hock the greater shock is there to the part when the foot comes to the ground; the defective flexion, at any rate in many cases, I regard as the means the animal adopts to save itself pain, and not as due to any mechanical interference. We will touch on this point again.

In concluding this notice of the structure of the hock I beg to summarise what I consider to be the important clinical points in connection with it.

1. We should know what every prominence and depression on the joint means and the parts connected with them.
2. We must bear in mind that though the base of the external face of the hock is bony from front to rear, this is not the case with the internal face.
3. The only bones which can be indistinctly felt in the triangle of the hock are the projection on the astragalus, a piece of the medium, and a small portion of the parvum; a considerable portion of the metatarsal can be distinctly felt.
4. The magnum cannot be felt, as it is covered by the slip of the flexor metatarsi; its position can only be indicated, not felt.

5. The groove which can be felt in the base of the tarsal triangle is the furrow between the inner small splint and the large metatarsal bone. This part lies much nearer the céntre of the hock than is generally supposed.
6. Anterior to the saphena vein the medium and magnum are so enveloped by ligamentous and tendinous tissue that they cannot be felt, the exposed bone in this region being the head of the metatarsal, and not the medium.
7. The cuboid and parvum are practically at the back of the hock, and but little of them is present on the lateral aspects of the joint.

Strange as it may appear, I do not think it is a simple matter to define what a spavin really is. We cannot describe it as an exostosis affecting the hock and limited to a certain region, for though this definition would cover by far the majority of cases which present themselves to our notice, yet it fails to deal with those cases of hock disease where there is no exostosis, or one so situated as not to be seen or felt. If this difficulty were overcome, and we described a spavin as an anchylosis of certain bones of the hock with or without exostosis, even then the definition would not be sufficiently comprehensive for our purpose, for it would not take cognizance of the worst and incurable form of spavin, viz., that attended by articular disease.

Assuming, however, that these difficulties were overcome, how are we to describe those cases of hock disease which occur at the back of and outside the joint?

I shall have to show that disease between the calcis and astragalus is far from rare, that the cuboid is by no means uncommonly affected, and yet to speak of a spavin at the back or external part of the joint, would certainly be taking considerable liberties with a term which rightly or wrongly has been used to define a disease occupying a limited portion of the hock, and confined to a very distinct area.

Such then are the difficulties in defining a spavin, and while our knowledge is so obscure, I would prefer provisionally to speak of it as a specific inflammation of any of the bones entering into the formation of the hock joint,—exclusive of the tibia—which may terminate in anchylosis and exostosis, or in ulcerative disease of the articulations, the region most commonly affected being the inner and anterior aspects of the joint. I do not like the term specific, as it might possibly be liable to misconstruction, but at present it appears almost necessary to use it for reasons which have been previously given.

Spavins are of two distinct kinds.

a. Those terminating in anchylosis and exostosis.

b. Those terminating in ulceration of the articular surface of the joints affected, with no attempt at anchylosis, often with a very limited exostosis, and frequently with none whatever.

a Is a curable disease, *b* is incurable.

Each of these classes may be still further subdivided according to the nature of the lesion and the parts affected. In *a*, for example, we may have—

1. What is perhaps the most common form of the disease, anchylosis of the cuneiforms magnum and medium, with exostosis, ,which is common, or without exostosis, which is rare; the

latter can of course only be determined after death, though we may suspect its existence during life.

2. The same as No. 1, with the addition of the parvum and the cuboid, the former more often than the latter.
3. The same as Nos. 1 and 2, with the addition of the head of the large metatarsal bone and the inner small one, rarely the outer. The implication of the inner small bone is a trifling matter, but the implication of the head of the large metatarsal bone may be a very serious consideration.

Class *b* may also be divided into groups.

1. Ulceration between the cuneiforms magnum and medium with very little external manifestation of the disease.
2. Ulceration between the medium and large metatarsal with but little if any external disease.
3. Ulceration between the astragalus and magnum with perhaps little external disease.
4. Ulceration between the astragalus and calcis with no external manifestation.
5. Ulceration between the cuboid or parvum and the cuneiforms magnum and medium with no external disease.

In Class *a*, so long as the diseased process confines itself to the three cuneiform bones hope of recovery may usually be entertained, but so soon as the astragalus and the head of the large metatarsal bone are affected, the case almost at once places itself in Class *b*. I wish to be perfectly clear and impressive on this point, and though I still have again to refer to it, I feel I cannot state these important facts too early.

If the astragalus becomes implicated in the diseased process, instead of anchylosis taking place ulceration occurs and the case is incurable. If the head of the large metatarsal bone is affected ulceration *may* occur, in which case the disease is incurable. So long as the affection confines itself to the cuneiforms there is every chance of a permanent recovery.

It is singular why the introduction of the head of the metatarsal bone should increase the gravity of the case, and why the introduction of the astragalus places it at present beyond the pale of our art ; such, however, is an undoubted fact, the demonstration of which it has been one of the objects of this communication to bring about.

A most interesting pathological point here arises :—Are the diseased processes which lead to articular and non-articular spavin identical? One may at once say, No! they are not the same, for one leads to joint destruction, whilst the other leads to joint consolidation—but that is not the point ; the effect of the processes we know to be markedly different, but does the effect depend rather upon the nature of the bone, viz., a special proneness to decay, or upon the surroundings of the patient, viz., the inability to allow it perfect rest?

My own views on the matter are far from mature, but every year I am more and more inclined to regard the two processes which lead to articular and non-articular spavin as different. I do not think that one runs into the other, that is to say, that the originally non-articular may eventually become articular, or that the originally articular may end in anchylosis. I have never seen anything in all my *post-mortem* experience to support such a supposition ; every particle of *post-mortem*

evidence points, so far as I can see, to the two processes being quite distinctive.

I have used the term articular spavin, but this is liable to mislead ; *every spavin is articular*, inasmuch as it affects one or more joints, but every spavin does not produce destructive caries of the joint, and that is certainly the outcome of what we commonly speak of as articular disease.

Let us here consider the changes which take place in these small bones of the hock as the result of disease.

Without doubt the cuneiforms become inflamed ; perhaps in some cases the word congestion would be more suitable than inflammation, though I confess to be unable to determine where congestion ends and inflammation begins ; but I use the term for the reason that where, in those rarely occurring cases, we have an opportunity of examining in the early stage bones affected with specific disease, it is astonishing how little there is to show for the lameness which has been present. The bone on section is perhaps dark, and minute blood points are visible here and there in the compact tissue, perhaps freely distributed through it, often not. These blood points are not to be confused with those observable in a healthy bone after making a section and allowing it to stand. The general tint of the compact tissue is very pale purple, sufficiently marked to attract the eye, but not sufficiently gross in its character to account for slight, let alone acute, lameness.

We cannot learn too early that it requires very little alteration in bones when suffering from specific disease to constitute severe and often incurable lameness ; unless we learn this lesson early our examination of a pastern bone in ringbone or a hock in spavin will, if no external disease be present, lead to a very unsatisfactory feeling.

It is, then, owing to what I may term the subdued nature of the lesion in early cases of spavin, that I would rather speak of the bone as congested instead of inflamed.

We will imagine, however, that our diseased process has gone on a little further ; the bone now throws out on its surface small bony deposits, which may or may not assume well-marked proportions. While this change has been taking place the articulations formed by the diseased bone are suffering, the earliest change occurring in the cartilage, which disappears by absorption, or, what I consider the more rational explanation, it is worn away by the friction of the opposing bones and is not regenerated.

It is at this point that articular and non-articular spavin overlap. As a matter of fact the articulations in both of them are affected, but, as I expressed it just now, one is a destructive, the other a constructive, process. At present I am dealing with the latter.

The articular cartilage, not being regenerated, gradually disappears, and the bones to be united become here and there, especially at their margins and posterior part, securely fixed by small bony growths. These latter are most important ; they act mechanically as splints in keeping the two or more bones in complete apposition while their articular surfaces become cemented. Around the margin of the bones these splints can be detected as minute spicula, and they are favoured in their growth by the margins of the bones swelling or slightly enlarging. I have seen reason to believe that these spicula found around the margin and on the external surface of cuneiform bones undergoing the process of anchylosis, originate in the ligamentous tissue binding the bones together, for in the completely anchylosed joint, the pattern of the spicula and deposits on the surface of the bones correspond with the direction of the fibres and shape of the ligaments here situated. That ligamentous tissue does undergo this change is undoubted, for the interosseous ligaments of the cuneiforms are distinctly converted into bone, and preserve their shape and direction, as may be seen on making sections of affected bones (Figs. 5 and 6, Plate II.).

While all this is occurring the cartilage is absorbing, more rapidly anteriorly than posteriorly, and at last the surfaces of the bones are in apposition. They do not however unite at once; we find that the next step is a removal of the upper compact layer of bone tissue, which gets apparently eaten away for a very limited depth. The shape of this surface is peculiar; it is generally seen as a narrow streak across the cuneiforms from side to side (*see* Figs. 1 and 2), and looks as if some insect had been at work, just nibbling away the upper layer of compact tissue and no more; in the bone resting on this exactly the same pattern of streaky shallow excavation may as a rule be seen, indicating where the two surfaces touch. If this streaky excavation be examined, the bone forming it is found to be rough, but quite solid and firm. The depth of the streaky marking is so slight that particular attention is not commonly directed to it, but I can positively affirm that it, and not destructive caries, is the initial stage of anchylosis of the hock.

No further change than this may occur; the streaky surfaces in course of time unite, and the bones are perfectly fixed together, not, be it observed, over the entire articulatory surfaces, but only at those parts where the posterior deposits have been thrown out, where the ligamentous tissue within and without the bones has ossified, and where the streaky surfaces just alluded to have united.

If, therefore, sections be made of these bones, we find that there are not uncommonly large areas of the articulation absolutely ununited, the firm union between the bones depending entirely on the factors we have just enumerated (*see* Figs. 5 and 6).

The streaky appearance described above is not always seen. Many articulations present cavities, some even distinctly deep, and looking so like the caries of true articular disease that I have one joint in my possession I am still uncertain about (*see* Fig. 3); as a rule there is no difficulty in determining the character of the change. These cavities may be like pin holes, or irregular and streaky in pattern; sometimes, though rarely, they may be fairly wide and deep, but they all present one appearance, and that is, their surfaces are rounded; they do not look like the angry hole produced by caries—a hole containing partially dead bone, rough, brittle, and running deep beneath the compact layer. The excavation of anchylosis is smooth on all its surfaces, and generally shallow; but the deeper it goes the smoother its interior becomes, no matter how irregular the pattern may be which it forms within. In true articular spavin the surface of the cuneiform magnum is grooved from friction, and an ulcer on one surface as a rule has a corresponding ulcer on the surface of the bone immediately in apposition with it. This is not the case in non-articular spavin; here we find no grooving or eburnation of the articular surfaces, perhaps

PLATE II.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

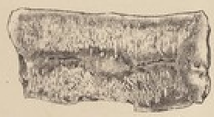


FIG. 5.

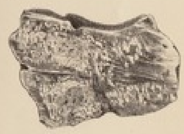


FIG. 6.

FIGS. 1 and 2.—The streaky superficial erosion of the cuneiform bones antecedent to anchylosis. *Fig.* 2 is more advanced than *Fig.* 1.

FIG. 3.—Cuneiform medium with parvum attached, showing articular disease anteriorly, which I am inclined to regard as not true articular spavin.

FIG. 4.—Cuneiform medium with parvum attached, showing articular disease posteriorly, which is the antecedent of anchylosis and not of true articular disease.

FIGS. 5 and 6.—Longitudinal and transverse section of anchylosed magnum and medium; observe the ossification of the interosseous ligaments, and especially that the whole articular surface is not fully united.

PLATE III.

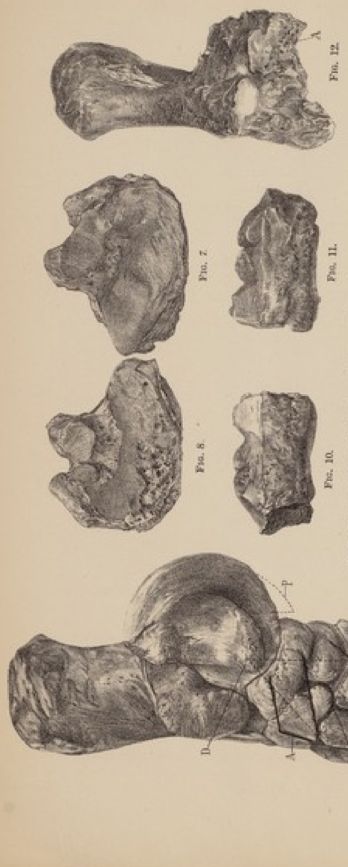


Fig. 8. Fig. 7. Fig. 10. Fig. 11. Fig. 12. Fig. 9.

Fig. 7.—Early stage of true articular disease; the magnum is grooved and burnished from friction.
Fig. 8.—A more advanced stage, the grooving followed by extensive caries.
Observe in both bones how the disease is limited to the anterior and internal aspect of the articulation.
Fig. 9.—Inner aspect of the hock joint. The ridge of the astragalus does not extend over or touch the magnum. The dotted line "p" shows the position of a ridge which hangs over the magnum, though in this case it does not touch it.
A. The heavy lines enclose the area occupied by the insertion of the slip from the flexor metatarsi.
B. A line indicating the position of the vena saphena.
C. Dotted line indicating the base of the tarsal triangle, the apex of which is at D.
This figure should be studied in conjunction with Fig. 8, Plate I., in the preceding number of the Journal.
Figs. 10 and 11.—Complete anchylosis of the cuboid, magnum and medium; the figures are intended to convey an idea of the amount of bony material which exists anteriorly and quite out of touch. In Fig. 11 the space between the cuneiforms is distinctly seen, also the edge of the articulation, yet the hock is badly spavined. Such a condition is incapable of being diagnosed.
Fig. 12.—Articular disease between the calcis and astragalus with no external indication of the same. The area affected is A.

because they are not moving on each other; here a hole in one bone has not necessarily a hole in the opposite articular surface, but rather an outgrowth from this latter, as if it were endeavouring to fill up the cavity formed in its fellow, and this is really what is taking place (Fig. 4).

I look upon these as most important distinctions, serving in the majority of cases to absolutely determine the nature of the lesion almost at a glance, with the single exception of the specimen I have previously spoken of.

Does this false articular disease ever run into the true articular spavin? I have previously discussed this point, and have given it as my belief that it does not, and that they are distinct processes. I have, however, seen false articular disease between the cuneiforms, and true articular disease between the astragalus and magnum. Such specimens are rare.

With the absorption of the articular cartilage the bones are brought closer together, and as the result of this compression their edges appear to overlap, apparently in consequence of the weight of the body; it is as if the bones were becoming flattened, and the superfluous bone had run over the side. This is a well marked change readily seen in almost any specimen of non-articular spavin which has not gone on to complete anchylosis.

True articular disease starts as absorption of the articular cartilage and grooving of the compact bony tissue; this, accompanied by eburnation, is the characteristic feature of early articular disease of the magnum and astragalus (Fig. 7, Pl. III.). This grooved surface is faintly purple, with the cartilage removed, and the bones showing minute pin point holes with ragged edges; the holes increase in size and gradually run together, destroying the compact and exposing the cancellated tissue; the edges of the ulceration are rough, the carious part filled with granulations, and the depth to which this process (true caries) is carried may be very considerable (Fig. 8, Pl. III.). The surface of the articulation which is most affected by true articular disease is the anterior and inner surface of the bones (cuneiforms and astragalus).

Grooving of the bones is only seen in true articular disease between the astragalus and magnum. In all forms of the true disease the ulceration on one surface corresponds detail for detail with the ulceration on the opposite surface.

Up to this point our time has been occupied considering the question of true and false articular disease. We have shown that in all spavins more or less articular disease is present, in the one case leading to consolidation, in the other to destruction, one being curable the other incurable; we have also shown that there is good reason for believing that the characters presented by these two joint lesions are so sufficiently distinctive as to be nearly unmistakable; and, lastly, have stated that the relative frequency of true and false disease is probably dependent upon the part of the joint affected, the articulation between the small bones themselves being especially prone to the constructive disease, whilst between the small bones and the large bones the disease is essentially destructive.

We have now to consider whether there is anything in the anatomical formation of the hock which will determine either the production of disease or settle the course it shall run. I am inclined to think that we have some evidence on this point, which it will be necessary for us to consider.

I have always believed that the anatomical arrangement of the astragalus plays an important part in the production of disease. In a well made astragalus the inferior extremity of the inner ridge should not touch or be below the articular surface formed between this bone and the magnum (*see* Figs. 9 and 17). Now, there are two departures from this normal condition, one in which the inner ridge is continued down so low that it overhangs the articulation without touching it, while in the second case it overhangs the articulation and touches it as well; in some cases the ridge of the astragalus may be seen pressing into the front of the magnum, and I am convinced that though this condition may be associated with a healthy hock, yet it is very often associated with a diseased condition, and that the worst of all conditions, viz., true articular spavin (Fig. 18, Pl. VI.).

It is not difficult to see how an overhanging ridge of the astragalus may produce hock trouble, when we remember the "stops" placed on the astragalus to bring up the tibia and prevent over-flexion of the hock, and how the concussion from this and other causes must be a constant source of irritation to the magnum, and indirectly to the bones below it.

It will almost invariably be found that in those cases where there is true articular disease present between the astragalus and magnum, the inner ridge overhangs the magnum, sometimes to a remarkable extent. I am quite aware that this is not an invariable rule, but it happens with sufficient frequency to be worthy of consideration.

Though I have laid stress on this overhanging ridge, yet I do not say that every hock possessing it is necessarily diseased, I have perfectly sound hocks in my possession with an overhanging ridge, but we must draw a distinction between a simple overhanging ridge which does not touch the magnum and one which does. It is the latter which I regard as so serious.

Another anatomical factor of importance is what I have vaguely termed a weak cuneiform bone. A strong cuneiform is a thick bone with its articular surfaces as nearly flat as possible (Fig. 17); a weak bone is a thin bone with its articular surfaces as curved as possible (Fig. 18); it is impossible without examining a number of joints to gain any notion of what is meant by the purely relative expressions of "thick" and "thin," "curved" and "flat." I believe, though I have no absolute proof, that a short compressed hock is one where the cuneiforms are thin.

The above are the essential anatomical points which, according to my observations, may influence the production of disease in the hock, but I do not consider that the presence of them necessarily produces disease, any more than I consider their absence guarantees the safety of the joints.

We are now in a position to consider the question of spavin more closely, and first of all as to the parts of the hock which may become involved in the diseased process.

Without doubt the most common lesion is anchylosis of the magnum and medium; conjoined with this may be anchylosis of the parvum or cuboid, or both, the parvum being more commonly affected than

PLATE IV.

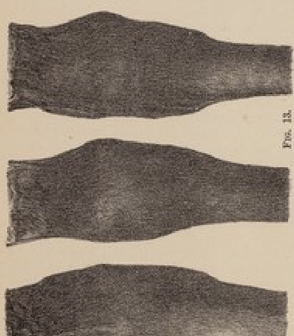


FIG. 13.

FIG. 14.

FIG. 13.—To illustrate the effect on the shape of the inner outline of the hock when regarded from different standpoints. B is the appearance when viewed directly from the front, the inner part of the joint being on the right hand side; A is the same joint as B, only looking slightly outwards; there is a marked enlargement over the seat of spavin; C is the same joint as A and B, only turned slightly inwards; it has a phantom spavin.

In the following Figs.—14, 15, 16, 17, and 18—two figures are represented. On the right is a plaster cast of the hock before dissection, the cast being limited to the inner face of the joint; on the left is the joint itself with the bones in position. All the joints are "off" joints, so that in each case the right edge of the figure represents the inner aspect of the joint.

In FIG. 14 there is a prominent and abrupt head of the metatarsal bone at A, causing a phantom spavin at A'. The joint is quite healthy.

There is also a prominent ridge on the medium.

the cuboid. Occasionally, though very rarely, the head of the small metatarsal may be affected. I think I only have one specimen where such is the case. Though union of the small to the large metacarpal is so common as to be a rule, union of the small to the large metatarsal is so rare as to constitute an exception. The reason of this is that the small metatarsals are outside the line of the body weight.

The bony material which unites the magnum and medium is often very irregularly distributed, occasionally being so great as to cause considerable enlargement over the inner aspect of the joint, but at other times being limited to the anterior and posterior part of the joint, leaving the inner aspect quite clean; in such cases, though the horse is spavined, it is impossible to determine the condition, as the part where the exostosis exists is completely covered by tendons and ligaments (*see* Fig. 11, Pl. III.). This is a most important point, for it shows that it is never possible to say that a horse is free from spavin; all we can say is that "*so far as it is possible to determine*" such and such a horse is free from spavin.

The character of the bony material uniting the cuneiforms partakes of the direction occupied by the ligaments binding the parts together; occasionally the most perfect representation of the ligament in a bony clothing may be produced—it will be remembered that this has been touched on before.

So long as the disease process is limited to the joints formed between the *small* bones of the hock, so long is it as a rule curable. When it affects those articulations of the small bones which form joints with the astragalus and large metatarsal, quite a different aspect is placed on affairs, and a disease perfectly curable becomes now quite incurable. So far as the astragalus is concerned this is explainable owing to the movement of the parts, but it is difficult to understand why the joint between the medium and large metatarsal should be more liable to destructive than constructive disease.

There are other seats of hock disease than those we have named. I have specimens in my possession of disease between the calcis and astragalus, always apparently of a destructive character, sometimes extensively so (Fig. 12, Pl. III.). It would be an utter impossibility to determine the existence of this condition during life.

Disease between the parvum and magnum is very common; it is generally limited to the superior-posterior part of the parvum and posterior part of the magnum; no external condition could exist to point to its presence. There are cases, of course, where there is external anchylosis, but these are comparatively rare.

Disease between the cuboid and magnum and medium has been dealt with in describing union of the cuneiforms. I have a specimen in my possession where a large cavity exists in the cuboid where it articulates with the magnum. Such a condition could never be diagnosed.

For these and other reasons I hold it to be absolutely impossible to declare a horse free from spavin, or, to put it in its wider and more correct sense, to be absolutely free from any disease of the bones of the hock; further, as I have yet to show, there are cases so like spavin that we may swear to its existence while the hock is quite sound (Fig. 14, Pl. IV.).

These apparent contradictions are largely the cause of the grave differences in opinion which exist as to the soundness or otherwise of a hock—differences which it is impossible to avoid, but the number of which it is possible to reduce by greater accuracy in our knowledge of the structure of the joint, and a more exact acquaintance with the changes which are possible in it.

Up to this point we have considered the hock as revealed to us by dissection; we have now an important but less exact subject to deal with, viz., the condition of the joint during life and a determination of its soundness or unsoundness.

Hocks vary as much in shape as any other part of the animal's body, the variation being due in the majority of cases to structural differences. It is difficult, if not impossible, to describe the various shapes of joint met with; upright or bent, narrow or wide, prominent or flat, express differences well marked to the eye but nearly incapable of any useful description.

The shape of a hock and its proneness to diseases are believed by many to act as cause and effect. Personally—in the case of spavin—I am far from clear on the matter, for it is astonishing how well the most unpromising looking hock will stand work, and how indifferently the most promising one often turns out. In fact, so far as my experience in the matter goes, no rule can be laid down with respect to shape as influencing the production of spavin.

In the examination of hocks I am convinced that the senses of sight and touch should be combined, relying exclusively on neither the one nor the other; we must both look and feel; both of these senses may be so employed as to give utterly unreliable results, and these we must now consider.

If we take a perfectly accurate sphere and look at it from any point on its surface, the curve presented to the eye is always equal and the same at any and every part; if now we take an object shaped like a spoon the curves presented to the eye are obviously not all identical, some being flatter or more curved than others. This, I think, is the first elementary lesson to be learned in hock judging; both hocks must be looked at from an identical position. If, for example, in joints identical in size, we take the outline of the near hock well forward, and that of the off hock well back, it is obvious that one will look larger than the other. No one, of course, with any experience would think of performing an examination in such a careless manner; I simply use the illustration to convey a point of great practical importance, viz., that the position in which we look at each limb must be identical.

This identical position does not mean that we are to stand so many inches away from the fore-leg in looking at each limb, for it might and is often necessary to stand a foot or two away from one fore-leg to see one hock, and only a few inches away to see the other; we are not, in other words, to pay any attention to the relative distance we stand from the fore-legs, but to keep our attention solely concentrated on our position relative to the hind-legs. Unless a horse is standing perfectly square with both hind-feet together, it is impossible to avoid one hock being turned in or out slightly more than its fellow; this slight difference makes an enormous difference in hock-judging, for, as the hock is for our purpose like a spoon, the lines of its curvatures are of equal value only when measured at the same place on each joint

(*see* Fig. 13, Pl. IV.). I use the term measure, as this is really the process employed; we mentally measure the joints by comparison.

To ensure this operation being carried out with exactitude we may chose any point on the limb to work from; I mentally draw a straight line down a part of the front of the thigh, cutting the hock through the middle of its anterior face, and continuing the line on to the shank. I now stand exactly opposite to this line, and take in the inner outline of the joint; in the position in which I am standing I should see slightly behind the vena saphena, and I take in the outline of the hock from the prominence on the tibia to the shank. The operation is repeated on the opposite hock, an identical position being taken up, over which no difficulty will be experienced if we regulate the position of the body according to the land-marks we have laid down for ourselves on the first joint.

In this way, passing from side to side of the horse, we can form a very fair estimate of the relative size of the hocks. But this method if not supplemented by touch is open to great fallacy when the vena saphena is unusually prominent.

Looked at in the position we have described, considerable variation will be found in the outline of hocks; some run with a nearly unbroken straight line to the shank; others present a prominence in the middle of this line, due to the inner projection of the astragalus, and just before the line gains the shank give an abrupt curve inwards to join it; others have a distinctly curved line below the astragalus, and join the shank by a rather long sweep instead of a sudden one. All these appearances are compatible with perfect health, and at this point we must learn the lesson that *an enlargement which will constitute a spavin on one hock may be a perfectly normal condition in another.*

This paradox is explained by anatomy; the ridges on the cuneiforms, and the prominences on the inner side of the head of the large metatarsal may be exaggerated, but providing—within limits which only experience can lay down—that the two joints are identical in size and shape, the enlargements are normal, and the hock so far as we can determine free from disease. Another hock may have a similar exaggeration of these prominences of no larger proportion than in the case just assumed, yet the prominences may be absent from this position in its fellow, and therefore such a hock is diseased; in other words, we are reduced to the old rule of practice, which is capable of a scientific explanation, that if both hocks are the same size pass the horse, if of unequal size reject. This rule very properly takes no cognizance of the extent of the difference in the size of the two; it may be slight or great, and personally speaking, in respect of the animal's future usefulness, I would rather that the difference be great than slight; big spavins give less trouble than little ones; one is constructive the other often destructive.

Our inspection of the hock need not and should not be confined to an inspection from one side; we may, for instance, view both hocks by looking through the fore legs, but to conduct this examination without fallacy, the feet should be together so as to insure that the hocks are in an identical position; further, an inspection from behind carried out with the same precautions may in some cases of doubt be of great assistance.

The sense of touch is capable of affording considerable information, though open to great fallacy; we must deal with the latter first.

We feel the hock to gain some idea of its outline and size, and to check the information thus obtained we compare the joints; if this comparison is to be of any value, both hocks must be felt in the same way, viz. *in the same direction* and under the same conditions; it is no use passing the fingers over the inside of the near joint in a direction from above downwards and backwards, and on the other joint from above downwards and forwards, and yet, owing to the position in which the hand has to be placed, it is difficult to unconsciously avoid committing this error. The result of committing it in its most aggravated degree would be to compare the feel of the inner projection of the astragalus, magnum, medium, and head of large metatarsal in one limb, with the inner projection of the astragalus, magnum, parvum, and head of inner small metatarsal of the opposite limb. Such results can only be misleading.

There are other fallacies in manipulation. Suppose, for instance, we are standing on the near side and feeling the near hock, the direction of the pressure we apply to obtain the needful feel is towards our own body, whereas when we compare this joint with its fellow our pressure is away from our own body; again, when feeling the near hock the index finger is forwards, whereas when we pass our hand to the opposite limb the index finger is backwards, and much of the information it is capable of conveying is thus lost, *for identical points are not compared with the same finger*. These are the only explanations I can afford of the great difference which *appears* to exist between hocks which are really identical in size—a difference which is unsupported by the sense of sight, and quite uncorroborated by a reversed inspection of the opposite limb.

When I find that first one hock and then the other is the larger to the touch, I always know that it is the individual and not the joint which is at fault, and it is here that inspection is so very valuable in correcting a wrong impression.

When feeling a doubtful hock, it is well to temporarily empty the vena saphena, and while the head remains in position to take in the outline of the inner face of the joint; we next pass over to the opposite side of the body, temporarily obliterate the vein there, and with the head and body in an identical position inspect the outline of the inner face of this joint. The two joints should agree.

In inspecting a hock, whether combined or not with touch, great care must be taken to get the horse's legs together, not necessarily with the feet touching, but in the same line; without this precaution errors will occur, for the hock which is behind its fellow cannot be inspected from the same position as the other—it is not only being looked along but also being looked *down* on.

Our inspection and touch can only be exercised over that region we have termed the tarsal triangle, and the part immediately in front of the saphena vein; it is here where the bones come to the surface, and the anatomy of the region must be not only in our eye but in our fingers (Pl. III., Fig. 9 and Plate I., Fig. 8).

We have now to consider what conditions may be present in a healthy hock which cause us to be suspicious of its soundness. I only know of two—1. A prominent ridge on the medium (Figs. 14,

PLATE V.

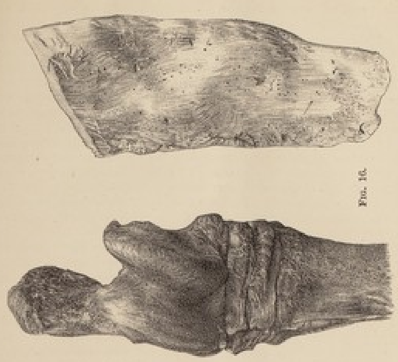


FIG. 16.

FIG. 15.

FIG. 15.—For arrangement of Figure see Fig. 14.
The Figure shows an enlarged head of the metatarsal bone at A, very prominent but quite normal, producing a distinct enlargement over the spavin region at A'. The joint is free from disease.

FIG. 16.—For arrangement of Figure see Fig. 14.
The Figure shows a sound hock; a prominent ridge on the medium (which in the Plate is not well seen) produces a bulging over the seat of spavin.

16, and 17); 2. An abrupt and prominent inner head of the *large* metatarsal bone (Figs. 14 and 15). This second condition is perhaps more common than the first, and decidedly more misleading. The rule to avoid the error is simpler in theory than in practice—viz., if both hocks are the same size, in all probability the enlargement seen is a natural one to that particular hock; this rule presupposes that the enlargement is distinctly not excessive; any considerable enlargement, though both hocks be the same size, constitutes a spavin. The value of our opinion will depend upon our experience and judgment; I have previously stated that the rule given to feel between the ridges of the magnum and medium, or the medium and large metatarsal, cannot be practically employed.

It will be remembered that the tarsal triangle is bounded anteriorly by the saphena vein, while its apex is the prominence on the internal aspect of the astragalus, and its base is part of the cuneiform medium and parvum (Fig. 9, Pl. III.). In giving our opinion on hocks which are clean so far as the triangle is concerned, we must not forget the rule previously laid down, viz., that there is more in the hock than meets the eye. The extensive tendinous insertions over the front of the joint hide from view or touch much which it is desirable we should be acquainted with; and when we have horses with apparently clean hocks which are yet unable to bend them properly, it is in all probability due to anterior anchylosis of the cuneiforms (Fig. 11), a condition which can only be demonstrated on *post-mortem* examination, excepting that the anchylosis be so large as to project in the space formed between the anterior part of the saphena vein and the internal border of the extensor tendon.

In the examination of horses for soundness I would urge, from *post-mortem* experience, that where any reasonable doubt exists in the mind of the examiner to give it in favour of the horse, pointing out to the client exactly what has been done, and letting him share any responsibility in the matter.

On this point I would say that as a profession we are responsible for having brought up the public very badly; the entire risk of an examination for soundness falls on the shoulders of the examiner. If our science were an exact one, and our methods of diagnosis had reached finality and perfection, this state of affairs would be reasonable and proper, but who can say that such is the case? Our judgment and experience will always be better than that of our clients, and so long as palpable unsoundnesses exist we do not ask him to take his share of the risk; we advise, and he acts on it or rejects it as he thinks fit; such an opinion is worth from one to two guineas. But assume a case where the matter is not so clear—a contracted foot with no evidence of disease; a hock we are unable to call positively sound or unsound, which may or may not affect the animal's usefulness; a coronet a shade larger than its fellow—the client is anxious to buy the horse, but is determined that the entire risk of purchase shall lie with the practitioner; such an opinion as he may give under these circumstances should be paid for, and well paid for, considering the risk he runs; and if as a profession we insisted on a much higher fee for this thankless task we would either get it, or, what is more likely, force our client to take that share of responsibility which it is reasonable to ask a man to accept where doubt exists, and where neither art nor science can avail. We must educate the public to understand that the veterinary surgeon is not a prophet, and that his vision into the future is necessarily limited. In days gone by our conceit ran hand in hand with our ignorance; there was nothing we did not know—no case too obscure for diagnosis, no lameness on the seat of which we could not at once place our finger, no question of soundness on which we did not at once make up our minds; our own practice was most successful, our neighbours' most fatal; and so on *ad nauseam*. Thank God we are emerging from this state of primitive ignorance and savagery, and leaving the quack and charlatan to occupy the ground we have held so long!

How constantly we hear of a spavin being described as far back, and clients recommended to purchase notwithstanding; experience has shown this to be a perfectly safe proceeding, for spavins situated here are not under the line of weight, and, further, are comparatively rare. What is constantly being taken for a spavin far back is a well-developed head to the inner splint bone, and it is perfectly safe to say that this will never interfere with the horse's usefulness. Of all the hocks I have examined, I have less than half-a-dozen specimens *with any external manifestation* of spavin far back, viz., anchylosis of the parvum to the medium or magnum.

In forming a judgment as to whether a spavin will produce lameness or not, it is unnecessary to say that the age of the horse, the nature of the work, and the character of the hock all require our attention.

The next aspect of spavin which demands our attention is the clinical one, viz. the diagnosis, treatment, and prognosis of the disease.

All horses with spavins do not go lame, but I know of no method of determining what spavin will, and what will not, interfere with an animal's usefulness; as I have previously said, the most unsound hocks often last the longest, and the largest spavins are by no means the worst to deal with.

I do not know what risk a man runs who purchases a young horse with spavined hocks, but I should say that, excepting the disease is hereditary, the chances are that the animal will go lame with work. I acknowledge the inexactness of this statement, but I have yet to learn how to determine the point. The fact is that we can make no definite statement on the subject; the whole question is involved in supposition and doubt, and we are surprised at nothing which occurs either for good or for evil.

In the natural order of things young horses are more liable to lameness from spavin than adult or old ones, and there is no difficulty in understanding the reason. A young horse with spavin stands a good chance of recovery; an old horse with spavin stands a good chance of disintegration; but there are spavins and spavins, some curable others hopeless, and it is evident that the nature of the diseased process must alone determine the future results of the case. I have not sufficient evidence to adduce, but I believe it will be found that young horses tend to anchylosis, while old horses tend to true articular disease.

It is not necessary that a spavin should cause a horse to go lame during its formation. I am certain that in many cases anchylosis of the small bones of the hock is a change unattended by lameness.

PLATE VI.

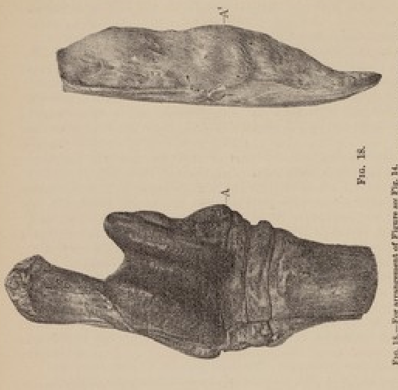


FIG. 18.

FIG. 18.—For arrangement of Figure see Fig. 14. A diseased hock; enlargement of the inner projection of the astragalus at A producing the spavin A1. The disease is articular; the magnum and astragalus are ulcerated. The inner ridge of the astragalus bulges over and presses on the magnum; the cuneiform bones are thin and weak, the hock compressed and stumpy.

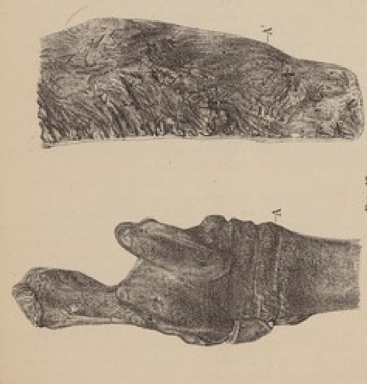


FIG. 17.

FIG. 17.—For arrangement of Figure see Fig. 14. The Figure shows a healthy hock with good large square flat cuneiforms. The inner ridge of the astragalus does not overlap the magnum. A very prominent ridge on the medium at A (as will be seen in the Plate) produced an appearance A1 during life over the spavin region.

I have even evidence to prove that it is possible for a horse to be suffering from true articular disease *between the calcis and astragalus* and to show no sign of lameness; this must be rare, but is nevertheless important evidence.

As a profession we are quite agreed that we have two forms of spavin to deal with; let us now consider what course these two cases run, and how we determine between them.

There are certain classical symptoms present in bone spavin which are practically unmistakable—the enlargement and perhaps heat of the part, the marked lameness which largely wears off with work and returns with rest, the wearing out of the toe of the shoe through bearing largely on the anterior part of the foot, and the persistent resting of the hock, are symptoms of undoubted value.

All cases of true bone spavin do not necessarily take the same course; it is not uncommon for the most important symptoms, viz. enlargement of the hock to be delayed, or even in some cases never to occur; such a course is followed when the disease exists in those parts of the joint which can neither be felt nor seen, or when the length of time for an outgrowth over the orthodox region has not been sufficiently long to admit of the disease appearing. Personally, I do not like hock lameness without enlargement; rightly or wrongly I am anxious about a joint until enlargement appears.

We have learned that the most suitable place for disease to occur is between the cuneiforms; if the joint admits of mapping out we can meet an enlargement of the cuneiforms with fair equanimity, as the chances of recovery are great.

If the exostosis occurs high up on the joint, over the projection of the astragalus (Fig. 18, Pl. VI.), or low down over the head of the large metatarsal, the disease can only be regarded in the light of a serious condition, especially the former. If there is persistent lameness with practically no enlargement—a lameness which increases with work, and which does not benefit with rest—such a condition is one of great gravity. In both these supposed cases there is true articular disease, the enlargement high up being infinitely more common than articular disease low down.

Reviewing these facts, it is only possible from a clinical point of view to diagnose the probable change in the joint: (1) By the position and size of the enlargement; (2) by the persistent or intermittent lameness; (3) by the length of time the case lasts.

I prefer a big spavin to a small one, that is to say, an enlargement within the bounds of moderation to one which requires the eye of the expert to detect; the one case generally yields to treatment, the other in all probability will not. I prefer an enlargement situated midway instead of one high up or low down. A midway enlargement is simple anchylosis, the high up or low down enlargement being probably articular. In fact, it may be stated as a general rule, that *when the enlargement is situated on the projection of the astragalus, incurable articular disease may be foretold with almost positive certainty* (Fig. 18).

For clinical purposes I have spoken of a midway enlargement. I am quite aware how defective in exactitude this really is, but I would define a midway enlargement as one where the inner projection of the astragalus is absolutely normal in size, and where there is no considerable enlargement of the head of the large metatarsal bones—where, in fact, the disease is confined to the cuneiforms.

As to spavin far back and spavin forward, the term is a relative one; if we mean by spavin far back something over the head of the inner splint bone, such cases need cause us no anxiety, for they are rare and curable; if, on the other hand, we mean a spavin situated *posterior* to the saphena vein, and call this far back, then I do not agree with the commonly expressed opinion that they are harmless. If we understand by a spavin being far forward something placed *anterior* to the saphena vein, then I think that, though there is grave risk of lameness in a young horse, such lameness is curable.

Post-mortem examination shows that the most serious region of enlargement is when the disease affects the part occupied by a line drawn from the inner projection of the astragalus to the saphena vein.

As to the treatment of spavin, I have nothing to add to what we already know. Rest, blister, and firing have stood the test of two centuries, and, so far as bone spavin is concerned, are apparently satisfactory. I have had no success in dividing the slip of the flexor metatarsi, and still less in directly attacking the interior of the joint in articular disease.

It is articular disease which is at present our opprobrium—such cases up to the present are perfectly hopeless. When we can learn to attack the interior of joints with the same impunity as the human surgeon is capable of doing, we may probably be able to arrest the destructive change and set up a reparative one.

A spavined hock is never as big as it looks; much of what appears to be bone during life is found after death to be thickened ligamentous material. So marked at times is this that it is often impossible to believe that the bones after boiling can represent the joint we saw during life.

I cannot conclude this section of my communication without offering my best thanks to my late colleague, Asst.-Professor Butler, A.V.D., for the care, patience, and trouble he has bestowed in photographing the material which illustrates this paper.

RINGBONE.

The term ringbone is as meaningless as the term spavin, but we are forced to retain it from custom.

In studying the distribution of lameness in the fore leg one is struck by the fact that so little occurs above the knee and so much below it, and, further, that lesions of tendinous material are common between the knee and fetlock, whereas lesions of bones are common between the fetlock and foot. Let us inquire into the causes which bring this about

We know that the function of the fore limb is not only to support the weight of the body but also to propel it. In all paces the fore leg is advanced and at the same time flexed; the leg having been carried sufficiently forward the extensors are brought into play and the limb straightened, and in this position the foot comes to the ground in advance of the body; the body now passes over the foot, and in such a manner that the fore leg, from taking a direction of

downwards and forwards when the foot meets the ground, now assumes a direction of downwards and backwards as the foot is about to leave it This change in the direction of the limb is brought about by the movement in the shoulder, elbow, and foot joints principally.

The mechanisms existing in the limb are roughly speaking of two kinds viz. (1) those for receiving the weight of the body on the leg when the foot comes to the ground, without the part suffering from the concussion of impact, and (2) those which admit of propulsion by one fore limb without the parts suffering from the concussion of propulsion. The first is principally provided for by the flexible joints formed in the pedal and fetlock articulations, by the arrangement of the foot, and by the tendinous and ligamentous material at the back of the limb; the second is provided for by the column of bones forming the limb being broken up from the scapula to the os pedis, and progressively increasing in size from the seat of the largest amount of concussion, viz. the foot, to the least amount in the scapula.

Probably the coronet and pastern represent the weakest part of the fore limb, and their small size in comparison with the weight they have to support is evidence of this

To ease the skeleton from concussion the muscles and tendons are brought into play and rendered taut; we know for instance how much better we are prepared to stand a sudden shock if we get sufficient warning, and, further, the risk of damage incurred to bones and ligaments if weight is suddenly imparted to a limb without the needful preparation for its reception.

The tendons and muscles of the limbs help to take the shock; so long as the muscles are capable of contracting the work done by their tendinous attachments is comparatively slight; as the muscles tire the strain on the tendons increases, and in consequence they may give way, and this will occur at their weakest part. In this tired condition of limb the skeleton suffers, the bones forming the column are receiving more shock than normal, and the smallest and shortest bones situated nearest to the seat of concussion, viz. the ground, may even fracture under the strain, and under any circumstance run a grave risk of becoming inflamed.

This argument is based on clinical observation. I do not believe that any horse sprains his back tendons or suspensory ligament until his muscles tire and are no longer capable of contracting or exhibiting that small but perfect elasticity inherent in muscular tissue. I do not, however, say that no horse suffers in his pastern bones until his muscles tire (for example the cart horse), though the strain on them is undoubtedly greater at this time than any other.

The strain on the pastern bones during draught work depends upon the force exerted; that this is something considerable may readily be seen in any heavy draught work, and the fractures of the pastern teach us some useful lessons; we may regard them for our purpose as experimental evidence of the shock inflicted on the lower bones of the limb. This shock is caused when the foot comes to the ground, not when it leaves it, and it may occur on hard ground or on sand; in the former case the cause of the concussion is obvious, in the latter at first sight it is not so clear, and yet when we remember how rapidly horses tire working at any fast pace over sand, and, owing to the nature of the ground, the manner in which they must misjudge applying the muscular bracing which saves the skeleton from concussion, it is not difficult to explain the well-known fact that pasterns fracture on sandy soil; that direct concussion in a horse which is not tired and not working on sand may also produce a fracture of this region is equally undoubted. Two specimens exist in the Museum of the Army Veterinary School, of pasterns fractured in dozens of pieces in a riding school by the horses striking with the foot the edge of a skirting board when jumping. In these two cases the animals made contact with a hard substance some fraction of a second before they expected to, and when the skeleton was not braced for the shock.

My only object in dealing with a subject which appears to be foreign to the one under consideration, is to bring some light to bear on the strain to which the pastern bones are exposed; this strain would appear to be greatest on the suffraginis, for fracture of this bone is incomparably more common than fracture of the corona, which is probably accounted for by the density of the latter and the absence of a medullary canal. In concluding these remarks on fracture of the pastern I would draw attention to the fact that the strain imposed on the bones in all cases is probably nearly identical in direction, for there is a remarkable similarity in appearance presented by fractures of either the os coronæ or os suffraginis, the fractured portions agreeing in shape and size in some cases almost piece for piece.

In spite of what I have said about direct concussion affecting the pastern bones, I do not think that this is necessarily the only factor present in the production of ringbone The concussion of propulsion must, I think, take a part; I mean by this, the shock imparted to the pastern bones while the foot is on the ground and the body is passing over it. The fore leg from the knee to the foot is only intended to open and close in one direction—we can readily make the foot touch the point of the elbow, but we cannot make it touch the front of the fetlock; now if we study the movement the limb makes from the time the foot comes in contact with the ground, we observe that the fetlock at first descends and then ascends, and having reached the desired point the limb passes over the foot, which remains fixed on the ground, and at this moment an important movement occurs in the pastern, viz., its rotation from rear to front; while the fetlock was ascending the metacarpal was moving on the os suffraginis, the os suffraginis on the os coronæ, and the latter on the os pedis, but as soon as the limb becomes vertical in the rotation of the body over the foot, then the movement between the os suffraginis and os coronæ becomes exceedingly limited, and for all practical purposes, owing to their immobility, they may be regarded as one bone, and so the remaining rotation of the body occurs between the os coronæ and os pedis. It is only possible to understand this by following it out on the dead limb, the leg being upright and the foot fixed.

My point is this, I believe that during the rotation of the body over the foot considerable compression must be experienced in the pastern bones, that this compression must be most severely felt at the articulation between the os suffraginis and os coronæ, owing to the fact that these are locked together during the main extension of the limb; and further, that as the upward and forward propulsion to the body is given as the foot leaves the ground, much of the shock resulting

from this must be expended on the pastern bones, as the foot possesses a mechanical arrangement for saving itself.

Whether the reasoning I have advanced is sound or unsound, pathology teaches us that lesions of the pastern bones are frequent, experience teaches us that they result from work, and in practice we speak of this work as concussion.

A study of the bones entering into the formation of the pastern is interesting. The os suffraginis is larger superiorly than inferiorly, both from side to side and from front to rear, the bone narrowing from above to below. A little above the inferior articulation two prominences exist on either lateral face of the bone. These prominences in some horses are developed to a remarkable degree, in others they are barely present. When well developed they produce a false ringbone high up. The inferior articular surface of the os suffraginis is continued on the posterior face of the bone, and is larger than the surface of the os coronæ on which it rests. This is provided for on the os coronæ by a peculiar ligamentous arrangement (which reminds one strongly of the sesamoids) formed by the insertion of the perforatus tendon and straight inferior sesamoideal ligament, the fusing of which structures into the posterior and upper part of the os coronæ forms a dense pad on which the os suffraginis reposes, and by this means not only increases the articular surface of the os coronæ, but provides it with a flexible articulation posteriorly, where the concussion and strain first come.

The os coronæ is wider above than below, whilst it is nearly one third thicker superiorly than it is inferiorly. Its superior articulation forms a joint for the os suffraginis which is partly flexible, whilst in turn it rests on a flexible articulation in the shape of the navicular. Quite half of the os coronæ is buried in the hoof, and nearly the entire lateral surface is lost within the cartilages of the foot.

At the posterior and upper part of the os coronæ the bone looks as if a navicular had been fixed on to it; the resemblance between it and the navicular is remarkable, and its function is to afford attachment for the sesamoid-like pad described above.

Ringbone is not merely a process involving the large and small pastern bones, but it affects the articulation between them, often producing destructive joint disease; and, further, it involves the ligaments surrounding the joint. So much is this latter the case that I have often wondered whether it were possible for the joint formed between the os suffraginis and os coronæ to be sprained; earlier in this article I have drawn attention to the loose manner in which the term sprain of joints has been employed, but I think that I have seen cases where the enlarged coronet during life was found after death to be mainly ligamentous trouble.

Ringbones are commonly spoken of as of two kinds, high and low. The former we may practically dismiss from our consideration; it is probably no more dangerous than a splint, and it solely affects the os suffraginis. The low variety, or true ringbone, is a disease which always affects the os suffraginis and os coronæ, and the joint between them; it is a true ostitis and arthritis, accompanied by exostoses of varying proportions, from a mere roughness on the surface of the bones to a considerable deposit. If it were not for the joint trouble a ringbone would not be any more dangerous than sore shins; it is the arthritis which renders it such a serious complaint during the period of lameness.

The class of limb which appears most likely to be affected with the disease is the short, stumpy, upright pastern, though I confess to have met with the trouble in pasterns of irreproachable shape. But that the upright pastern is the one most liable to concussion goes without saying.

In the examination of coronets we employ both the sense of sight and touch; we not only feel for enlargements around the coronet, but we measure the two limbs for comparison. The sense of touch is, however, open to the same fallacies as in the examination for spavin; we do not compare corresponding parts of the same limb; the outside of one limb is examined with the thumb, whilst the outside of the other is examined with the fingers. It is quite true that owing to the manner in which we are able to encircle the joint the danger resulting from the comparison of corresponding points with different parts of the hand is not so serious as in the hock, and our mental measurement is not affected to the same degree, so that any distinct difference in size is, as a rule, readily appreciated; but we should make it an invariable practice to examine corresponding points with the same fingers, though it may have to be effected by using different hands. In examining the near coronet I use the right hand, and compare the feel with the off coronet, I then pass to the off side and feel this coronet with the left hand, and compare it with the opposite limb. I cannot lay too much stress on this method. I may be deficient in tactile sensibility and accuracy of mental measurement, but I am convinced that I never felt so certain of my examination of coronets until I adopted the principle of passing at once from one side of the animal to the other. To my fingers the opposite coronet nearly always feels the smaller, and this error of observation I correct in the manner described; when first one coronet and then its fellow feels the larger, I know that it is the examiner and not the coronets which are at fault.

But there is another equally if not more important condition, viz., that in feeling coronets both legs should be in the same line, and bearing as nearly as possible an equal amount of weight.

The difference in the position of the os coronæ in a limb bearing weight, and in one bearing but little, is something astonishing. The os coronæ is wider than the os suffraginis in the region of the joint, and this extra width of the os coronæ is due to two lateral projections for the insertion of the lateral ligaments of the joint. When there is very little weight on one fore leg these projections are *above* the level of the lateral cartilage, as when weight is placed on the limb they sink *below* the level of the cartilage; if, therefore, we compare coronets with one foot slightly advanced and one under the body, the former appears larger than the latter, for the reason that the projections of the os coronæ are more in touch. I look upon this as the only new point which I have to make in connection with the diagnosis of ringbone.

It is easy to obtain the limbs in correct position for examination by bringing the feet close together; and, to keep them there and equalise the weight, have one hind leg lifted if this is considered necessary.

In the same way that we must guard against confusing the natural projections of the os coronæ with disease, so must we avoid taking

the natural projections of the os suffraginis for a pathological condition. It is true that these prominences are often exaggerated, and lead to the expression "coarse coronets," but this is not a diseased condition, and, moreover, both limbs are the same size. The old-fashioned rule applied to the hock—"if of equal size accept, if of unequal size reject," is just as applicable to the coronets, though I should guard it by saying that if enlargements or roughness can be detected beneath the extensor pedis tendon, in all probability ringbone is present.

Our examination of the coronet is not complete without an inspection. I do not think that this method is as valuable in the detection of ringbone as it is of spavin, but under all circumstances it is advisable to supplement the more exact method of manipulation by an inspection. With well-bred horses an inspection is not open to any great fallacy, but with horses possessing much hair on the coronet and a coarse skin, care has to be taken to avoid any error arising from these. I have sometimes in cases of doubt wet the hair of both coronets in order to get at the shape of the part.

The clinical aspect of ringbone has now to be dealt with, and here we are brought face to face with the fact that a horse may be lame from diseased changes in his os suffraginis and os coronæ without their being any external manifestation of the seat of trouble; this is an annoying condition and often taxes our patience and that of our clients, for it is very difficult to make a layman believe that the coronet is the seat of trouble unless he sees a something which he can almost stumble over, let alone feel.

In my experience I have met with many cases where, as the result of negative evidence, I have located the seat of trouble in the coronet, and in which no ringbone ever developed. I am unwilling to put all the cases down to errors of diagnosis. I have met with others where no enlargement occurred until the part had been blistered, and as a means of diagnosis I regard a blister as often valuable. If our patient comes to us lame, with one coronet larger than the other, and no other cause for lameness exists, our difficulties of diagnosis are trifling.

I am inclined to regard heat of the part as the most valuable symptom of trouble in the coronet; in the absence of external enlargement it is the only symptom worth calling by that name, for I am convinced after years of careful observation that there is nothing in the action or gait of the patient which has ever afforded me any assistance in determining the existence of inflammation of the pastern bones. I do not wish to be misunderstood on this point; there is something in the gait of a lame horse which tells me whether to look above the knee or below it, but more than that I have never seen.

In the prognosis of ringbone my experience leads me to be very careful. Joint as well as bone trouble exists, and all joint trouble in the horse is a serious matter, from the fact that we can never give the part absolute rest. It is certain that the joint trouble in ringbone does not so frequently lead to destructive disease as is the case with the hock, nor under any circumstance is the destructive disease of the joint ever comparable in degree with that seen in the hock; caries in ringbone I do not think I have ever seen in any joint examined where only an ordinary amount of disease was present. I have certainly seen extensive destructive changes on the surface of the articulation in some museum monstrosities, which made one wonder that the horse had been allowed to live sufficiently long for such extensive pathological changes to have occurred; but in the ordinarily incurable form of ringbone the cartilage of the articulation is eroded and the bone beneath grooved; what is left of the cartilage is swollen, darker in colour than normal; and the articulation is practically dry.

We have to get our case before the cartilage has undergone any change if we wish to effect a cure; articular cartilage can only become affected by extension from the adjacent bone, and if we can keep the inflammatory process in the bone under any control it is most likely we may prevent the cartilage from seriously participating. That control I regard as rest. While resting there is apparently very little pain felt, and probably because no seriously direct pressure is exercised on the os suffraginis or os coronæ while our case is standing in the stable; the ringbone horse does not "point," he puts a fair amount of weight on the inflamed column, but the lightest work, or the most steady trot, appears to shake up the diseased parts and to produce intense lameness.

Our prognosis must depend upon the age of the animal, remembering the marked difference in capacity for repair and regeneration possessed by young over old tissues; also the length of time the lameness has lasted is an important factor, and the amount and position of the enlargement. If the latter be situated well up on the pastern we need have no fear of the ultimate issue of the case, as the joint is not affected, but such examples of the disease are in my experience very rare, and we may in the large majority of cases count upon inflammation—or if I could define the difference—acute congestion of the lower extremity of the os suffraginis and the upper extremity of the os coronæ, with disease of the included joint.

In ringbone, as in spavin, *time* is the demonstrator of the curability or incurability of the condition, and in this way the client gets as early intimation of the probable chances of recovery as the practitioner.

Any case of ringbone lameness which does not yield sufficiently to treatment to trot sound in three months is serious, though not necessarily incurable.

I have said very little hitherto about the enlargement of the coronet. It certainly need not be present to constitute disease in the part, though should it be there it is a distinct advantage to the practitioner from a diagnostic point of view, and no serious detriment to the patient so long as it is limited in extent.

If we study the position of the deposits on the pastern bone we shall find that in small ringbones the os coronæ is affected at its superior extremity, the deposits being on the anterior and lateral aspects of the bone (especially the former), close up to the articulation; the os suffraginis is affected at its inferior extremity, the deposits being principally on the lateral aspects, though smaller ones may extend over the anterior face, and not uncommonly deposits may be found even on the posterior face of the bone. As a rule the amount of bone deposited on the os suffraginis is greater than the amount on the os coronæ; on the other hand I think the amount of

articular disease on the os coronæ is greater than that on the os suffraginis.

The deposit in ringbone may be so considerable as to obliterate the joint and disorganise the limb. Such cases I have spoken of as museum monstrosities, for, nothing can be gained, as a rule, by allowing horses to live till this amount of disorganisation has taken place.

When a ringbone is complicated with sidebone it is difficult to say how much of the lameness present belongs to the one and how much to the other, and such cases are not, in my limited experience of them, amenable to treatment.

As to the treatment of ringbone, I think the first essential is rest and cold douching, followed by blisters, and in bad cases firing; in fact finality appears to have been reached in the treatment of ringbone two hundred years ago.

I do not speak from my own experience, but I have been told by several careful observers that my sidebone operation gives relief in some cases of ringbone,—probably it is in those where the os coronæ is affected with deposits low down inside the hoof.

A *post-mortem* examination on an ordinary case of ringbone is about as satisfactory as on a case of tetanus; the joint trouble may or may not appear marked, and we resolve to examine the bones after boiling in the hope of finding something more definite; but it will often be found that the enlarged coronet during life is represented on the boiled coronet by a few specks or nodules of exostosis and nothing more. In fact the swelling we saw during life was largely fibrous tissue, viz., the lateral ligaments of the joint and the extensor tendon. These become thickened and infiltrated with inflammatory exudate, and therefore in looking at a ringbone during life we may always say with positive certainty that it is "never as big as it looks."

The right method of examining the parts *post-mortem* is not to boil until the last thing; the ligaments around the joint should be dissected, and sections of both bones made; the latter will be found darker than normal, and the blood-vessels in the compact tissue larger than usual, and nothing more. It takes very little congestion of the os coronæ to produce lameness, and this is the explanation why *post-mortem* examinations of the past are often so unsatisfactory; I refer, of course, to cases where the amount of deposit is trifling.

I have made no mention of ringbone affecting hind limbs. Compared with the fore limbs, the condition is comparatively rare, and in a limited experience of such cases I have not found them any more satisfactory to deal with than those occurring in the fore legs.

NAVICULAR DISEASE.

Some years ago I published an article on the "Pathology of Navicular Disease," [1] and lately I have ventured to reproduce some of the practical aspects of the views previously stated.

My opinion on the causes operating in the production of this serious form of lameness has undergone no important change, and the *post-mortem* appearances and microscopical changes recorded have been repeatedly verified. All I purpose doing, therefore, is to summarise

[1] Veterinary Journal, 1886.

my previously recorded observations, in order to render this communication on specific joint disease as complete as possible.

The physiology of the navicular bursa is interesting; the horse has a navicular bone in order that the surface of the pedal bone may be sufficiently large for the os coronæ to rest upon; this surface could have been made larger by having the articular surface of the os pedis made larger, but that would probably have meant fracture of the posterior part of the articulation, owing to the direction in which the weight is imposed on the upper surface of the joint, from the fact that the posterior part of the foot comes to the ground first. A yielding articulation was therefore required, such as exists at the fetlock and in the joint formed between the os suffraginis and os coronæ; this yielding articulation is formed by the navicular; it is of undoubted delicacy, but its strength is enormously increased by having the broad expansion of the perforans beneath it, which closely invests the whole of the inferior face of the bone, and is attached all around it.

There are certain features in connection with navicular disease that are not explained by the structure or arrangement of the part.

1. That it always affects the inferior face of the bone, next the tendon.

2. That the fore feet and not the hind are affected.

It is, certainly to my mind, difficult to explain the first condition; the difference in the nature of the cartilage can be no explanation, for fibro and articular cartilage exist on the sesamoids, and yet it is certain that disease of the sesamoids is incomparably more rare than that of the navicular; the slight difference in the direction of the supporting perforans tendon at the sesamoids and navicular cannot explain the frequency of the one and the immunity of the other.

It may be said that the inferior face of the navicular is affected for the reason that this is the one most exposed to injury owing to its position, but the facts which to me appear to disprove this explanation are that the bone is not horizontally placed in the foot but at a fairly considerable angle, therefore the inferior face is not so liable to damage as one might at first consider; again, the navicular bone lies high in the foot, well above the lower margin of the pedal bone, and considerably above the plantar surface of the crust; in fact, had the early writers called it the coffin bone from the manner in which it is buried in the foot, and also from its shape, one could have felt no surprise at the term. Again, had external violence much to do with the production of navicular disease, bruising of the frog should be a common pathological condition, or indications of injury on the external surface of the tendon or plantar cushion should be apparent, but such changes have practically never been observed; further, if external violence played any serious part in the production of the trouble the hind feet could not have escaped the affection. These, I think, are arguments of some value against the external origin of navicular disease, but they throw no light on the point under consideration—why the inferior surface of the bone is always affected and no other. I would not have it go forth that I do not believe in navicular being occasionally produced by external violence; I am only endeavouring to combat what I believe to be an error in considering concussion, bruising, or whatever term may be employed, as being the most common cause of the trouble. Lastly, the concussion theory will not hold good in those

cases I have recorded where horses from special causes have been laid up for a considerable time, and have developed navicular disease in consequence.

The only view I can offer to explain the inferior face of the bone being affected, is that which, from my published writings on the subject, may be known as the *compression* theory. This, briefly stated, is as follows:—The weight of the body is always tending to depress the navicular bone, the perforans tendon is always tending to keep it in its place and prevent undue depression; between these two forces the navicular bone comes to grief, the compression acting injuriously on its circulation; whether this compression is greater on the inferior face of the bone than on its upper articular surface I have no means of knowing, nor can I see how it is to be determined by experiment, unless we adopt the existence of disease as a natural experiment. I fully and freely confess my inability to satisfactorily explain the invariable existence of the disease on the inferior face of the bone, but the side issues which a consideration of this question have raised are of great interest and of practical importance. I am convinced of the truth of the compression theory, though I am sufficiently broad minded in my views not to be led away by the idea that it is the sole cause of trouble.

The second problem propounded is, why does the disease elect the fore feet and not the hind? It is unnecessary here for me to recapitulate the anatomo-physiological views of the function of the fore and hind legs discussed when we considered the causes operating in the production of hock disease. I have endeavoured to show that the shape of the hind limb and the arrangement of its joints lend themselves to hock trouble, but the anatomical arrangement of the leg below the hock being practically identical with the leg below the knee, the compression of the navicular bone of the hind limb must occur just as it does in the fore limb, and yet navicular disease of the hind feet is practically unknown. This is no proof against compression, but rather assists us in estimating its value, for we know that no horse at rest stands perfectly square, but that first one and then the other hind leg is always being rested; and I conceive that the alternate resting of the hind legs relieves the continuous compression imposed on the navicular bone, and that if it were natural to the animal to rest the fore feet alternately navicular disease would be comparatively if not very rare; he learns to rest them by "pointing" when it is too late and the damage done is undoubted. This, then, I believe to be the explanation of why navicular disease affects the fore and not the hind feet.

My observations have led me to classify the causes operating in the production of navicular disease as follow:—

1. Compression; 2. A weak navicular bone; 3. Defective or irregular blood supply to the bone; 4. Senile decay; 5. Hereditary predisposition; 6. Concussion; that all these causes need not and do not have a separate existence is undoubted. With a weak bone I should expect defects in the blood supply, and the weak bone would probably be hereditary; it is the combination of causes rather than their isolation to which I should attach the most importance, though of all single causes I lean to compression first and then to concussion.

It is only over the influence of concussion as a factor in the production of navicular disease that my views on this disorder have undergone any modification during the past seven years. I have given reasons for thinking that concussion as a cause has been exaggerated, but I here embrace the opportunity of saying that in my original communication I placed too low a value on it as a source of trouble.

I have mentioned a weak bone as being a cause of navicular disease, and on this point it is essential that I should give some explanation of what a weak bone really is. The navicular bone consists of compact and cancellated tissue, and the relative proportion of these varies; sometimes the compact layer is found of considerable thickness and clearly defined from the cancellated portion, at others there is a deficiency of compact material and an increase of cancellated; it is this latter I have termed a weak bone, and though it is far from present in every case of the disease still I consider it a factor of great importance.

The irregular or defective supply of blood to the navicular bone is produced by excessive and irregular work, and by the opposite condition—rest. That a certain amount of movement is necessary to assist the circulation in the foot is undoubted, and that this reasoning will apply to the navicular bone is more than probable, as evidence of which we have the improvement which occurs in a navicular case as the result of work. All the changes which operate in the production of navicular disease bring it about through the medium of the blood-vessels in the bone, and the weaker the bone and the more irregular the blood supply the better chance is there for these factors to operate.

The terms defective and irregular blood supply must be more clearly defined. The vessels passing to and from the navicular bone run in the substance of the inferior navicular ligament, or in such proximity to it that I think it conceivable that under certain circumstances mechanical interference may occur to the navicular circulation. During work the circulation through the navicular bone is hurried, but during rest there is a tendency, as in every part of the foot, to the parts becoming congested; this congestion is relieved by work and recurs with rest, and I cannot help thinking that irregularities in the blood supply in a naturally weak bone must be a factor of some importance in the production of this disease, especially when the kind of work a horse is performing is a series of vigorous efforts followed by rest. A typical example of the kind of work I refer to is that performed by the butcher's horse.

As horses grow older changes in their organs occur, and in no place is this seen to better advantage than in the limbs. Senile decay as a cause of navicular disease is as undoubted a pathological fact as anything can well be. I shall have to show that as a rule the lesions are of a distinct type; the only point that I wish here to emphasise is that I believe the changes are brought about by the years of compression and congestion to which the navicular has been subjected.

Hereditary predisposition is an equally undoubted cause, and so universally acknowledged that no necessity exists for insisting on it here.

In my original communication on this disease I attempted to demonstrate an entirely new fact, viz. that horses could contract navicular disease by standing persistently in one position, and it was this which forced compression as a cause of the disease on my notice. I have carefully observed this point during the last seven

years, and I am convinced of the accuracy of this view; the five cases originally recorded might now safely be doubled, but even then they would only represent a small proportion of the cases of the disease which come under one's notice; to what then are we to attribute the causes of the other cases? If I have distinct evidence that 10 per cent. of the cases which I have seen are due to compression, it is safer and more reliable than speculating what the other 90 per cent. are due to, but at the same time I am not anxious to be understood to say that all horses contract the disease through standing, for that would be tantamount to saying that horses are kept for idleness and not for work. I cannot positively say how the remaining 90 per cent. incurred the disease; I suspect that a weak bone, irregular blood supply, irregular work, senile decay, hereditary predisposition, and concussion all take their share, but the exact proportion to be alloted to each of these it is obviously impossible to state.

For the histories of the first five cases of the disease caused by long-continued compression, I refer those interested to the paper I have before quoted. To those who doubt compression as a cause of trouble I recommend the dissection of every navicular bursa which has been bearing considerable weight for some time, as in the case of an injury to one fore leg necessitating the opposite limb doing all the work. In making this enquiry coarse changes, such as holes in the bone, are not required to establish the existence of navicular disease; the least absorption of the fibro-cartilage and roughness of the navicular bone, or slight erosion of the perforans tendon, are sufficient to cause intense lameness; this is not speculation or theory but the result of direct clinical and *post-mortem* evidence.

Experience has suggested that cases of navicular disease may be grouped according to their clinical aspects, viz.: 1. Young horses developing the disease; 2. Cases which have occurred with sudden lameness; 3. Chronic cases with very little interval between the attacks of lameness; 4. Chronic cases with long intervals between the lameness; 5. The navicular disease of old age. Each group is not always clearly or sharply defined, but the clinical features are sufficiently distinctive to warrant the grouping adopted.

Navicular is certainly not a disease of young horses, though I have undoubted evidence that young horses are by no means immune, nor am I a believer in the sudden onset of lameness as being a common condition in this disease, though I have met with it in a few cases; by far the most common history is that of repeated lameness, often in the first instance of a slight character, but gradually developing into something of a more permanent nature; the lameness is not necessarily acute, but on the other hand often described as stiffness which passes off with work and is rendered more marked by rest. Chronic cases with long intervals between the lameness are much more uncommon, whilst the navicular disease of old age is nearly as common as old horses are.

Post-mortem evidence shows that it is possible to have navicular disease present in a well-marked degree without lameness occurring, though, of course, such horses have considerably lost their action and "go short." I have not made a distinct group of this, for it is obvious that such cases come but rarely before us, and I have only met with it as the result of an enquiry instituted into the condition of the navicular bursa of all horses which were destroyed or died from any disease or accident, and the previous histories of which were perfectly well known to me.

The symptoms of navicular disease are in the first instance by no means well marked,—intermittent lameness, stiffness on coming out of the stable, short stilty action, and pointing and contraction of the feet, are highly suspicious in the absence of any evident cause. We arrive at the presence of navicular disease by a process of elimination, and by the length of time the case has lasted. For years I have made it an invariable rule never to give a decided opinion in a case of obscure lameness in an adult horse until some time has elapsed, and undoubted evidence been brought to my observation. By the exercise of tact this time may be gained by telling the client that the horse is lame in the foot, that with judicious treatment the case may recover, but that it must ever be present before him that the symptoms are of a suspicious nature, and that only time can decide. In all obscure cases of lameness,—and I have always held that 50 per cent. of all lameness is obscure in the first instance, and 25 per cent. permanently obscure—we require more professional backbone, and the public a better education. It is no use one man being honest and saying "he does not know," when a rival practitioner is prepared to diagnose the seat of trouble from afar, and without even handling the limb!

The pathological changes occurring in navicular disease are perfectly well defined, (1) as affecting the bone, (2) the investing fibro-cartilage, and (3) the flexor tendon and synovial membrane.

The bone is in my experience always first affected, though I have notes of one case where I considered the tendon to be primarily diseased. The changes occurring in the bone consist of enlargement of the blood-vessels, and absorption of the intervening bone tissue; it is convenient, and for clinical purposes permissible, to speak of the blood-vessels of the bone as congested. They are certainly crammed with cells, and the naked-eye appearance of the bone is best described by the word congestion.

If a section be made of a navicular bone as early in the disease as it is possible to conceive, long before the cartilage has gone or the tendon become affected, it will be found that the compact tissue is of a very pale purple colour; not throughout, but here and there, especially over the central ridge of the bone; the vessels are seen plainer than usual, but nothing more to the naked eye is observable; and if we imagine a rather more advanced stage the osseous lesions are better marked, but the bone is exposed over the centre ridge, due to a removal of the fibro-cartilage, and on the exposed bone may be seen blood specks indicating minute hæmorrhages. That portion of the perforans tendon actually in contact with the exposed surface of the navicular bone has lost its shining peritendineum, and looks as if it had been lightly scraped with a knife; in a further stage we have merely an exaggeration of these appearances, the exposed bone having now a cavity more or less deep and of variable width, whilst the tendon erosion is more extensive; the remaining fibro-cartilage has also changed in colour, having pale brown patches on it, and yellow, flaky, partially coagulated synovia covering its surface here and there.

At this stage, or much earlier, may be found calcareous deposits in the fibro-cartilage and bone; they are scattered like fine sand here

and there, generally across the inferior half of the face of the bone; they are sometimes numerous, frequently scanty, occasionally entirely absent. The amount of calcareous degeneration depends upon the lesions present; if much destruction of bone exists there will be but few calcareous deposits, whilst if there are many calcareous deposits there may be but slight ulceration of bone tissue, and perhaps none at all; in fact, I have held the opinion, and see no reason to modify it, that the calcareous deposits are safeguards against caries.

These deposits produce some roughness of the inferior surface of the navicular, and this increases the destruction and erosion of the perforans tendon. The erosion from all causes is sometimes astonishing, large fibres being torn out of their place, almost invariably in an upward direction, so that the free end lies by the superior navicular ligament; the tendon is stained brownish, the fibres are glue-like from fatty degeneration, pale and friable, and if they be examined microscopically are found full of large fatty cartilage cells derived from the opposing cartilaginous surface.[1]

Sometimes the tendon becomes adherent to the bone or partly so; this is an attempt at cure. I have known a hole in the navicular the size of a pea completely filled in with a portion of the perforans tendon, and if this condition were only more frequent, we might almost talk of recoveries from navicular disease.

There are three distinct forms of navicular disease, or rather there are three ordinary *post-mortem* appearances met with which appear to be distinctive :—

1. Absorption and staining of the navicular fibro-cartilage, with staining and erosion of the perforans tendon and dryness of the bursa.
2. Absorption and staining of the navicular fibro-cartilage, the bone and cartilage being studded with minute calcareous deposits, whilst the tendon is stained and eroded as before, and the bursa dry.
3. Any of the above changes, and in addition caries of the bone and ulceration of the cartilage, thickening or even ossification of the superior navicular ligament, with swelling of the bone and dryness of the bursa.

The navicular disease of old age is almost invariably No. 2.

I do not say that each of these varieties may not here and there run into each other, but I am convinced that most cases of navicular disease will fall under one or other of these groups; there is nothing, unfortunately, in the clinical aspects of the case which can help us to determine the nature of the pathological change present; the lameness is no guide, for the intensity and duration of the lameness bears no proportion to the extent of the pathological changes which may have occurred. The most intense and persistent lameness may be produced by a slightly eroded tendon, a bone only congested, and the cartilage of which is only partially absorbed; whilst a carious hole, large enough to admit a split pea, may only cause slight lameness, and, as I have said before, the disease may be present without actual lameness occurring.

I know nothing of the treatment of navicular disease; operative

[1] For those requiring a more detailed account of the microscopical changes in navicular disease, I refer to my original paper in the Veterinary Journal.

measures are indicated but the part is difficult to get at, and at present interference is hopeless, considering that in veterinary practice all our recoveries must be complete and not partial. At one time I believed that the friction of the perforans tendon helped to keep up the irritation on the navicular bone and I, therefore, divided the tendon above the fetlock in one case, and gave the horse six months' rest. He was as lame at the last as before the operation, and had to be destroyed.

In the examination of navicular bursæ it will be found in a small percentage of cases that the bone is "chipped" on its inferior edge, close to the articulation with the os pedis; it is more a dent than a chip, and is always, in my experience, confined to one place, viz., about half an inch or so to the right or left of the central ridge; sometimes the dent is not seen until the cartilage dries. I know nothing of the cause; I have found it both in diseased and healthy feet, and at least five specimens of the condition exist in the Museum of the Army Veterinary School.

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A CHEMIST'S VIEW

OF THE

SEWAGE QUESTION.

BY

EDWARD C. C. STANFORD, F.C.S.

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1869.

PREFACE.

THE papers published together in this pamphlet are simply reprints of the papers as each was read. Though somewhat unconnected, both were written with an honest intention of looking the great difficulty full in the face.

The first paper is devoted to a general consideration of the sewage question from a chemical point of view, from a belief that this view has been narrowed and obscured. In speaking of the pneumatic system, attention is called to an engineering problem which is worthy of discussion and trial. Experiment only will show if it can really be carried out without odour, as, if not, it can never be introduced into our country.

The second paper describes a process the results of which do not admit of doubt. It is a chemical process which, in a sanitary and economic sense, fully meets the evil. As such, the author commends it to the consideration and common sense of his countrymen, in the full assurance that its adoption would largely add to their health and wealth. It may be asked, Should this be the case, where is the seaweed char to come from? To this it may be answered that the process depends ultimately only on the char from the excreta itself; but its general adoption would, nevertheless, create sufficient demand for seaweed char to revive the value of kelp-bearing shores, supply food to a large indigent population, and effectually stop the emigration from the West Highlands and the West of Ireland.

If, therefore, the utilisation of waste materials be the most progressive and valuable branch of chemical manufacture, this process has special claims to public attention.

EDWARD C. C. STANFORD.

GLASGOW, *June* 15, 1869.

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.

Read before the GLASGOW SEWAGE ASSOCIATION, *March 30th*, 1868.

No. I.

OUR great object is to consider, first, how to carry away from our houses the excreta of our large population; and secondly, how to treat it so as to recover for our use its full fertilising value. The peculiar character of the material to be dealt with renders some vehicle necessary for its transport.

This vehicle may be either solid, liquid, or gaseous; and the secondary proposition depends so entirely upon the vehicle employed for the first, that I intend briefly to review these three several means of conveyance in their chemical aspect. To avoid complication in speaking of either, I shall assume its general adoption.

Of solid vehicles, the cheapest being earth, of liquids water, and of gases air; I shall speak of the three different methods as water, earth, and air carriage, taking water first, as being now most common.

I wish to premise, however, that I regard both the above propositions as essential and necessary; and take as my text Mr. F. O. Ward's celebrated formula—"the rainfall to the river, and the sewage to the soil,"—no system of sewerage is worthy our consideration which does not give back to the soil that which in our food we have taken from it; and I consider the mere ridding ourselves of a valuable fertiliser, simply on account of difficulty in dealing with it, quite beneath the enlightened spirit of our age.

For convenience of calculation, I take the population of Glasgow at 500,000, and the value of the excreta at 8s. 4d. per head per annum, or £208,333. This is the value given by Professor Way and Mr. Lawes (the highest authorities on this subject), in the third report of the Sewage Commission, and it is now generally adopted by all chemists, each person being reckoned as contributing the value of 12½ lbs. of ammonia per annum.

The total bulk of excreta, making allowance for loss, is estimated at 10 cubic feet per head per annum, and its weight 630 lbs., making an annual total of 5,000,000 cubic feet, weighing 140,625 tons; or, per day, 13,698 cubic feet, or 385 tons.

This, then, is what Glasgow has to remove. The value is 10d. per cubic foot, or 29s. 6d. per ton, and equal (Professor Way) to 16,666 tons of Peruvian guano annually. Of this amount the solids form 1-10th., and the liquids 9-10ths; or 1 cubic foot per head per annum solid, and 9 cubic feet of liquid. The solid and liquid excreta have a relative chemical value of 1 to 6, or 1s. 2d. per head for the former, and 7s. 2d. per head for the latter. The total is thus divided:—

	Tons.	s. d.	£
Annual value of solid excreta ..	14,062 at	41 5 ..	29,161
" " liquid " ..	126,563 "	28 3 ..	179,172
			£208,333
The value of the daily removal is	385 "	29 6 ..	£569

Let us now see how this is proposed to be removed, and what is to be gained in the process.

Water Carriage.

Taking the amount of water used per head at 5 cubic feet daily, and the rainfall the same, we have the 10 cubic feet diluted with 3650 of water, and the annual material to be removed increased from 500,000,000 cubic feet to 1,825,000,000 cubic feet, or 140,625 tons increased to 50,920,401 tons; in other words, we require daily to pump away 140,000 tons of sewage to remove 385 tons of excreta, of which only 38½ tons is solid matter! No wonder we are called upon for lavish expenditure to carry off such a quantity as this, for even if no pumping were required, the cost for sewers must be enormous. And then does it carry it away?—and does it utilise it? Suppose an elaborate system of intercepting sewers to convey our sewage to some point several miles down the river; would that meet the evil? Let the experience of London answer this. The metropolitan sewage works are the greatest effort of this kind, and, from the difficulties overcome, are a perfect triumph of engineering skill, reflecting the highest honour on Mr. Bazalgette; but they cost the princely sum of £4,250,000, or £180,262 per annum, the cost to be paid off in forty years by rating, at the end of which period the Thames will probably be closed as a port by their deposit, the sewer gases will have proved themselves the most deadly of enemies, and London will stand on a substratum of soil loaded with sewage from infiltration and leakage.

To show that these are not improbable speculations, I append an extract from an able article in the *Pall Mall Gazette* of February 26th, 1868, entitled "The Sanitary Dead-Lock":—

"It has now been decided that although Parliament has conferred the right of drainage into the sea and public rivers, this right can only be exercised subject to the condition that no other nuisance is thereby created. 'The notion of collecting all the sewage of a large town,' says Vice-Chancellor Wood, in the case of Blackburn, 'and pouring it into a river without the slightest attempt to clear it of any of its grossest materials, is simply monstrous.' And, again, in the Attorney-General *v.* Birmingham Town Council, the court went as far as to declare that it would not balance the convenience of a town against the legal rights of an individual complainant—the latter must be respected. . . . . The case of the metropolis differs from that of the provincial towns, but has occasioned a similar sanitary dead-lock. The main-drainage system discharges the refuse of London into the Thames at Barking and Crossness, comparatively out of the way of population. Although there is, therefore, no sanitary objection to these works, except as regards the towns below London, such as Barking, North Woolwich, Woolwich, Greenwich, Erith, &c., a serious difficulty of another kind has arisen. The mass of matter daily washed down by the sewers of London is so great that, during the few years that have elapsed since the opening of the new sewers, an enormous concentrated deposit of mud, street sweepings, and sewage refuse has accumulated in the bed of the river at Barking and Crossness, and now obstructs the navigation of the river. Last November Mr. Cave stated in the House of Commons that a ship had already stranded on one of the banks thus formed. A chart of the bed of the river at Barking, which has recently been prepared, shows that in the very centre of the channel the soundings have diminished at low water from 21 to 10 feet. . . . Whatever may be the legal aspect of the question, it is quite evident that the navigation of the Thames cannot be allowed to be obstructed even for the sake of draining the metropolis, and that legislative interference will be required if the existing Acts are at all doubtful on this point. Indeed, the whole subject demands the careful consideration of Parliament, in order to release the municipal authorities throughout England from the embarassing position in which they are now placed. Some way must be discovered of draining our towns at a less sacrifice than is involved in the pollution of streams and blocking up of navigable rivers."

And as to the sewer gases, it appears, according to the evidence collected by the sewage commission, quite impossible to get rid of them; one of the engineers examined making this terribly suggestive answer:—"I am afraid we must let out the stink in the middle of the streets."

Now stink is not the word, for sewer gases are gases of decomposition, and carry malaria, pestilence, and death with them. Dr. Fergus has related one of many instances in which a number of houses at Leith, previously healthy, have been affected at once with gastric (or typhoid) fever, when connected with the sewers; and, showing the constant infiltration of sewage into the soil, and thence into wells, he has also pointed out cases of gastric fever where the long unsuspected cause was the drinking of the water so contaminated.

Mr. Bazalgette states, that to ventilate the London sewers by air would cost £460,000 in plant, and £201,480 annually for fuel alone, exclusive of labour and other expenses; he also states that to flush them with water would cost £383,250 annually, even if the water-works could supply the quantity, which is out of the question. The water-closet system is also open to great objection—the best constructed closet is seldom perfectly free from odour; the back rush of deadly gases up the sewers when a high tide covers them, or a strong gale blows into their outlets at low tide, is of enormous force, and will rise through any closet, however well trapped.

Water is a mere carrier, and no disinfectant; its cost, also, from the great quantity required, is very considerable. Mr. Smith has stated the cost here at £40,000 per annum, and, no doubt, if general, £50,000 at least would be required to provide the water and keep up the closets.

The whole system of sewerage by water carriage is recklessly extravagant; it carries the solid and liquid excreta down to our neighbours to rot at their doors, and it leaves us a legacy of deadly gases to remind us that our endeavour to cheat nature has signally failed. As applied to even ridding ourselves of the nuisance, it is the finest effort of "the circumlocution office," and the best illustration of "how not to do it," in our generation.

Engineers have employed an elephant to do the work of a mouse, and the burly brute has trodden down and laid waste the country.

Then, as to its utilisation; here the system almost entirely breaks down. Notwithstanding numerous attempts, no portable manure ever has been, or ever will be, made out of sewage. The chemical value of average sewage, if it could be extracted, is 1d. per ton, taken at 4 grains ammonia to the gallon; this value is deduced from 93 analyses of Rugby sewage by Professor Way, and now generally admitted. One thousand tons are equal to 12 cwts. Peruvian guano.

Much has been said here about the solid matter deposited from sewage by standing; let it be clearly understood that it is almost valueless. At Birmingham it accumulates in large quantity, and cannot be sold at 6d. per ton. The reason of this is obvious; almost the entire

manurial constituents are soluble in water; and no wonder all companies looking amongst the deposit for their dividends have failed to find them. They are exactly in the position of a ferret, watching patiently one end of a rat hole while the rat has escaped by the other.

The report of the sewage commission gives abundant evidence that even sewage irrigation only pays in certain favourable circumstances. This report is full of information, and represents an enormous amount of labour by its learned authors. They have worked hard to pick out the grain of wheat from the sack of chaff; but we must all admit that it would have saved them much trouble if we had never allowed the admixture.

Irrigation, the only method of utilising sewage, puts an amount of money value on the ground out of all proportion to the return obtained by the ratepayers. There appears no doubt that the farmer will not give ½d. per ton for it, delivered free of expense. Where gravitation and open carriers can be employed without pumping, its application is remunerative; but in no case is anything like the full money value obtained to the ratepayer. The cost of transport, where the chemical value of a product is only 1d. per ton, is far the more important item.

According to Professor Way's estimate, Glasgow would require 10,000 acres, constantly in use, at 5,000 tons sewage per acre per annum, and it would really require 15,000 acres, as one-third must be under root crop.

Now, in a damp climate like ours, what land would take this extra amount of water? and what farmer would ever dream of top-dressing his grass with manure equal to 3 tons of Peruvian guano per acre, if he had to pay the full market value for the manure? Moreover, what could be done with the grass where, as in our case, it would be impossible to make it into hay?

This system of sewage by water carriage is, however, now so general, that any means of modifying its evils may be worth our notice.

The sewer traps should all be provided with sieves of charcoal; and I propose to avoid the unsuspected dangers of the sewer gases rising in our present water-closets, to employ a double sieve of wire gauze, containing charcoal, which will slide in just under the seat, and completely close the opening, and which, by a little mechanism, can be made to slide back automatically. Or to enclose the charcoal in a small box with wire gauze sides, and simply place it in the closet. I employ, by preference, seaweed charcoal, the use of which I propose also for the filtration of town sewage, before it is allowed to pass into rivers. It is singularly allied to animal charcoal, which it excels in its porosity, its high oxidising power, and in the ease with which it admits the rapid passage of thick liquids. The thickest sewage passes through perfectly odourless and colourless. It entirely removes the organic matter from ordinary sewage, and can be used for a considerable length of time, without change. To gain its full power, the sewage should be run into large tanks, which can be used alternately, and allowed to deposit for 24 hours. The filtration should be upwards, through a stratum of char, and, when the deposit rises to the char, the whole should be mixed together, and made into manure; the char mixed with the sludge would render it more easy of transport. I do not intend to imply that the char removes the manurial value of the sewage to any great extent, but it renders it innocuous.

Earth Carriage.

This subject has been already brought before you; but as its chemical aspect has not been treated, I shall briefly allude to it. Some misconception appears to have prevailed here as to the disinfecting power of dry earth and ashes; both are absorbents of moisture, and to this extent, and no further, are these disinfectants. This may be easily proved by filtering putrid urine through either of these media; it passes unchanged.

These materials are only, therefore, deodorisers when largely in excess of the fœcal matter to which they are added.

Thus to take dry clay, the best substance of the kind, it would require three and a half times as much as the excreta, or 17,500,000 cubic feet to be brought into the city, and 22,500,000 cubic feet to be taken out again; and the actual value of this product would be £208,333, or 2¼d. per cubic foot, or 6s. 7d. per ton. Its practical value would, however, be much less, because, on account of the expensive carriage, the value of a manure decreases in inverse geometrical proportion to its strength. It stands to reason, therefore, that if a dry vehicle is to be resorted to, it must be more economical to use some substance which increases, rather than diminishes, the agricultural value of the product, especially if less of it can be employed to do the same work. That substance, which, while acting as a deodoriser, also absorbed the most water for a given weight, and added its value to the product, should, theoretically, be the best for this purpose. I find that, while perfectly dry clay only absorbs 45 per cent of water, dry seaweed char absorbs 147 per cent, and the former becomes a sludgy mud, while the latter can be easily removed.

The use of an absorbent of this kind would, therefore, reduce the amount of material to be brought into the city to less than one-third, or to an amount equal to the excreta to be removed; or 5,000,000 cubic feet brought in, and 10,000,000 cubic feet taken out, annually, the daily removal being 385 tons in, and 770 tons out. This is not more than the present daily removal of ashes, while there would be no greater nuisance, and the value, exclusive of the value of the charcoal, would be about 15s. per ton. Viewed in this light, the dry closet system presents strong

claims to notice, and, in a sanitary sense, its arrangements are perfect.

Air Carriage.

Carriage by atmospheric pressure possesses several advantages afforded by neither of the former systems, both of which add a large bulk of valueless, but costly, material to the excreta to be removed. Considering the great value, and easy application, of pneumatic pressure, it is remarkable that so little attention has been directed to it as a means of dealing with excreta; it has been entirely overlooked by those great authorities who have professed to look into all the bearings of this difficult question.

The principal effort in this direction is due to Captain Liernur. I will briefly describe the main features of this proposition, referring to "The Sewage Question," by Krepp, for further details. Captain Liernur proposes to place in houses a simple open-pan closet of a particular form, in connection with a vertical soil-pipe, and so shaped that the total excreta fall at once to the bottom of this pipe in the basement storey of the house, where it collects in a small syphon bend. The soil-pipe is made of earthenware, 14 to 16 inches in diameter, and is continued to the top of the house, where it is open to the air, and covered with a wind-guard for ventilation. The syphon bend and bottom of the pipe are of cast-iron narrowed from the soil-pipe to a 5-inch cast-iron pipe. This is continued to a central receiver, sunk in the public street. This reservoir has about 20 cubic feet capacity; and allowing 1 cubic foot to every thirty-six individuals, each serves about 700 persons and a number of houses. Each house has a so-called house-valve, which is accessible from the street, and closes the connection with the sewage reservoir. This reservoir may be placed in any central position in the public street, sunk under the ground, and surmounted by an ornamental lamp-post, within which the two communicating pipes are concealed. It is of a nearly spherical shape, or quite spherical top and bottom, with cylindrical sides. It receives the drain-pipes from a number of houses, collected in four main branches, which enter it with a slight bend at the top; the house pipes and main pipes are all about 5 inch bore, the former entering the latter horizontally at an angle of 30°, and a curve of 2 feet radius. The main pipes have a gentle downward inclination towards the reservoir, but enter it by a sudden bend upwards. There are two vertical pipes concealed within the lamp-post—one, the air-pipe, about 3 inch bore, fixed to the top of the reservoir; and the other the exit soil pipe, about 6 inch bore, continued nearly to the bottom of the reservoir.

The mode of filling and emptying these receivers is by a "locomotive engine and pneumatic tender," which is drawn by one horse, assisted by the steam power of the engine, to the several reservoirs during the night. The process is simple; the engine works a powerful air-pump, which is placed in connection with the reservoir and the tender; in about three minutes the gauge indicates a vacuum of about 10 lbs. to the square inch, or about 20 in. barometer pressure, and both are sufficiently exhausted. The several house-valves are then opened and closed consecutively, and the contents of the syphons instantly shot into the receiver by the downward pressure of air in the soil-pipe, the vertical ventilating shaft acting like a pea-shooter. When all the house-traps are discharged, the air-pipe of the receiver is disconnected, the exit soil-pipe connected with the exhausted tender, the contents thus transferred to it, and the whole machine is driven off to the next reservoir; the foul gas from the air-pump is blown into the engine furnace. The tenders have each 100 cubic feet capacity, 10 cubic feet of which is used as a water-tank to the engine. When full, these are taken to "decanting houses," where the contents are transferred to barrels. The barrels are 28 inches in diameter, 32 inches long, about 5 cubic feet capacity, and made of strong oak staves bound with iron hoops; they form the stores for the manure, and for its transport, and are to be sold direct to farmers. For applying the contents directly to the soil, which is Captain Liernur's special object, he proposes plans of ingenious manure ploughs and meadow manurers, which support the barrel and empty its contents at once into the furrow, where it is covered over and kept from decomposition. During frost, he proposes keeping these barrels in store.

The method of collecting, and particularly of applying, the excreta in these barrels, seems to me a most unnecessary complication. Glasgow would collect at the rate of 2,740 barrels a day, and a month's frost would accumulate an explosive store of 82,000 barrels; while in the summer I fear the barrels could not be used fast enough to prevent decomposition. There is also this great objection to this method, which applies, also, to irrigation, that we are compelled to sell our manure constantly to get it off our hands, and by making the farmer take it when he does not want it, and cannot advantageously apply it, we are entirely at his mercy, and must accept his prices; but if we could store it, make it into good manure, and sell it when he wants it, then, and not till then, can we expect to realise its full value. If the other parts of this plan work well, a modification would make this feasible.

We have a material to deal with in chemical works which presents some analogy with that under consideration; it must be kept from the air, it cannot be handled; but it is nearly double the weight of the excreta, and very corrosive. Yet this is lifted, without any difficulty, to great heights, and carried long distances, with no trouble and little expense, by atmospheric pressure; and could

not the excreta be dealt with in the same way? The drain-pipes from the houses should be led into iron reservoirs, the size and number of these to be determined; the total daily removal being only 13,700 cubic feet, twelve cylindrical boilers with egg-shaped ends, about 10' × 10', by 15 to 20 feet long, sunk vertically, would be sufficient for Glasgow. It might, however, be advisable to have smaller vessels in larger number; that is a matter of detail.

These reservoirs are all to be connected, by a small air-pipe, to one or more central pumping stations, where a powerful air-pump is fixed; each, also, to be furnished with an exit soil pipe, passing to the bottom, and continued up into a main pipe leading to one or two manure works situated some miles out of town.

This would, then, be the process of removal; at a fixed hour at night the air-pump would be set to exhaust a large iron reservoir at the pumping station, and communicating with the air pipes attached to the soil reservoirs. Two men for each district would then be sent round, and, opening the air-pipe valve, would place each receiver in connection with the exhausting pump, and then open, consecutively, the house-valves, by which means the soil-pipes would be nightly discharged, and the whole closet ventilated by a powerful blast of air. This is one operation. During the day, at a certain hour, the engine and air-pump would be reversed, and pump air into the air-vessel at the pumping station; the several soil reservoirs would then be placed in connection, and the contents lifted, by the atmospheric pressure, away to the manure works.

When we consider that a pressure of 50 lbs. on the square inch can be thus easily applied, there is merely the friction and some little weight to overcome; the plan seems quite practicable, and is, at any rate, worth a trial. The piping required would be an arterial system of small cast-iron piping; its cost, compared to sewers, would be little, and the cost for pumping must be insignificant, compared to that for lifting sewage in such enormous quantities.

The Abbey Mills pumping station has eight engines, 142 horse power each, or 1136 horse power; and these lift 15,000 cubic feet a minute 36 feet high. We have only to lift 385 tons, or 13,700 cubic feet, and the whole day's produce of Glasgow may be contained in a tank 30 feet square and 16 feet deep. These pumps, therefore, would do our day's work in fifty-four seconds.

When engineers talk of intercepting sewers for our sewage, they mean immense culverts of brick, which leak in all directions, and are full of noxious gases, to carry off 137,000 tons of sewage a day, containing 385 tons, or 355th of excreta, and only 38½ tons, or 3550th of its weight, of solid excreta. My notion of a true intercepting sewer is a perfectly tight and cheap cast-iron pipe, which will really intercept this excreta, and deal with it alone. It is, to all intents and purposes, a fluid, and subject to all the laws of fluid pressure; to add 355 times its weight of water to *make it fluid*, is not only "carting coals to Newcastle," but it is paying very heavily for the pleasure of doing so.

Engineers should consider the possibility of removing, without nuisance, the excreta, as it is, from where it is to where it should be; because, if it can be so delivered, the further disposal of it can be safely left to chemists, who may, then, be fairly asked to turn it to account. We have not hitherto had a fair chance; engineers are allowed to mix the excreta with an amount of water, and then to turn round and ask chemists to separate it again, forgetting that the "*reductio ad absurdum*" is not a chemical process.

Dickens, in his preface to the last edition of "Pickwick Papers," after referring to the great improvements which have taken place since he wrote the work, ventures a hope that "it may some day be discovered that the universal diffusion of common decency and health is as much the right of the poorest of the poor as it is indispensable to the safety of the rich and of the state; that a few petty boards and bodies—less than drops in the great ocean of humanity which roars around them—are not for ever to let loose fever and consumption on God's creatures at their will, or always to keep their jobbing little fiddles going for a dance of death.

No. II.

Read before the Chemical Section of the GLASGOW PHILOSOPHICAL SOCIETY, *April 19th, 1869.*

ABOUT twelve months ago, I read a paper on this subject before the Sewage Association of Glasgow; since then, the members of that association, with all their varieties of opinion, have passed one unanimous resolution—that, whatever system be adopted, the excreta must be kept out of the public sewers, the expression of a conviction which will be that of any patient enquirer into this difficult question.

In the paper referred to, I endeavoured to show that, whatever may be the best, the present water-closet system, with all its boasted advantages, is the worst that can be generally adopted; briefly, because it is a most extravagant method of converting a mole-hill into a mountain. It merely removes the bulk of our excreta from our cities, to choke our rivers with foul deposit, and rot at our neighbours' doors. It increases the death-rate, as well as all other rates, and introduces into our houses a most deadly enemy, in the shape of the sewer gases.

Since then, the report of Messrs. Bateman and Bazalgette has appeared, and it proposes (what every one knowing the views of the authors would at once have predicted) to put down miles of costly sewers to carry the excreta to the Ayrshire coast, where, perhaps, the inhabitants may oblige us to take it back again; in other words, to commit the error of London, and wake up in a few years to the same bitter repentance.

We cannot be surprised at this; we cannot expect homœopathic treatment from an allopathic physician, especially if, as in this case, "bleeding" is to be again the universal cure. The engineer's treatment of town excreta always reminds me of the country doctor in America, who put all his feverish patients through a course of convulsions, because, though he didn't understand *fevers*, he *could* cure *fits*. In our numerous discussions, I have always maintained that chemists have been most unfairly treated in this matter. The public like to see what they pay for; they can see bricks and mortar, and therefore have allowed engineers to give them an intimate pocket-purse knowledge of this expensive commodity, for which they have paid in more than one sense—through the nose. Engineers have too fondly believed that water is the great purifier, and so they dilute the excreta with 365 times its bulk of water, and reduce its value to 1d. per ton, and then turn round on the chemist and expect him to reverse the process, pick out the penny, and repay the expenditure. Now, if it were a simple mixture—if it were only to separate the grain of wheat from the sack of chaff—the problem would be difficult enough; but we know the case to be far worse than this—it is the handful of yeast in the sack of flour that we are called upon to extract, and the fermentation of which we are expected to prevent, *after* it has occurred. A small portion of dilute sewage, mixed with a large excess of water, soon renders it all equally offensive, and the problem of extracting its value is one which no chemist need ever attempt to solve.

The water-closet, with many apparent advantages, and with all our prejudices in its favour, carries an attendant train of evils, which I am fully persuaded will ultimately doom it to oblivion.

As, therefore, engineers have not put the subject fairly before chemists, I propose to take a noble revenge, and put the subject fairly before engineers. I ask them why they consider water to be the only vehicle for removing excreta?—why not earth?—why not air? Have they ever fairly investigated or thoroughly experimented on the other methods? Have they not rather confined their studies to *fits*, and forgotten *fevers*?

So many attempts have been made by chemists to pick up the halfpence that engineers have so plentifully flung into the mud, that I cannot even notice them, except to remark that, in the opinion of all the scientific chemists who have specially investigated these attempts, they have all signally failed.

I must allude, however, to the process of Mr. Chapman, as one of the latest methods of dealing with town sewage; this is a process of distillation, after treatment with lime and thorough putrefaction. He, however, confesses his difficulty, by wishing to reduce the sewage of this city from 31,000,000 gallons to 1,000,000 gallons daily. This, of course, requires a complete alteration in the existing system, and it still dilutes the excreta with more than ten times its bulk of water. The lime process, and the putrefaction required to decompose the urea, would be extremely offensive, and require vast storing tanks. In working 1,000,000 gallons daily (it would more probably amount to 2,000,000 gallons); he would have to treat 4464 tons daily, the total chemical (not the extractible) value of which is 2s. 6d. per ton; and he expects to do this with 20 tons of coal. He proposes to adopt an ingenious arrangement of eight boilers, steaming exhaustively, to distil off the ammonia, heating up the feed sewage, after precipitation by lime, by the hot water discharged from the boilers by a kind of brew-house refrigerator with its object reversed. He expects to distil off 1-12th; but I think it must be at least 1-10th, or 100,000 gallons, evaporated by 20 tons of coal = 5,000 gallons to 1 ton. The report of Professors Lyon Playfair and Johnstone puts the average evaporation for Scotch coal at 7·7 tons, or 1712 gallons per ton, and at this rate 58 tons would be required for the mere evaporation. Then, for raising the heat, the same report says that 1 ton of Scotch coal raises 56 tons of water from 32° to 212° F., or, say, 50 tons of water from 52° to 212° F., requiring, therefore, 96 tons for heating up, making a total of 148 tons a day. Mr. Chapman, therefore, expects to save, by heating feed water, and by exhaustive steaming, a total of 128 tons of coal daily, or 600 per cent. Can this be done? If it can, then whatever may be the result of his process, as applied to sewage, it will make him the greatest and most daring authority on that equally important subject, the economy of fuel. He puts down no loss for radiation. This should, I think, be at least 10 per cent, which would require nearly as much as his total calculated expenditure for fuel. In using eight boilers, of 4,000 gallons each, he expects to get off all the ammonia in half an hour's steaming. Now, we all know that the estimation of free ammonia in the laboratory is one of the most tedious processes, requiring a long-continued ebullition, and the experience of distillers, on the large scale, amply corroborates this, and proves that it does not pay to distil liquors containing under 1 per cent of ammonia (some manufacturers double this estimate). The total amount in the sewage to be distilled would be under 0·2 per cent; I think, therefore, that the process of Mr. Glassford, of evaporation with sulphuric acid (for which I must refer you to his pamphlet on London sewage), is better than this; fuel is the great question in both, but in his the results are certain, in Mr. Chapman's they are problematical.

Both are, however, connected with the water system, which I believe to be a mistake, and I think we must ultimately come, either to a system like Capt. Liernur's, by what may be called pneumatic despatch, or to the dry-closet system. Of the former I have fully treated in a former paper, and wish now to speak more particularly of the latter. During the past year, Moule's dry-closet has been largely introduced; all who have used it speak in the highest terms of its efficiency, and there are already strong indications of its becoming the system of the future. It is the only system that has succeeded during the hot fortnight at the Wimbledon meeting; and it is particularly adapted to hot climates, where the evils of the water-closet are most conspicuous. The objections urged against the system, when earth is used, are—1st, the large quantity of earth required—three and a half times the weight of the excreta; and, 2nd, the difficulty of obtaining the quantity required, and of drying it. Now, both these difficulties are disposed of by using charcoal. I employ, by preference, sea-weed charcoal, because it is the most porous, the best absorbent, and the cheapest. It only requires one-fourth of the weight, compared to earth; and when the mixture is removed and placed under cover, it soon dries. This mixture can be stored for any length of time, and used again several times. When convenient, it is re-burned, like the char in sugar refineries, except that this process is carried out in apparatus which admits of collecting the ammonia and other products condensed. The whole of the ammonia is thus collected; whilst the phosphoric acid, potash, and mineral matters accumulate in the charcoal, together with the carbon from the organic constituents of the excreta. The weight of the charcoal is increased to the extent of about 5 per cent with each using, and, if dried and re-used five times, about 25 per cent with each re-burning. With this constant addition, the char does not require replacing with fresh material, so that its cost is only a primary outlay—the ultimate result being that the excreta is deodorised by a charcoal derived from itself, and a company working this process would, in addition to securing the whole of the ammonia, become sellers of a charcoal second only in value to that from bones to the extent of, in Glasgow, if the process were general, 19 tons a day, or 6,935 tons a year; the total quantity of excreta which Glasgow has to remove being 385 tons a day, and its value, at 29s. 6d. per ton, = £569.* The ultimate result being the same, any charcoal may be used at first. The process is carried out without odour, from the closets to the finished products. Of course the process may be modified; for instance, suppose the char to be used five times, and only dried, the addition to its value would be as follows (I take equal parts, as this charcoal will absorb at least an equal weight of even urine):—

1 ton seaweed char, at £2 } = 30 cwts. manure at £9 7s. 6d.
5 tons excreta, at 29s. 6d. } = £6 5s. per ton.

Or, if re-burnt, it would yield 25 cwts. of charcoal, and the whole of the nitrogen would pass over in the distillation, as ammonia. Dr. Wallace estimates the cost of re-burning char in sugar refineries at 3s. 6d. per ton for labour and fuel, containing 31 per cent moisture, which would be much over that referred to. Here, then, we have a simple process for recovering the whole of the value from excreta, of general application, and the results of which can be predicted by chemists with absolute certainty, as far as those products to which we at present attach value are concerned; but the uncertain portion is, as usual, the most interesting, for in the destructive distillation of excreta we are exploring a new field, which promises great interest.

* Value given in my former paper.

I regret that I am obliged to bring this paper forward before the new products have been studied. The distillation generally is remarkably similar in its products to that of bones, and also to that, which most resembles it, of sea-weed. Besides ammonia, acetic acid, with a little butyric acid, acetone, and pyrrol are the most marked bodies. I cannot speak more definitely of these products in this paper, as they are still under investigation. The following analysis of urine is taken from Miller, representing the average composition in 1,000 grs., sp. gr. 1·020. The calculated percentage of nitrogen is appended:—

			Nitrogen.	In 100 parts of solid matter.	Nitrogen.
	Water	956·80			
Solid Matter, 43·20. Organic, 29·87.	Urea	14·23	6·64	33·00	15·40
	Uric acid	0·37	0·12	0·86	0·27
			6·76		15·67
	Alcoholic extract	12·53		29·03	
	Watery extract	2·50		5·80	
	Vesical mucus	0·16		0·37	
Inorganic, 13·33.	Chloride of sodium	7·22		16·73	
	Phosphoric acid	2·12		4·91	
	Sulphuric acid	1·70		3·94	
	Lime	0·21		0·49	
	Magnesia	0·12		0·28	
	Potash	1·93		4·47	
	Soda	0·05		0·12	
		999·94	= = NH_3 8·2. Sulphate of ammonia, 31·86, or 3·18 per cent.	100·00	= = NH_3 19. Sulphate of ammonia, 73·72.

The average portion voided by each individual may be taken at 40 ozs., and of fæces, 4 ozs., total 44 oz. daily; or, 1·7 ozs., solid, from urine, and 1 oz., solid, from fæces = total of 2·7 ozs. solid excreta daily. The following analysis of the fæces is from Berzelius:—

Water	75·3		
Bile	0·9		Containing, according to Playfair—
Albumen	0·9		15 p.c. nitrogen, and 45 p.c. carbon, and about 25 p.c. ash.
Extractive matter	2·7	5·7	= nitrogen 3·73 p.c.
Salts	1·2		= 4·53 NH_3.
Insoluble residues of digested food		7·0	= 17·65 p.c. sulphate of ammonia.
Insoluble matters added in intestinal canal—mucus, biliary resin, and peculiar animal fat		12·0	= 70·71 in dry solid matter.
		Solid matter, 24·7.	
	100·00		

The ash contains, according to Porter:—

	Ash of Fæces.	Ash of Urine (calculated).
Chloride of sodium	1·33	54·15
Phosphoric acid	36·03	15·89
Sulphuric acid	3·13	12·73
Lime	26·46	1·57
Magnesia	10·54	0·89
Potash	6·10	14·45
Soda	5·07	0·38
Peroxide of iron	2·50	—
Carbonic acid	5·07	—

Assuming, then, the proportions voided to be in the proportion of 17 dry, from urine, to 10 dry, from fæces, the resulting chars may be expected to have the following composition :—

	Urine.	Fæces.	Mixed Excreta.
Percentage of char in dry solid matter	50	70	57
Ammonia = sulphate ..	73·72	70·71	72·60

COMPOSITION OF CHARS.

	Per cent.	Per cent.	Per cent.
Carbon..	33·33	45·00	37·65
Chloride of sodium	36·10	0·33	9·51
Phosphoric acid..	10·60	9·01	10·01
Sulphuric acid ..	8·49	0·78	5·63
Lime	1·05	6·61	3·11
Magnesia	0·60	2·63	1·35
Potash	9·64	1·52	6·63
Soda	0·26	1·26	0·63
Peroxide of iron..	—	0·62	0·23
Carbonic acid ..	—	1·26	0·46

The nitrogen in the mixed excreta, in the proportions voided, is equal to 4·49 per cent of sulphate of ammonia.

In the char from urine, the phosphoric acid is principally combined with potash, and therefore soluble. This char alone would be a valuable manure as containing a large proportion of soluble phosphates; but the result of commencing with seaweed charcoal, which is rich in carbonate of lime, will be to form phosphate of lime at the expense of the carbonate—in other words, to form, by treatment with urine, re-burning, and washing, the animal charcoal required by the sugar refiner. This expected result is verified in the following tables of analyses. I regard the phosphate of lime thus gradually formed, from its minute state of division, to be quite equal, in agricultural value, to ordinary soluble phosphate. The washed residual char from fæces is at once available for the refiner, as it contains about 26 per cent of phosphates of lime and magnesia, with but a small proportion of carbonate. I know no reason why the product of disintegrated bone and muscle should not be used for this purpose as well as the bones themselves.

In distilling 100 tons of the dry product from mixed excreta, therefore, we should obtain 72 tons of sulphate of ammonia, and 57 tons of a charcoal containing 10 per cent of phosphoric acid in its most available form for manure, and 6 per cent of potash. It will be seen, from Berzelius's analysis, that nearly 50 per cent of the fæces consist of fatty matter—how will this appear in the distillation? In a population of 500,000, this item amounts to nearly 7 tons a day!

I expected a loss of ammonia in drying, but it is very small, and appears to arise from the free lime in the char,

as it will be seen further on that the loss decreases in using the char with urine. In a small experiment with urine, I found the total loss, in drying by artificial heat with new char, to be 2·06 per cent of the ammonia, or 0·105 per cent of the urine employed.

I append analysis of 1 lb. of char which was re-burnt fifteen times with an equal weight of urine; a portion of the char was lost, which prevents my giving the increase in weight; I believe, however, the addition of carbon would be too slight to effect an increase in the total, with so many re-burnings. The percentage is decreased :—

	Char used.	After re-burning.	Increase per cent.
Water	10·0	2·80	—
Soluble salts	0·6	11·15	10·55
Insoluble	89·4	86·05	—
Soluble.			
*Chloride of sodium.. ..	—	8·75	8·75
Sulphuric acid..	0·3	0·34	0·04
Phosphoric acid	—	2·00	2·00
Potash	0·3	2·40	2·10
Insoluble.			
Carbon	54·4	29·40	—
Silica, &c...	9·1	13·10	4·00
Phosphate of lime	4·8	20·05	15·25
Carbonate of lime	17·4	19·75	2·35
Carbonate of magnesia ..	3·4	3·40	—

The urine used appears to have been deficient in sulphates and high in phosphates, these two ingredients being subject to considerable relative variation. The distillates gave 192 ozs. liquid, containing free ammonia equal to 3,047 grs. sulphate, or 2·9 per cent of the urine, showing a slight loss, inseparable from destructive distillations on the small scale. The charcoal should be used at least five times before re-burning, and for urine alone it may be employed ten times. I append a table, showing the analytical results of this process with urine :— (See next page).

No. 1 is from charcoal dried up with ten times its weight of urine before re-burning; No. 2 has been treated with twenty times its weight, No. 3 with fifty times its weight, and No. 4 with 100 times its weight of urine before re-burning. It will be seen, that in No. 4 more than the theoretical amount of ammonia is obtained; that from Nos. 1, 2, and 3 are obtained by simple destructive distillation. No. 4 only yields ammonia equal to 50·48 per cent of sulphate when heated in this way, the quantity given, 105·64 per cent, being that obtained with soda-lime; the residual nitrogen is not left in the char, but goes off in the distillation in some other form than ammonia. I shall recur to this subject in a subsequent

* In this and the following analyses, the whole of the chlorine has been calculated, for convenience, as chloride of sodium, which, in some cases, is therefore too high.

	Increase, per cent. 1.	2.	3.	4.	Increase, per 1,000 grs. of Urine. 1.	2.	3.	4.
Dry solid matter	33·30	62·50	210·00	347·94	33·30	31·25	42·00	34·79
Char	7·50	12·90	80·40	151·96	7·50	6·45	16·40	15·19
Ammonia sulphate	21·70	36·80	51·12	105·64	29·00	29·90	31·60	47·31

RESIDUAL CHARS.

	Composition, per cent. Ordinary Char.	1.	2.	3.	4.	Increase, per cent. 1.	2.	3.	4.	Increase, per 1,000 grs. of Urine. 1.	2.	3.	4.
Water	10·00	1·60	3·00	—	—	—	—	—	—	—	—	—	—
Soluble salts	0·60	15·80	19·80	39·40	52·20	15·20	19·20	38·80	51·60	20·40	15·70	24·30	22·78
Insoluble	89·40	82·60	77·20	60·60	47·80	—	—	—	*41·60	2·04	23·90	19·60	12·47
Soluble.													
Chloride of sodium	—	5·40	13·10	28·02	24·70	5·40	13·10	28·02	24·70	7·18	10·60	17·30	11·06
Sulphuric acid	0·30	2·05	3·29	3·77	3·77	1·75	2·99	3·47	3·47	2·33	2·64	2·21	1·62
Phosphoric acid	—	2·20	0·40	trace	1·60	2·20	0·40	—	1·60	2·92	0·32	—	0·71
Potash	0·30	2·80	4·99	7·00	10·38	2·50	4·69	6·70	10·08	3·32	3·89	4·10	4·62
Insoluble.													
Carbon	54·40	37·40	40·00	35·40	28·20	—	—	—	*26·20	*4·50	5·30	11·06	7·19
Silica, &c.	9·10	13·60	10·00	8·00	4·40	4·50	0·90	—	*4·60	8·98	3·57	3·14	1·06
Phosphate of lime	4·80	8·00	9·60	11·40	10·20	3·20	4·80	6·60	5·40	5·84	5·40	6·10	4·08
Carbonate of lime	17·40	20·40	13·20	4·20	1·15	—	—	—	*16·25	9·73	2·00	*0·88	*1·22
Carbonate of magnesia	3·10	5·40	3·16	1·93	1·20	2·30	0·06	—	*1·90	4·08	0·98	0·57	0·23

WASHED CHARS.

	Composition, per cent. Ordinary Char.	1.	2.	3.	4.	Increase per cent. 1.	2.		
Carbon	54·40	45·30	51·80	58·40	59·00	*9·10	*2·60	4·00	4·60
Phosphate of lime	4·80	9·60	12·40	18·80	21·34	4·80	7·60	14·80	16·54
Carbonate of lime	17·40	24·60	17·10	6·90	2·40	7·20	*0·30	*10·50	*15·00
Carbonate of magnesia	3·10	6·50	4·10	3·10	2·51	3·40	1·00	—	*0·59

* Decrease.

paper. The retention of nitrogen after drying is, however, extraordinary, when the product yields ammonia equal to 105 per cent of sulphate. No Peruvian guano can be compared to this in fertilising value.

The washed chars acquire the composition which fit them eminently for the sugar refiner.

The experiments with closet excreta are unfinished, and it is difficult, in working on small quantities, to obtain uniform results. We find one of Smith's dry-closets use ½ lb. of seaweed char per charge, the charge of dry earth being 2 lbs. Moule's closet uses rather less. There were seven uses in our first experiment, the contents of the pail being re-burnt at once, without drying.

Weight before distillation .. .. 130 ozs.
Residual char weighed .. .. .. 48 ,,
Weight of excreta 82 ozs. = 11·7 ,, per use.

The distillation gave 66 ozs. of gas liquor containing free ammonia = 2·8 ozs. sulphate = 3·4 per cent of mixed excreta; this represents only the free ammonia, or that existing as carbonate, a portion is combined with acetic acid, which was not estimated.

The same method is equally well adapted for treating pot ale from distilleries, and blood and offal from slaughter-houses. The *former* is an important subject in Glasgow, and I can, in this paper, only shortly allude to it. According to Dr. Wallace, one of the distilleries in Glasgow sends into the sewers 83,000 gallons of this pot ale, containing nitrogen equal to ,118 grs. of ammonia per gallon; so that the daily discharge of this one distillery is equal to the total excreta of 48,970 persons, or one-tenth the population of Glasgow.

The process can be adapted with ease to urinals as well as closets. I am enabled to exhibit some mixtures of charcoal and night soil made twelve months ago. I was curious to know if these mixtures had gone further in the oxidation of the ammonia, and formed some nitrates, but not a trace can be detected.

I submit that the dry-closet system, with this process, has the following great avdantages:—

1. Total freedom from all odour. All must have noticed sometimes the sickly odour of a water-closet, arising, not from the excreta, but from the gas from the sewers.

2. Certain prevention of all contamination and spread of infectious diseases arising from sewer leakage into our wells or sewer gas into our houses.

3. Saving of water, equal, in Glasgow, to £40,000 a year, if the water-closet system were general.

4. Saving of expense in repairs and removal. 1 cwt. of charcoal per month is sufficient for each closet when used by six persons daily, and the whole may be allowed to fall at once from the closet, through a 12-inch pipe, to a cesspit below the house. A cess*pool* is a serious evil, but I know of no objection to a cess*pit*.

5. By this process alone can the whole of the valuable material be recovered for our lands.

Dr. Fergus has shown some remarkable examples in which gastric fever has been traced to the escape of sewer gas through small openings eaten through the top of the soil-pipe. This appears to be a wide-spread evil. I have examined some of these specimens, and find the substance to be a sort of lead plaster, containing, also, lime and some fatty acid, which requires further examination. I have shown that only remedial measures can be adopted, where the water-closet system has been carried out, by placing boxes of charcoal in the closets, and filtering the sewage through charcoal before allowing it to enter rivers.

Our authorities want, of course, some grand scheme; but they forget that the question is one of minute details. We are assailed by a large army of small nuisances—one, at least, to every house, and we must attack them one at a time. Attacked in their united strength, they will assuredly overcome us. Ought we not rather to strike at the root of the evil? Ought we not to stop the mischief at its numerous sources, and before these can combine into a mighty force, which carries everything before it?

Let the subject be calmly and carefully discussed; let us not be carried away by great schemes and useless expenditure; let us not leave to posterity heavy taxes, with barren wastes and desolate cities, but let us rather pay our own way, and leave our country fertile and our towns pure, and I shall never regret that, however imperfectly this subject has been brought before you, my earnest wish has been to strike "one more blow for life."

A lively discussion followed the reading of the paper, the general opinion of the members of the section being highly favourable to the process, which was considered the most novel and practical which has yet been introduced.

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PAMPHLETS

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