

LAND LEECHES IN THE "FAUNA OF BRITISH INDIA".—SOME CORRECTIONS.

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A season spent in India in the study of land leeches (Haemadipsinae) has afforded an opportunity of correcting or modifying a number of statements made in the account of this group in the volume on Hirudinea in the "Fauna of British India" series. When this account was prepared the author had never seen one of these creatures alive, much less in its native habitat, and all matter relating to their lives and habits was built of compilation and inference. Recent personal experience, though limited, has given first-hand knowledge of the conditions under which these interesting animals occur and has cleared up some hitherto obscure points in their life-histories and behaviour.

It is not intended to attempt here any general or complete summary of the results of these investigations, but it does seem desirable to present to Indian readers in a form that will have about the same publicity as the original some corrections that are required now.

So far as systematics are concerned the earlier conclusions are generally confirmed. The only important change that seems indicated is that *Haemadipsa zeylanica cochiniensis* should be considered a full species instead of a subspecies. Two new colour forms of the *zeylanica* type were discovered, the final determination of the status of which must await morphological study and it is possible that the two colour-pattern types of *H. montana* may require separation. These questions will receive full treatment later.

One of the most intricate problems concerning these leeches relates to their local distribution and the physical and biological factors determining it. One who has not visited the Himalayan foothills and lower ranges can have little conception of the topographical and meteorological complexities which they present. This gives them the greatest possible interest to the student of ecology and distribution but anything like a complete understanding must involve an experience extending over several years. Here will be considered only very broadly the general distribution of the four principal species found in the Darjeeling District and Sikkim, concerning which somewhat erroneous conclusions were stated. There is nothing to be added to the accounts of the other species.

The common small grass leech (*H. zeylanica montivindicis*, p. 267) has a wide altitudinal range, according to my personal observations from 800 to 11,200 feet, those at the higher elevations being generally darker in colour. While most characteristic of open or partially open grass and pasture lands they live equally in jungle which, no doubt, was their original habitat. The vertical range of the other species is much more restricted. *H. montana* (p. 269) is generally encountered on forest grazing grounds and along pony trails and cattle paths in the misty zone between 6,000 and 8,000 feet. It is a jungle species not found on open

grass lands. Like *H. ornata*, which may be considered as replacing it at lower altitudes, it is a characteristically bush-climbing species. Hooker refers to a large yellow-brown solitary leech as abundant below 3,000 feet. In the "Fauna" volume this was identified without hesitation as *H. sylvestris* (p. 283). During my own explorations this species was very rarely met with in the Darjeeling District and only in the lower parts of the Teesta and Balasan Valleys, and near Siliguri. It therefore seems much more probable that the large solitary leech encountered by Hooker was more often *H. ornata* (p. 289), which is generally distributed throughout this region below 3,000 feet.

In considering the abundance of leeches reference was made (p. 244, *et seq.*) to the accounts of several observers which now seem to me to represent these annelids as far more numerous than they actually are. Certainly I had been led thereby to a picture very different from that actually found. When a scientific observer like Dr. Hooker uses such language as incredible profusion, it produces an impression of numbers too great to count or even to estimate fairly. And similar terms are used by many other observers. Throughout my stay of 11 months I continually hoped to find leech populations of a density to meet my expectations. Every locality within reach where leeches were reputed to be excessively abundant was visited but invariably my hopes were dashed. Without intending to mislead, it is very easy to get and to give an exaggerated impression of the numbers of such animals. The activity of their exploratory and looping movements and the rapidity with which they concentrate on one's feet, combined with the repugnance which most persons feel toward them, all tend to lead to over estimates. These affect both the extent of their distribution and their abundance at particular spots. Land leeches are found by no means everywhere in jungle, forest or grass land but chiefly in local aggregations or colonies. Such areas of concentration may be only a few feet or yards in diameter or they may cover acres, especially of forest grazing lands. Elsewhere one may proceed often for several miles along a seemingly favourable jungle trail and meet with scarcely a leech. The first impression that one gets on finding a populous leech colony is of larger numbers than actual counts justify. If one quickly marks out a square foot or yard and, taking proper precautions to insure reasonable accuracy, captures and counts all of the leeches that appear on that area in a fixed time (say 2 minutes) the results prove surprisingly low. Many such counts were made and rarely did they exceed 6 or 8 leeches per square foot. But if one remained standing on such a spot for 10 or even 5 minutes the number of leeches on the square foot including one's feet would often be tripled or quadrupled. Only during July when the Southwest Monsoon was well advanced and young leeches were hatching in large numbers were these figures much exceeded. Under such circumstances as many as 14 to 20 per square feet were counted in a few cases, and owing to the small size of the young leeches some might have been overlooked. The figures given are maximum figures for selected square feet. Only rarely would several contiguous feet yield so many. If larger areas or if scattered square feet taken at random over a considerable area were counted the average number would fall much lower. On many feet none would appear, others would yield only one. On

100 square feet scattered at random over an acre of good leech ground the average was 1.8. On this ground there were spots where the leeches were concentrated in such numbers as to give the impression of great abundance, but the largest number counted on one square foot was 13 and in places one might walk 50 paces quite unmolested. The question arises whether the season of my observations, coming in a year of somewhat abnormal weather conditions, might not have been one of reduced number of leeches. Of course I lack the perspective to form a judgment myself. But this question was put to a number of planters, forest men and other permanent residents of the hills. The answers were conflicting. Some thought that the leeches were present in normal, others in reduced, numbers. I should be very glad to receive data on this point from any readers.

There has been much speculation but little observation on the disappearance of leeches during the dry season. In the "Fauna" account (p. 251) after summarizing the several suggested explanations and the available evidence bearing thereon, I was inclined to accept tentatively a limited migration as explaining the facts. Later observations partially confirm this view. There is, however, some difference in the habits of the several species, doubtless determined by the diverse conditions of their environments. *H. sylvestris*, the large 3-lined species of the plains, can be found throughout the year. In every month of the dry season, from November to April inclusive, I had no difficulty in finding many large fed individuals lying at the surface of the ground under tiles, bricks, sticks, etc., on air dry soil. However, they had left the open fields where they are found during the rains and were congregated at low spots often in the vicinity of a tank or ditch, where a little water or wet mud might remain and generally in the shade of jungle growth, mango groves, or other trees. Small and medium-sized leeches also were found during the winter and spring associated in small numbers with the large ones but mostly hidden at the roots of grasses or under fallen leaves, sticks, etc., along shaded roadside ditches and cattle paths and often in the vicinity of permanent water. Unlike the large fed leeches, which were in a semi-dormant condition, the unfed leeches were active and could be tempted to come into the open, particularly in the early morning when the grass was still moist with dew. After the coming of the rains few of the largest sized leeches could be found. They had deserted their winter resorts and were scarce elsewhere. But medium-sized and small leeches were generally distributed over the fields and in the jungle and by the end of July their number was largely augmented by newly hatched young from $\frac{1}{2}$ to $\frac{3}{4}$ inches long. It seems evident that with this species there is a slight movement to sheltered spots at the beginning of the dry season and a wider dispersal to the open during the rains.

With *H. z. montivindicis*, the little mountain leech of the eastern Himalayas, with a vertical range of at least 10,500 feet, the habits appear to differ somewhat with the elevation. In the lower part of the misty zone, with its high humidity and mild climate, active individuals may be found at all seasons, although they are much less evident during the dry season. I rarely found resting individuals and those found were invariably fed leeches hidden under stones and not buried in the soil.

Above and below the misty zone the seasonal wax and wane in abundance of the leeches is very marked, as is well known. During May and June, 1931 there was abundant evidence to show that the active leeches were mostly concentrated in the ravines and gulleys and along the *jhoras* and nullahs and that with the early rains they were spreading over the neighbouring grass lands and drier jungle. The evidence for this movement was found not only in counts on successive days of the number of leeches on the same measured and marked areas, but even more directly by tracing the movements of marked leeches from the gulleys, where they were liberated for many yards out into the open but not in the other direction. Unfortunately no such crucial observations were made at the close of the rainy season to determine if a reverse movement into and down the gulleys was in progress. There seems to be a seasonal local movement, chiefly altitudinal, but there is no direct evidence that this extends to any considerable distance.

In describing the functions of the caudal sucker stress was laid upon its use as a vacuum disk and prehensile organ (p. 248). A third means of adhesion is the stickiness of the mucous, which applies not only to the suckers but to all parts of the body surface. This is noticeable especially when a leech is moving over a surface, as of glass, not actually wet, when the mucous reaches a consistency making it very effective as an adhesive, at times even to the point of hampering the movements of the leech.

Not a few persons, including even some scientific observers, have attributed to land leeches not only great agility but even the ability to actually jump. Impressed by the competency of the testimony I was led to partially accept it (p. 248), having particularly in mind the power of certain earthworms (like *Pheretima*) to flex the body with such violence that they are thrown clear of the ground. Careful attention was paid to this, with the result that I saw not the slightest evidence that these leeches are capable of any activity that by any stretch of the meaning of the word could be described as a jump. They do reach far out from their places of attachment and transfer themselves to a passerby with such rapidity that a careless observer might think that they had projected themselves. The bush-climbing leeches (*H. ornata* and *H. montana*) will frequently abruptly loosen their hold on a leaf or twig and drop to the ground or on to a passing animal, and the ground leeches will similarly drop from grass stems on to one's foot. Such performances have no doubt been mistaken for leaping. I now fully agree with Whitman that the several species of land leeches that have come under my observation are incapable of leaping in any proper sense.

In the account of *H. sylvestris* it is stated that this species enters streams and Mr. G. Mackrell is quoted (p. 283) that they swim well. Many futile efforts were made to induce individuals of this species to swim and experimental studies on the motor mechanism were made, the conclusion being that the land leeches not only do not swim but that they have lost the effective swimming reflexes.

Concerning the ability or even the attempt of land leeches to gnaw through a pasteboard box as quoted from Green (p. 264) I am quite sceptical. Most probably the hole which he describes was the work of a mouse. My leeches were offered many opportunities to show such

powers, of which they never took advantage. They will discover and force a way through an astonishingly small orifice which they may enlarge by muscular pressure and in the case of textiles sometimes by cutting one or two obstructing threads, but I have seen nothing more. My cultures were kept in wide-mouthed vessels with one to three thicknesses of closely woven cloth tied securely over the top. During my early experience several times on coming into the laboratory in the morning large holes were found cut through these covers and the leeches gone. Recalling Green's statement this was at first attributed to the leeches themselves. It was soon discovered, however, that the building was overrun with mice which were the real culprits. When suitable precautions were taken there was no further trouble.

There is a very widespread belief in India that most land leeches never secure a meal of blood, failing which they subsist on plant juices. While my limited experience makes me unwilling to deny that they ever imbibe plant juices no affirmative evidence has been found and it is practically certain that they do not do so habitually. This statement is based upon the examination of the stomachs of hundreds of leeches fresh from the jungle, which in no case contained anything resembling plant juices, and upon unsuccessful attempts to induce hungry leeches to imbibe the juices of highly vascular plants found in their habitats, of various fruits (oranges, peaches, mangoes, grapes, raisins) and sugar water.

In considering the origin of land leeches I was led to quote with approval a manuscript note of Prof. Whitman (p. 251) in which he suggests that the elevation and drainage of the Siwalik lake-beds was the occasion of the evolution of the true land leeches from their aquatic ancestors. While this subject must necessarily remain speculative my observations on the mode of life of both aquatic and land leeches in India incline me to believe that a more immediate explanation is at least as probable.

Any naturalist visiting India must be impressed by the tremendous influence of the monsoons on the character and rhythm of life. The outstanding biological fact is the adaptation of practically all life—both plant and animal, including human—to the stress of the alternation of well defined wet and dry seasons. Human social and economic customs have been adjusted thereto, as have the habits of most animals and plants. In general the dry season is one of comparative growth, rest and inactivity; the wet season one of reproduction, development, growth and general quickening. Practically all animals dependent upon a plentiful supply of water have a dry season rest period.

The habits of the aquatic blood-sucking leeches of India, the putative progenitors of the land leeches, conform to these principles. The species of *Hirudinaria*, *Hirudo*, etc. during the season of rains spread out into the paddy and jute fields and other flooded or irrigated areas. After the cessation of the rains many of them follow the receding waters back through the main nullahs to rivers or tanks or swamps where there is permanent water. Large numbers, however, remain in smaller ponds and pools which later become nearly, or quite dry. In such places, under logs or in the last remaining mud, these leeches may often be found aggregated in large numbers. In ordinary seasons, when the mud does not become dried completely for too long a period or where the aggrega-

tions are very large, most of these leeches are likely to survive. Probably there is a selection of those best fitted to survive dry conditions which one would expect to become rigid in times of severe drought. Thus the regular seasonal changes and the adjustment of aquatic leeches to them offer recurring conditions that are favourable to the evolution of terrestrial forms.

Another fact of interest in this connection is the frequency with which aquatic leeches are carried by their hosts well away from the water.. It is a common sight to see buffaloes leaving the water bearing on their skins a number of feeding *Hirudinaria manillensis* or *Hirudo birmanica*. Those that are sated usually drop off at the water's edge but those only partially gorged will continue their meal and may be carried a considerable distance before they drop off and seek shelter. I have been told that elephants similarly often carry leeches on the thin protected skin of the axilla, groin, and behind the ears for long distances from the water in which they originated. In general it may be said that the aquatic blood-sucking leeches of India are better adapted to an amphibious mode of life and a periodical shortage of water than are those of western countries. It seems possible that the true land leeches may have evolved through the operation of everyday factors without the necessity of any distance and far-reaching geological changes.

No evidence was found that any mimetic relation exists between land leeches and land planarians of similar colour pattern (p. 254). Indeed the evidence all points against it.