

of light in space, it was not till 1889, so far as I can make out, that the possibility of such an extinction being brought about by fine particles of matter was suggested,¹ and he referred to the constitution of comets, falling stars and meteorites in support of this idea.

Now that the nebulae and stars giving us bright-line spectra, as well as comets and falling stars, have been associated with meteorites, we must expect that the extinction of light, if produced as suggested by Schiaparelli, must very rapidly increase as the Milky Way is approached.

Hence the small magnitude stars in the Milky Way are stars of which the light has been dimmed, and the gap which separates system from system may be gathered from Pickering's diagram (Fig. 4).

We may perhaps, after the recent surveys of space, go a little further than Schiaparelli. A stoppage of light by solid bodies, whether small meteorites or condensed stars like the sun, would affect the spectrum equally from one end to the other. But we now know that many of the stars are not condensed bodies like the sun, and that in the surroundings of these, as well as in the so-called gaseous nebulae, are gases and vapours which would undoubtedly stop the short more than the long waves of light passing through them; and there is ample evidence, as we have seen, that such stars and nebulae are more numerous in the plane of the Milky Way than elsewhere. If we take stars of the same chemical species in and away from the Milky Way, and find differences in the lengths of their spectra in the ultra-violet, the inquiry would be carried one stage further.

It is a sure sign of the interest taken in such subjects as these, that, since the above was written, two important contributions to our knowledge have appeared. I hope it may be possible for me to refer to them on a future occasion.

NORMAN LOCKYER.

THE MALARIA CAMPAIGN.

DURING the last two years, no subject has been more discussed in the medical world than paludism, and in the discussion the general public has taken an interest which purely medical matters seldom enjoy. But this is not a matter of only scientific interest, as is readily seen when one hears that five million human lives are the toll India alone pays annually to the grim spectre of malaria.

The prevention of malaria is a problem of great human, political and economic importance, and the Secretary of State for the Colonies, and many wealthy individuals in London and Liverpool, have shown their recognition of this fact by great personal interest and generous contributions of money for the founding of schools of tropical medicine in these two great seaports.

The fact of mosquito agency in the spread of malaria suspected by many, asserted by King (now almost forgotten), Laveran and Manson, and subsequently proved by the brilliant work of Ross, was not accepted at all generally two years ago. Since then, however, expeditions have been to various parts of the world to study the whole question anew.

Two expeditions have been sent to our colonies in West Africa by the Liverpool School of Tropical Medicine, another by the Royal Society to British Central Africa, some members of which subsequently followed the Liverpool men to West Africa, and lastly, in May of this year, at the instance of Dr. Patrick Manson, the London School of Tropical Medicine despatched an expedition, of which more anon, to the Roman Campagna.

¹ "Sulla distribuzione apparente delle Stelle viribili ad occhio nudo."

In addition to these special expeditions sent out from home, Bignami, Celli, Grassi and other well-known Italian observers have been hard at work in their own country, while many medical men of our Colonial service have in their own districts been on the trail of the malaria parasites.

Germany, too, as is her wont, has been equally energetic. The great Koch, at the head of several expeditions, has visited many parts of the world and contributed largely to the sum of our present knowledge. Furthermore, Hamburg, the principal German seaport, has rightly been chosen the seat of a school of tropical medicine, whose objects are identical with those of our own schools and whose head is Prof. Nocht. It is interesting to note that the foundation of this school is due to the initiative of the Imperial Government and the enterprise of the municipal authorities of Hamburg. Save sympathy, our English schools owe nothing to the Government of an empire whose interests are more vitally affected by the problems of tropical medicine than any other in the world.

In the aggregate, the addition to our knowledge from these various sources has been immense. The whole life-history of the *Hæmamoebidæ* responsible for malaria has been accurately worked out, and a particular genus of mosquito (*Anopheles*) has been, after due trial, definitely convicted of carrying these parasites from man to man and of acting as definitive host to the parasite during its sexual phase of development. On the other hand, man, the intermediate host in this cycle of alternation of generations, has been proved equally necessary for the propagation of the species. A constant association therefore of man with mosquito seems the rule in a vicious circle, which keeps up the supply of parasites and precludes the possibility of their destruction and extinction.

One day, however, it may be shown that the human *Hæmamoebidæ* can complete their asexual cycle in some mammal other than man. But as yet there is no evidence of this, and Koch has stated his disbelief in the existence of any second alternative host.

As soon as there was a fair presumption (if not positive proof) that the parasites of malaria multiplied by a process of alternation of generation, in which man and a mosquito played the leading parts as intermediate and definitive hosts respectively, all workers in the subject turned their attention to the identity of the species of mosquito concerned, their habits and bionomics, and to the best method of applying practically their newly-found knowledge with a view to reducing the ravages of the fever.

New species of *Anopheles* were met with, and statistics of health and meteorological observations collected, with the result that our knowledge of mosquito life generally, and especially its relation to malaria, has greatly increased. Major Giles, in his recent monograph on "Mosquitoes," has collected and arranged many of the new facts, but even now we do not know how many varieties of *Anopheles* there are nor are we certain if all species of this genus are hospitable to the malaria parasites.

In a report recently issued by the trustees of the British Museum, Mr. F. V. Theobald gives us much further information about the *Culicidæ*, their distribution in nature and some points to help in the identification of species. From this report we learn that twenty-two species of *Anopheles* are now known, and of these ten are entirely new to science, while of *Culex* some ninety new species have been described.

It would appear that as a genus *Anopheles* is world-wide in its distribution, but is more limited in regard to species. This pamphlet is a valuable contribution to knowledge, and is evidence of the magnitude of the work now being done to increase our meagre knowledge of the *Culicidæ* and gives a good idea of the special difficulties of the subject.

Necessarily there has been some differences of opinion, and what has been found true in one place has been denied elsewhere. This is not remarkable if one considers how much mosquito life and habits are influenced by meteorological factors, and these obviously differ greatly in different latitudes and at different altitudes. On certain essential points, however, all observers are agreed: malaria is caused by three (possibly four) species of the *Hæmamœbidæ*, and these are indisputably conveyed from man to man by mosquitoes of genus *Anopheles*.

Another important point has been noted in West Africa by Stephens and Christophers and by Koch in Java and elsewhere. Native children of one to three years old are peculiarly the victims of malaria parasites, and as they grow older the invasion by parasites becomes less and less. These facts have been taken to prove what has long been asserted, viz., that prolonged residence in a malarial country produces a relative amount of immunity.

Koch used the presence or absence of parasites in the blood of young children as a criterion of the question as to whether malaria was endemic or merely imported. It further shows how great a danger to white men is living in close proximity to native habitations. This has been insisted on in West Africa, much to the indignation of the educated blacks.

Incidentally, additions to our knowledge of the fauna of West Africa have been made by these expeditions. Mr. Ernest Austen, of the Zoological Department, British Museum, accompanied the first expedition to Sierra Leone, and a report on his work there has been recently published by the authorities of the museum.

Fifteen hundred specimens of insects were obtained, chiefly of the Lepidoptera, Diptera and Neuroptera, though four other orders were represented in the collection. In his report Mr. Austen describes a variety of Tsetse fly (*Glossina longipalpis*), and a Muscid (probably new) known locally as the "Tumba" fly. The latter deposits its egg under the skin of man and other animals, and when the larva is hatched a boil of a peculiarly painful character is produced. The departure of Mr. Austen, immediately on his return from Sierra Leone, to South Africa with the City Imperial Volunteers has prevented us as yet of obtaining the full fruits of his work, which, now that he has safely returned, we shall eagerly look for.

The best methods of malaria prophylaxis have been much discussed. The original views of Major Ross and the first Liverpool expedition, in the light of wider and more recent knowledge, seem somewhat too sanguine. The destruction and extermination of mosquitoes by drainage and the use of culicicides, as suggested in their report, is now regarded as impracticable in some districts, although in many places these methods, in conjunction with the intelligent use of mosquito-curtains and quinine, could not fail to bring about a marked improvement.

On the whole, however, we must rely, as Dr. Manson has insisted, on the prolonged treatment of patients with quinine and during the time they have parasites in their blood on their rigorous isolation and protection from mosquitoes.

Paradoxical as it may seem, we must first aim at preserving mosquitoes from infection and so limit the chances of the dissemination of the parasites as far as possible.

It cannot be too strongly emphasised that in a malarious country where *Anopheles* are present a case of fever is infectious.

The value of the proper use of mosquito netting is strikingly shown by the following experiments. In March last Dr. Manson, speaking at the Colonial Institute, announced that the Colonial Office, in conjunction with

the London School of Tropical Medicine, had authorised him to make an experiment to show the practicability of preventing malaria by easily applied means. A hut was to be erected in the most malarious part of the Roman Campagna with wire gauze doors and windows so as to render it mosquito proof. This hut two skilled observers were to occupy from May to October, that is, during the whole malarial season. By day they would be able to go out, but at sunset, before the mosquitoes rose, they were to enter their hut and remain closed until daybreak. By this means it was contended they would be free from all possibility of infection by mosquitoes. In accordance with this plan Drs. Low and Sambon, of London, took up their residence in June, and the latest information is that they have passed through a trying ordeal unscathed and without any appearance of fever. This experiment is of great value, though open to criticism on the grounds that the conditions are somewhat artificial.

A similar experiment, under more natural conditions, and therefore, perhaps, of a more searching character, has been tried by the members of the second Liverpool expedition to West Africa. For four months, in the most malarious districts on the Niger, Drs. Annett, Dutton and Elliott have lived, relying, not on quinine, but only on their proper use of mosquito curtains. A recent communication shows that they have retained their health throughout their stay.

Another important experiment has recently been tried, an experiment which may be considered the complement of those just mentioned.

A consignment of *Anopheles*, fed on the blood of a patient in Rome known to contain parasites, was received in London from Prof. Bastianelli in July last. A son of Dr. Manson, who had not been in a malarious country since childhood, submitted himself to the bites of these infected mosquitoes. Within a fortnight Mr. Manson had a typical attack of fever, and in his blood were found parasites similar to those causing the fever of the Roman patient on whom the mosquitoes had originally been fed.

This is a crucial experiment, and proves to the hilt, if further proof were needed, that malaria is conveyed by mosquitoes from man to man. Similar "feeding" experiments had been done before, but never has such a striking and satisfactory demonstration been obtained. We have now to deal no longer with theories, but with facts, and it remains to put into practice the valuable information we have obtained as to the possibility of limiting malaria, and so improve the sanitary condition, and thereby increase the commercial prosperity of many of our greatest colonies. R. FIELDING-OULD.

THE GEOLOGICAL SURVEY OF GREAT BRITAIN AND IRELAND.¹

THE summary of progress of the Geological Survey of the United Kingdom for the year 1899 has been issued by Sir Archibald Geikie, Director-General. The field-work was carried out in England and Wales principally in the coal districts and bordering tracts of North Staffordshire, Leicestershire and Glamorganshire; in the slate and granite areas of Cornwall; and in the Cretaceous and Tertiary regions of the southern and southern-midland counties. In Scotland the survey of the Highland regions was prosecuted as vigorously as the nature of the ground permitted, and progress was also made in the surveys of Arran and Skye. In Ireland the revision of Silurian areas was continued.

The bulk of the summary is taken up with a somewhat detailed record of the observations made in the field; and

¹ "Summary of Progress of the Geological Survey of the United Kingdom for 1899." Pp. v + 214. (London: Printed for H.M. Stationery Office, 1900.)