ORIGINAL COMMUNICATIONS.

THE THANATOPHIDIA OF INDIA.

By J. Fayrer, M.D., C.S.I.

(Continued from page 49.)

The Ophidia are oviparous and viviparous.

The colubrine snakes generally are oviparous; but there are exceptions, such as the Hydrophidæ and Homalopsidæ, which are all viviparous, producing from 4 to 9 young ones.

The viperine snakes, as their name implies, are all viviparous.

The distinction is not one of such great importance, as might at first appear. In the oviparous snakes the young are produced from eggs of an oblong obovate form with a soft leathery white shell. These, from 10 to 40 or 50 in number, are deposited in some place where the natural heat is sufficient to hatch them.

Of all the Ophidia the Python only, according to some authorities, incubates; it coils itself over the eggs, and sits on them till they are hatched.

The viviparous, or rather ovoviviparous snakes produce their young alive. The eggs are hatched in the oviduct, development having proceeded in them to the point at which the delicate covering of the egg bursts before or during parturition, and the young ones come into the world alive, and immediately show all the activity of their race. A higher temperature than that which is natural to the viper, in its ordinary condition, is necessary to effect this. The temperature of the reptile increases at these times, and the parturient female is said to expose herself to the heat by basking in the sun's rays, at which time she is more sluggish and inert than on ordinary occasions. The female of all snakes is said to be larger than the male; there are certain differences in color also, which may distinguish the sexes. In the Hydrophidæ the male is known from the female by a distinct swelling on each side of the tail extending from the root to, or beyond, the middle of its length. But in other snakes there is no certain external anatomical character to distinguish the sex; dissection, of course, reveals it.

In cold and temperate climates, snakes hybernate or remain in a state of lethargy or torpidity. Active life is suspended until returning warmth rouses the vital energies into a state of activity. They differ much in their modes of life, habitation, food, &c. They are all carnivorous. Mollusca, insects, reptiles, birds, mamalia, eggs and milk are their food. Vegetable matters have been found in the stomach, but they are essentially carnivorous, and most, if not all, take their food only whilst it is alive.

Irrespective of the ordinary natural classification, they are arranged under the following heads:—

Tree snakes; those that live for the most part in trees or bushes, and are characterized by their brilliant colors, generally green, their slender and whip-like form, and great activity. Both the non-venomous colubrines and the viperine snakes are found among this section.

The water snakes are the salt water and the fresh water snakes;—the first are all venomous, the second are all innocent.

The salt water snakes have a peculiar form adapted to their mode of life—a compressed tail. Nostrils above the snout; they are all poisonous and viviparous.

The fresh water snakes have the nostrils like those of the salt water snakes. They live in the fresh, though they may be found like the others in brackish water; they have not the compressed tail; they are viviparous, and all belong to the sub-order of non-venomous colubrines.

Ground snakes.—Representatives are found in all the three sub-orders. They live, generally, above ground. They are more or less cylindrical in shape and very flexible in body. The greater number of snakes are found in this section.

Burrowing snakes live much under ground; have a rigid cylindrical body, short tail, narrow mouth, and small teeth. No ventral shields; they are all innocuous.

The Thanatophidia comprise the two sub-orders: Ophidii Colubriformes Venenosi, and Ophidii Viperiformes: these are represented in India, the former by the Elapidæ and Hydrophidæ; the latter by the Crotalidæ and Viperidæ. In these families the most deadly snakes are found.

A few words on the characteristics of each of the sub-orders and their sub-divisions as found in Bengal.

The members of the poisonous colubrine sub-order are distinguished by their form, which is like that of the innocuous snakes. By the formation of the maxillary bone, which, though shorter than that of the harmless snakes, is much longer and less moveable than that of the vipers. The poison fang is shorter, and less moveable than that of the viper owing to the comparative immobility of the maxillary bone, with which it is anchylosed.

It is to be observed that the mobility of the poison fang in all snakes depends entirely on that of the maxillary bone, as the active tooth is firmly anchylosed to the bone. The reserve fangs lie loose in a reduplication of mucous membrane. The canal through which the poison flows is less developed in the poisonous colubrines than in the vipers, and in the Hydrophidæ it is actually an open groove. The maxillary bone also in some cases bears other teeth besides the poison fang.

The third sub-order Viperidæ.

The viperine snakes are distinguished by their form, the broad head, small very mobile maxillary bone, to which is anchylosed a long perforated poison fang, which, on account of the mobility of the maxillary bone, is erectile.

There are other less important distinctions which will be noticed in describing genera and species. It may be briefly noticed that the general characters of a viperine or a colubrine snake are easily recognised. The formation of the maxillary bone and the dentition are certain guides in distinguishing one from the other.—*(To be continued.)*

ON THE RELATION OF FUNGI TO DISEASE.

By Assistant-Surgeon D. Cunningham.

(Read at the Meeting of the Bengal Branch of the British Medical Association, on the 19th January.)

The subject on which I propose to say a few words, is the relation of fungi to disease, and more especially to disease in the human subject. The full discussion of this subject would take up much more time than is at my disposal at present, and I am, therefore, obliged to confine myself to a few general statements on the more important points involved. The importance of this question has been greatly enhanced of late, for although up to a quite recent period the diseases associated in idea with fungal agency were, almost without exception, trifling in their nature, yet many authorities are now inclined to ascribe two orders of diseases, which yield to none in destructive power, *i. e.*, the miasmatic and enthetic to fungal agency.

The great argument which has led to this belief is founded on the similarity existing between the action of the specific poisons of many of these diseases on the blood, and that of vegetable ferments, such as yeast on fermentible materials. We

have in both cases an alteration in the substratum and a multiplication of the material by which the change is effected.

So, again, the result of the process is alike in both cases, in being apparently not dependant on the amount of the active material introduced, but on the peculiar condition of the substratum as favouring or otherwise its multiplication after introduction. In short, the state which we term predisposition to a morbid process of this kind, is, from this point of view, to be regarded as equivalent to fermentibility.

That this similarity exists between the two processes is undoubted, but similarity does not necessarily imply identity.

The diseases ascribed to a fermentation process in which we have any clear proof of a multiplication of the poison, are, almost without exception, induced by the introduction of an animal poison into the tissues of a living animal, and we know as yet far too little regarding the action of such poisons in such circumstances to warrant a definite conclusion that they are identical with vegetable ferments merely because they show certain apparent similarities to such bodies in their action. Fungi, as regards their actually demonstrated or supposed action in inducing disease processes, may be conveniently divided into four great classes:—

I.—Those producing injuricus effects on health by injuring or destroying the nutritive value of articles of diet.

II.—Those producing injurious effects by means of poisonous principles which they contain, and which when ingested are capable of producing the phenomena of poisoning, just as like principles contained in the higher plants are under similar circumstances.

III.—Those supposed to produce injurious effects by means of the entrance of their ultimate germs into the blood. These germs being supposed, if they find a suitable nidus in it, to multiply at its expense, and in the process to alter its properties, just as yeast cells act in a fermentible fluid.

IV.—Those producing injurious effects by local invasion of some special tissue or organ.

Let us now look at each of these classes a little more in detail, and endeavour to estimate the value of the evidence on which the belief in their action depends.

CLASS I.—*Fungi which injure or destroy articles of diet, and thereby favour the occurrence of disease processes.*

It is very hard to draw an exact line between the species belonging to this class and those which ought properly to be referred to the next one, *i. e.*, to the class of the directly poisonous fungi.

That any species of fungus affecting and destroying articles of diet to such an extent as to induce any degree of famine, will, in doing so, favour the occurrence of various forms of disease, is evident at first sight, and we have not far to go for a striking example of the fact.

The potatoe disease and the disastrous results following its wide diffusion, are not likely to be soon forgotten, and the weight of evidence at present goes to prove that it is actually caused by the development of the mould with which it is so invariably associated.

The fungal diseases affecting cereal crops in England are familiar in name at any rate to every one. Rust, (Trichobasis rubigo vera) and mildew (Puccinia graminis) affecting the leaves and so interfering with the vigour of the plant and its power of fructification, while smut (Ustilago Segetum) and bunt (Tilletia caries) attack the ear itself and destroy its tissues. Some would rather be inclined to refer bunt to the class of directly poisonous fungi, but that its properties warrant this, is at present very doubtful.

The above are perhaps the most important members of this class, at least of those at present known to belong to it, but there are of course an almost infinite number of other species affecting other esculent plants, though their importance is, on the whole, trifling, varying in proportion to the greater or less degree to which the plant affected enters into the ordinary dietary of the population of any country. Examples of these are to be found in the turnip mould, (Peronospora parasitica), onion mould (Peronospora schleideniana), pea mould (Peronospora vicice) &c.

The fungal diseases of the plants entering into the dietary of the natives of this country is an important subject, and one which as yet to a great extent requires to be worked out.

These may serve as familiar examples of this class, and of the evil results following the wide diffusion and development of members of it when affecting certain plants.

CLASS II.—*Fungi of directly poisonous properties.*

That some fungi are poisonous is notorious and as a safe general rule the whole order may be looked on with suspicion as articles of diet. A few species no doubt seem to be constantly harmless, but others which at one time are partaken of with perfect impunity, may, at another, produce the phenomena of poisoning. Examples of this class are so familiar and their properties so fully recognised that it is almost unnecessary to allude farther to them. Ergot (the mycelial condition of Cordyceps Purpurea) is practically the most important, from the extent to which it is liable to enter into food in countries where rye is much cultivated. Some might be inclined to refer it to the former class, but the phenomena induced by the prolonged use of grain considerably contaminated in this way seem sufficiently specific to warrant its retention here. That a prolonged use of ergoted grain is necessary in order to produce the specific effects is shown by the fact mentioned by Berkeley, that children in Germany often eat large quantities of St. John's bread, that is, bread prepared from ergoted grain, without any ill result.

CLASS III.—*Fungi whose germs are supposed to enter the blood, and there multiply at its expense, inducing a species of fermentation, and thereby causing specific diseases according to the nature of the entering germs.*

That fungal germs may enter the blood, or may even originate in it, is impossible to deny. For though we know of no means of entrance, yet neither can we detect means of entrance for the germs of the fungi which are to be found in such anomalous situations as the interior of eggs or of nuts, or the brain substance of living birds, and we are, therefore, obliged in these cases to believe either that they do enter in some manner which as yet has escaped observation, or that they are originated *de novo*. That fungal germs do actually enter the blood, and having entered can multiply in it, is a very different matter, and one of which up to the present time no sufficient proof has been adduced.

The occurrence of destructive fungi in insects does not bear on the point, for in this case we have the numerous openings of the respiratory system through which germs can easily enter the fine air tubes in which they germinate, and from which they spread through the tissues, and the consequent interference with the respiratory and nutritive changes of the victims is quite sufficient to account for all the symptoms induced, without supposing any fermentive process in the blood induced by multiplication of germs. All that has been really proved by the supporters of the fungal theory, seems to be little more than that blood after its withdrawal from the body affords a favourable nidus for the growth of fungi, which is nothing very remarkable, considering what its chemical constitution is. The whole subject has been greatly complicated and obscured by the fact that many of the observers have given specific names to all the varieties of mycelial filaments or yeast cells observed, the glaring absurdity of which must be evident to every one who has ever carried on any series of observations on fungal development, no fact being more thoroughly established than that the true fructification is the only test of specific identity or distinction. Even though however it were fully established that

the blood of each specific disease did on cultivation constantly yield a specifically distinct fungus, the question of the presence of the specific germs in the blood would remain as unsettled and unproven as ever, for the specific peculiarities of the blood might in themselves be quite sufficient to determine the species which would acquire developmental supremacy.

Even if we put the question of so-called spontaneous generation aside, which we certainly have no right to do as yet, we still have a great difficulty remaining, *viz.*, that we have no means of putting any material in such circumstances as to favour the development of the germs, which it is supposed to contain, and at the same time of absolutely excluding the possibility of the entrance of extraneous germs; and unless the exclusion were perfect, we have no right to conclude that bodies afterwards appearing are necessarily derived from germs intrinsic to the material.

For the establishment of the theory it appears to be imperiously demanded—

1*st*.—That distinct unmistakeable foreign bodies be recognised in the blood immediately on its removal from the body (and not only appearing plainly after it has been kept for some time, as is reported regarding the fungal cells said to occur in the blood in the Texas' cattle disease.)

2*nd*.—That these bodies exist in large quantities, and are constant in their occurrence.

3*rd*.—That these be actually observed to develope into, or give rise to, fungal growths, or at least that their vegetable nature be clearly demonstrated in some way or other.

4*th*.—That the species to which the cells belong be, if possible, determined by cultivating them so as to ascertain what their fructification is.

5*th*.—That the species having been determined, it be clearly shown that the introduction of its cells or germs into the blood is capable of producing the disease with which it is associated, as if this is not the case, the relation cannot be that of cause and effect, but *vice versâ*.

The germs introduced into the blood in an experiment of this nature must, of course, not be derived from plants grown on the diseased blood, as it is quite possible that the cells of plants so grown might absorb enough of the specific poison to produce constitutional effects.

The German observations which have of late attracted so much attention in England, on the supposition that they went far to prove this point, are—the more one looks into them, the less reliable and convincing, for, in the first place, they involve a total disregard of the possibility of spontaneous generation, and secondly, they have as their essential basis the assumption that we can almost absolutely secure the exclusion of external germs from the material experimented with.

The theory is no doubt a very attractive one, and if established, would explain many obscure points very satisfactorily, but we ought to be very cautious of letting a desire for explanation, and an impatience of doubt lead us to conclusions founded on imperfect or partial observation.

We know very little of vital chemistry at present, and it may be that the diseases ascribed to fungal agency, are in fact induced by a purely chemical process. It appears to be now allowed that even the ashes of yeast will induce fermentation in a suitable fluid, which clearly shows the non-necessity of any vital agency in the process. Of course, the difficulty as to the multiplication of the poison remains to be accounted for, but, if the fermentive agent were such as to decompose the fermentible material into any number of bodies, one of which should be identical in composition with itself, we should have every condition fulfilled for the explanation of those morbid processes in which there is a multiplication of the original poison. This, of course, is not propounded as a theory, but merely as a suggestion of the possibility of some chemical process, being the active agent in the production of infective diseases. All miasmatic and enthetic diseases have been ascribed to fermentive changes, dependent on fungal agency, and some of the more enthusiastic supporters of the theory are even prepared to name the species belonging to various of the more important members of these orders of disease.

It seems quite possible that fungal germs, without entering the blood at all, may be really effective agents on producing or propagating certain of those diseases, such as hospital gangrene and pyæmia, in which there are open wounds and other exposed surfaces. The germs themselves may remain quite localised, and yet in their processes of growth and development may effect important and prejudicial changes on the fluids and tissues of the part, so as to produce directly or indirectly a poison, which may be conveyed by the blood through the whole system.

Although we have no satisfactory evidence supporting the fungoid theory of disease, yet, on the other hand, we certainly have no right to assume that the point is definitely settled against it as yet, for it will certainly require a much larger number of observations than have yet been made, to prove that there is no foundation for it. The thing which is now requisite is an accumulation of correctly registered facts, and not mere ingenious theoretical arguments for or against it.

Class IV.—*Fungi producing disease by local invasion of some tissue or organ.*

The association of fungal growths with certain diseased conditions of the skin and mucous membranes has long been observed, and of late years we have had the constant occurrence of fungal elements in the disease of the lower extremity termed fungus foot, &c., so common in certain parts of this country, very clearly demonstrated.

There is no difficulty in accounting for the presence of fungi in the cutaneous and mucous surfaces, and the great question regarding their occurrence is, whether they are mere accidents, or the causes of the diseased conditions with which they are associated, or if they occupy an intermediate position as modifying agents which introduce peculiar features into processes of independent origin.

Experiments proving innoculability will not settle the point, as long as they consist in mere transfers of material from a diseased surface to a healthy one, resulting in subsequent manifestation of the same disease, for the essential cause of the disease in such cases may not be the fungal elements, but a poison contained in or adhering to them, derived from the tissue on which they grow, and which by its action on the sound surface produces a suitable nidus for the growth of its associated cells or germs. Unfortunately, almost all innoculation experiments which have been as yet made involve this fallacy. We find Berkeley, however, stating that Dr. Lowe succeeded in producing skin diseases by the innoculation of yeast cells, and there is certainly a great argument in favour of the causative relation of the fungal elements with the diseases with which they are associated in the efficacy of local remedies, and especially of those of an antagonistic nature to fungal growth in the treatment of such diseases.

It may, very probably in many cases, be the fact, that the fungal elements alone are not capable of producing the disease, but that in an unhealthy condition of the skin they determine the form and aggravate the character of the local diseased action, for if they were alone capable of inducing the diseases with which they are associated, such diseases ought surely to be much commoner than they are. Until we know what is the mature form of the fungus associated with each individual skin disease, we shall be in no position definitely to settle the question of causation or mere association, and it is only by a series of careful cultivation experiments that this can be done. Even if it were merely shown that each skin disease has a distinct species of fungus belonging to it, a great step would be gained, as if this is not the case, the conclusion will almost necessarily follow that the relation is merely one of association. If, on the other hand,

it be proved not only that each disease has a distinct fungus associated with it, but that the cells or element of these fungi are capable of producing the corresponding diseases in healthy tissues, then the point will be definitely settled in favour of the relation being that of causation.

As regards fungi affecting the mucous membranes little need be said, as they appear to be mere accidents resulting on the existence of a suitable nidus. Sarcina ventriculi was at one time looked on as an object of pathological importance, but its occurrence has since been noted under such various circumstances, as to deprive it of any definite value. It is probably merely a condition of some common mould, and will tend to occur in all conditions favouring decomposition of any ingested material within the alimentary canal. This decomposition will be liable to occur either where there is any obstruction to the passage of the ingested material, or where more material is ingested than can be thoroughly asismilated. Cancer or stricture of the pylorus affords an example of the first of these conditions, and a dietary such as that of the natives of this country, consisting of great quantities of vegetable food, much of which escapes digestion of the second, and in both these cases sarcina is apt to occur in the vomited matters in the former case, and in the stools in the latter.

The fungi occurring in association with diptheria are to be regarded in the same light as sarcina, *i. e.*, as mere accidental occurrences of fungi in a suitable nidus, as consequences not causes. If the new views as to zymotic diseases be established, of course, a fungal cause for diptheria will have to be determined, but the mere occurrence of fungi on exudations, an occurrence which is by no means constant, has no bearing on the point.

Perhaps the most important local disease associated with or caused by fungal agency, is the disease of the lower extremity, termed madura or fungus foot.

This disease is especially interesting from the present point of view, in that the specific nature of the parasite occurring in it has been scientifically determined by the labours of Carter and Berkeley, who, instead of being satisfied with observing its immature and modified form, and instituting a new name for it according to the ordinary method, have, by careful observations, been enabled to trace its affinities to other fungi, and in accordance with these to refer it to its genus.

I have now very cursorily run over the bearings of fungi on disease, and have been able to say very little of a definite nature regarding many of the most important questions involved, but the truth is, that at the present time the theories are so various, and the records of observations so conflicting, that the more one considers the subject, the less can one feel that there are any thoroughly satisfactory grounds for definite conclusions regarding them. The thing to be done at present is to wait patiently until the accumulation of facts and observations derived from trustworthy sources is much more extended than it is at present, endeavouring in the meantime to weigh the value of each observation and fact, and to estimate its bearings on the essential points at issue. In conclusion, I would merely state that it appears to me that at the present time all the length which we are warranted to go to as regards fungi as disease producers, is:—

1*st*.—That they are very probably capable of producing local disease.

2*nd*.—That they are capable of producing disease by direct poisoning.

3*rd*.—That they may favour the spread of disease by inducing famines.

4*th*.—That as yet it is quite premature to assign to them any power of producing disease through a fermentive action on the blood.

DALHOUSIE AS A SANITARIUM.

By Assistant Surgeon E. A. BIRCH, F.R.C.S.I., *Civil Surgeon.*

(Concluded from page 75.)

THIS may be the proper place to allude to an experiment which proved of interest when the question of the disposal of filth was being discussed. A quantity of night soil, the produce of the inhabitants of a certain compound, was buried in trenches in the garden, and freely diluted with earth; two seasons later the trenches were opened up, when it was discovered that the ordure retained almost all its original characters, putridity being added. The earth appeared to have been washed completely away. This pretty well sets at rest the question of the possibility of disposing of night soil in the hills by burial. In consequence of the physical characters of the station it is impossible to adopt cultivation to an extent sufficient to be of any service in the way of utilizing and absorbing ordure, &c. The zemindars even refuse to take away the stable refuse free of charge, for they say its possession would in no wise repay the labour, time, and expense of conveying it away.

Fever to a most marked extent prevailed this season amongst the European residents in the station. It commenced with the first heavy fall of rain, and I may mention that on the 5th day of this downpour I was called to visit 15 separate houses, in none of which a week previously had I a patient; all these were cases of fever in children. As to the nature of the fever it was undoubtedly malarial, generally remittent. The remissions were feebly marked, and the low type was characteristic of the affection. Quinine was found to be absolutely necessary for its treatment, but it produced *comparatively* little effect. The affection did not run a course of any definite length, sometimes lasting only a few days, and in some instances persisting for weeks. Bowel complications were not present, except in one instance, in which abdominal tenderness, tympanitis and bloody stools were symptoms. I repeatedly examined this child (3½ years old) for the typhoid rash, but discovered nothing; the blood persisted in the stools for 8 weeks, and the fever lasted 5 weeks, the liver throughout was torpid. I must not omit to mention that this child resided in a house, the back wall of which was part and parcel of the hill side, which had been excavated out, as it were, to receive the house. On the hill above and at a distance of about 100 feet is situated another residence, and I found that all the night soil of the upper house was deposited in a hole in the ground about midway between either, under pretence of being daily removed by the municipal sweepers. Quinine seemed to possess no power in the way of cutting the fever short in this case, yet the moment I attempted to omit it all the symptoms increased in severity. At last I found it necessary to insist upon removal to a more healthy situation, when improvement at once set in, slowly indeed at first, but subsequently satisfactorily. The case possesses some interest, as it is particularly to be noted that this was the child of very healthy parents, its own consitution being good, and he had never been in the plains or indeed out of Dalhousie. Here then we have a clear case of malarial disease originating in the hills, but was it the fault of the hill climate or not? I shall again allude to this subject, and shall only remark "*en passant*" that it appears to me a good example of the mode in which the hills may be abused unjustly, and it teaches the lesson of the necessity of a careful selection of houses for invalids in the hills. Out of 31 cases of fever such as above described,—9 lasted 3 days, 12 lasted 4 days, 4 lasted 19 days, 5 lasted 6 days, 1 lasted 5 weeks.

In only the last were there decided bowel symptoms. In none jaundice. In all quinine was necessary, but it acted feebly, and was generally assisted by diaphoretics, and