PILOT CHARTS.

FROM the popular and astrological point of view, meteorology is as old as the oldest of the canonical writings; but as a scientific study it may truly be said to belong wholly to the great Victorian era of scientific development. It was only in the 'thirties of last century that Redfield and Reid—the former in America, the latter in the West Indies—set about the patient study of the vagaries of storms, and discovered that these meteors were, like everything else in Nature, subject to natural laws. By the middle of the nineteenth century the progress made by the early pioneers was such that Maury felt justified in utilising the results in the preparation of his pilot charts for mariners all the world over. Maury's charts were certainly not perfect; fifty years afterwards many would, no doubt, regard them as a confused mass of information which would weary the most persistent student in an endeavour to unravel them; but useless as they seemed to be at first sight, they have proved to be the pioneers of the most useful works published in the interest of navigators. It has long been recognised that the sailor wants, in addition to ponderous tomes dealing minutely with every phase of navigation, handy summaries of the more essential features of everyday life on the ocean, arranged in a simple manner for immediate reference. The Board of Trade published charts containing varied information forty-five years ago, and the Hydrographic Department issued its well-known quarterly pilot charts more than thirty years ago. Other nations, France, Holland, Denmark, &c., have devoted much attention to the necessity of keeping mariners acquainted with all the latest information relating to the meteorology of the various oceans. For many years past the Hydrographic Department at Washington has left no stone unturned to popularise its Pilot Chart of the North Atlantic, and of late years it has been perfecting a similar work for the North Pacific. In the meantime, Germany has not only been increasing her naval strength, but her mercantile fleet is daily becoming more and more important, and the latest evidence of this is found in the January number of the *Annalen der Hydrographie und Maritimen Meteorologie*, in which Dr. Neumayer announces the issue, by the Deutsche Seewarte at Hamburg, of a monthly chart for the Atlantic, mainly for the steamships engaged in the Transatlantic trade.

But the importance of the question of keeping the mariner in touch with the progress of meteorology has not escaped the attention of the English authorities, for the Meteorological Council has just distributed a specimen monthly pilot chart of the North Atlantic and Mediterranean for the month of January, it having been decided to commence a series of such publications in April. In the compilation of the charts, advantage is to be taken not only of information in the possession of our own Hydrographic and Meteorological Offices, but also of any suitable facts published by similar establishments in other countries. Just as we are certain that the atmospheric conditions during winter are different in various ways from those which obtain in summer, so we may conclude that between the extremes there are, on the average, more or less gradual changes in the controlling features, and, therefore, we must expect that every month in the year has its own individualities, which are not exactly in agreement with even those of neighbouring months. To be of real use to the navigator, then, information should, as far as possible, be sorted out into its principal monthly features, and this is to be the aim of the Marine Department of the Meteorological Office under Commander Hepworth, R.N.R., the superintendent. Each ocean area of 5° of latitude by 5° of longitude contains a wind-rose showing the prevailing winds, some of the less frequent winds, and the frequency of calms, a simple method being adopted to indicate the mean strength of the wind, whether light, moderate, or gale. The normal limits of the Trades; the sailing routes recommended to and from the Equator; the steamship routes to and from America; the mean paths followed by cyclonic areas; the region in which gales exceed 10 per cent. of the wind observations; the localities affected by fog; and the ice limits about Newfoundland are laid down. A feature of as great interest to the theoretical physicist as to the practical sailor will be the ocean currents for each separate month, based upon observations covering a period of sixty-five years. Until the Admiralty and Meteorological Office recently published a selection of the currents in representative months, the scientific world had to be content with studying the circulation of the waters from a chart representing the annual results only. There will now be an opportunity for a much closer study, as the monthly winds and currents are given together in the same sea-room, while the distribution of atmospheric pressure for the same month is given, with that of the air and of the sea temperature, in an inset chart, and all three subjects must be considered as inseparable when investigating ocean currents. Two other inset charts represent south-westerly and westerly types of weather over Western Europe. In addition to the foregoing pictorial method of displaying the facts, a considerable amount of valuable information is conveyed in descriptive letterpress on all available spaces, directing the navigator's attention to the dangers associated with making the Spanish coast, to the Harmattan winds of West Africa, the Northers of the Gulf of Mexico, the Mediterranean sirocco and other winds; to treacherous inshore currents; to the difficulties arising from the low-lying haze and the great refraction along the west coast of Africa; to the rollers breaking on the South American coast, from Trinidad to Guiana; and advice is given as to the best routes for crossing the Equator. An interesting article is devoted to Atlantic storm systems, showing how the mariner must combine his wind and barometer observations when he wants to ascertain the behaviour of the disturbance which may be affecting his ship, the problem being much more complicated than is generally supposed, and more particularly in this age of swift steamships, which may be travelling faster than a cyclone, so that the experiences on a liner travelling eastward through a storm would be largely different from those on another meeting it going westward. Everything depends upon the particular circumstances, and with the aid of these notes and an intelligent interpretation of them, officers should be able to have a much better knowledge of the cyclonic areas through which they so frequently have to steer. For many reasons, the new pilot charts deserve to have a long and successful career.

MALARIA AND ITS PREVENTION.

SINCE the work of Laveran (1880) proved malaria to be a fever caused by the invasion of the blood by minute animal organisms, steady progress has been made in the work of probing and elucidating the etiology and pathology of this dreadful scourge.

The extent of its ravages was—and, unfortunately, still is—appalling, and the recognition of this fact has impelled many eminent scientific men to direct their best efforts towards solving the problems which have been facing us for the last twenty years, and which were the natural offspring of Laveran's discoveries.

English, Italian and German workers have competed with each other in the race and shown unprecedented keenness and enthusiasm; of their work an immense bibliography remains as a monument to-day. In America, too, has been done some of the very best work.

At the present time, however, though our knowledge of the Hæmamœbidæ has so much increased and though their pathological significance is now more clearly defined, yet we cannot say certainly that all the species which invade man have been identified.

In England we group all malaria parasites under three heads:—

(1) *Haemamoeba malariae*, the parasite of Quartan fever.

(2) *Haemamoeba vivax*, that of Tertian fever.

(3) *Haemamoeba precox*, that of Quotidian or æstivo-autumnal fever.

But in Italy Grassi states positively that he has observed a fourth species, which he names *Haemamoeba immaculata*. This species is without pigment and has been accepted by Marchiafava and Bignami, but our knowledge of the facts is still somewhat limited. In West Africa the first expedition which went out to investigate malaria was inclined to divide *H. vivax* into two distinct species differing in the colour of their pigment, one with fine brown and the other with fine black granules. Furthermore, it has been suggested that *H. precox* may be also split into two or more distinct species.

On these points we must await the results of patient investigations now pending.

For many years after the inseparable association of the Hæmamœbidæ with malaria had been demonstrated, the means whereby they could enter the blood and attack the corpuscles was unknown. But at last the work of Ross in India (with which Manson must ever be associated) enabled us to see light. King (1841) had suspected that mosquitoes were a factor in malarial infection, as also had Laveran; but Ross led us, by his researches in the life-history of *H. relicta* (the parasite of birds), from mere hypothesis to fact. Confirmation was soon forthcoming in Italy, a country where the prevention of malaria is of great economic importance; and later expeditions were dispatched by the Liverpool School of Tropical Medicine, the Royal Society and the German Government to various malarial districts, to thresh out the whole question and to evolve, if possible, some practical method or methods of prophylaxis.

Valuable experiments, too, were made in the Roman Campagna last year by the London School of Tropical Medicine, which afforded valuable confirmation of the views advanced by previous expeditions. More recently, too, an expedition from Liverpool has returned after making a complete survey of the lower reaches of the Niger, with the result that previous observations have been confirmed and further additions to our knowledge made.

Now we know, with a certainty rarely attained in medical matters, that malaria, instead of being inhaled with the night air as a noxious miasm from marshy countries or ingested with water, as was at one time suggested, is caused by the direct injection of animal parasites into the blood by mosquitoes previously infected by some human being suffering from the fever.

Careful microscopic work has shown that the Hæmamœbidæ of human malaria are parasitic not only in man but also in certain mosquitoes.

The parasites have two phases in their cycle of development, and need a different host for the completion of each phase, that is to say, that like many other well-known parasitic organisms, they exhibit "alternation of generation," in which man is the "intermediary" and mosquito the "definitive" host.

But it has been proved that all mosquitoes are not hospitable to the hæmamœbidæ of malaria. One genus only—Anopheles—has so far been convicted, though Culex has been subjected to an equally searching cross-examination.

Although Anopheles, as compared with Culex, is a small genus with a comparatively limited distribution, yet all its species have not been proved hospitable.

In West Africa *A. Costalis* and *A. funestus*, in British Central Africa *A. funestus*, in the West Indies *A. Costalis* (?), in Italy *A. Maculipennis*, are the species chiefly concerned as agents of transmission.

With the information at present obtainable it must, therefore, not be too hastily concluded that the whole genus Anopheles is hospitable to the parasites, but I venture to say that it may now fairly be assumed, on the other hand, that no species of Culex ever conveys the human parasites, though this genus is chiefly concerned as definitive host of the avian hæmamœbidæ.

White men who have travelled in the tropics say, assuming what you teach about the parasitic nature of malaria and the part played by mosquitoes to be the truth, there remains the question as to where the mosquitoes originally became infected. This was for a time a mystery, but the recent work of Koch in Java and Stephens and Christophers in West Africa has afforded an explanation. These observers independently discovered that though adult natives suffered little or nothing from malaria, yet their children from earliest infancy exhibited great numbers of parasites in their blood, though, like their parents, they rarely showed marked symptoms of infection. The blood of 80 to 90 per cent. of native children in some districts has been shown to contain parasites, and it has been noticed that these varied in number inversely as the number of years of life; that is to say, evidence of parasitic invasion decreased as the children grew to manhood, and gradually a condition of partial immunity was attained.

Similar instances of acquired immunity are occasionally seen among white men who have lived many years in malarious countries. The mechanism of this immunity is as yet unknown.

It appears, therefore, certain that the prime source of mosquito infection is the native children, who, though not indifferent to mosquito bites, appear to view their ravages with equanimity. It follows, then, that the proximity of native habitations is a constant menace to the health of white men provided that the necessary connecting link—Anopheles—is also present. In considering the best means of prophylaxis, it will be seen that important deductions have been drawn from these facts.

The prime cause of malaria being known, its method of invasion having been satisfactorily demonstrated and the official seal of scientific approval to these facts having been obtained in Lord Lister's recent address to the Royal Society, it remains now to apply our knowledge in a practical way, so as to evolve some method or methods of prophylaxis and thereby crown a piece of scientific work as far reaching in its power to benefit the whole human race as any of those brilliant discoveries which have made the Victorian age conspicuous above all others.

And that this is not the language of exaggeration is readily seen when one considers the enormous tale of deaths caused annually throughout the world by malaria, and when one realises how much the control and development of new territory are arrested by the constant invalidism of Government officials, medical officers and traders in tropical climates, where it is constantly necessary to employ two men to do the work of one.

This latter point will appeal specially to those who recognise that the British Empire is now world wide and tending to still further extend its borders.

During the last two years various authorities on paludism abroad, and members of the various expeditions from England, have made suggestions and recommendations as to the prophylactic measures which should be taken in consequence of the recent additions to our knowledge.

Some have advocated wholesale destruction of

mosquitoes by surface drainage and by the treatment of their breeding puddles with substances fatal to their development; others have suggested the careful and more extensive use of mosquito-proof curtains and blinds, &c.; while one distinguished authority holds that the continuous administration of quinine is likely to give the best results.

This apparent difference of opinion has afforded an opportunity for unbelievers to scoff; but there exists, notwithstanding differences of opinion as to detail, an entire unanimity as to the principles on which we should work.

With our present knowledge we are not justified in saying that any one alone of the measures mentioned above is of preeminent value, for all are not applicable to the same district, nor is the application of one method alone likely to prove sufficient.

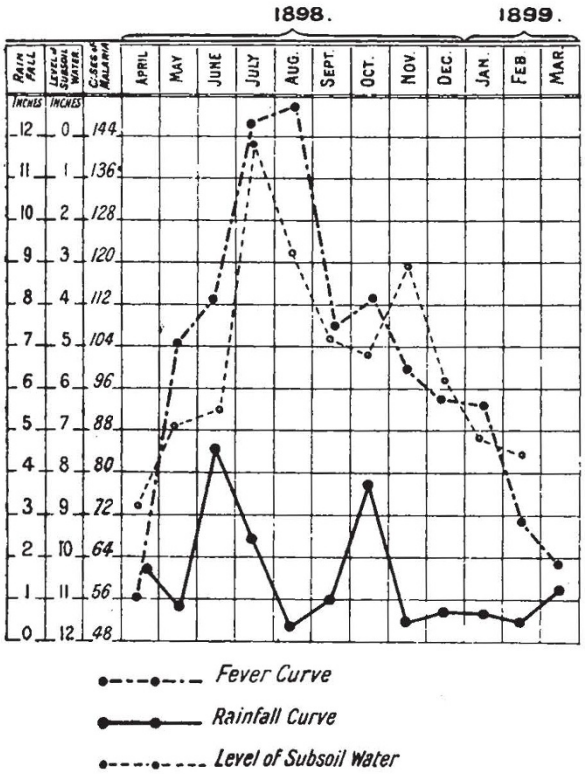

FIG. 1.—Chart showing relation of incidence of fever to rainfall and to level of subsoil water. (From figures supplied by Dr. Strachan, P.M.O. Lagos.)

It is in a due application of all these methods, in so far as each is practicable and suited to the district under consideration, that the truest salvation will be found.

In support of this view I would mention the conditions of rainfall and geological formation which obtain at Sierra Leone, Accra (Gold Coast) and Lagos (Fig. 1). In the first, surface drainage is possible and could not fail to somewhat reduce the ravages of malaria, but in the last-named colony any system of drainage is impossible; the town is built on a sandy island which has the general form of a saucer; here some other method must be considered. At Accra, on the other hand, the rainfall is so small and the soil so absorbent that there are no puddles or marshy lands which need draining. Here, again, some method other than drainage must be sought for.

Since the days of Empedocles of Agrigento (B.C. 500) the efficacy of surface drainage has been known and, where practicable, is doubtless one of the surest methods. But in districts unsuitable from any cause, the application of larvicidal substances (petroleum, tar, lime, &c.) has been suggested; but, so far as experiments go, the effect of such applications has proved too transient to be of much value. The essential point is to avoid being bitten by infected mosquitoes by night and also by day, for, notwithstanding statements to the contrary, I have repeatedly noticed Anopheles gorging themselves in full daylight, though no doubt their habits are chiefly nocturnal.

For this purpose the constant use of mosquito curtains of a proper kind is essential. Unfortunately, since familiarity breeds contempt, it is only too frequently that one finds in the tropics curtains of an utterly useless kind being used; either they are torn or the mesh is too large, or by their arrangement the free ingress of mosquitoes is possible.

They are best fixed on four posts at the four corners of the bed, and as the netting descends around the bed it should be tucked in under the mattress. The enclosed space should be of sufficient size to allow a certain freedom of movement during sleep, so that the danger of coming into contact with the netting is impossible.

More effectual, however, is the employment of wire gauze blinds to windows and doors, so that bedrooms and houses generally are kept entirely free from mosquitoes.

Celli recommends that windows should be protected by wire netting the meshes of which measure from 1 to 1·5 mm. square, and that all doors opening exteriorly should be protected by a cage of similar netting, so as to oppose two screens to the ingress of mosquitoes (see Fig. 2). He further suggests that to facilitate the capture of any stray mosquitoes all walls should be bare and painted white, and that trees should not be allowed to grow near dwellings, as they afford a retreat in which mosquitoes may hide. Experiments carried out in the Roman Campagna have proved that these and similar devices have been sufficient to protect from fever for considerable periods; but it is to be feared that unless unceasing vigilance be exercised all such precautions may prove ineffective, and one mistake may render them entirely abortive.

We need yet, however, further information as to the habits of mosquitoes. We do not yet know certainly how far they are able to travel, or at what height can they raise themselves from the earth. On these and many other points in the bionomics of Anopheles our information is very scanty. Giles' recent work on the Culicidæ has brought together practically all we know; but workers in many distant fields find that the habits of mosquitoes are liable to vary according as local conditions are suitable or the reverse; they are, it would seem, capable of a certain measure of adaptability to their environment.

All patients suffering from fever should be specially protected, for now we know that where malaria and Anopheles co-exist the fever is infectious; in consequence of the transmission power of the mosquitoes a fever patient is a source of danger to all his neighbours.

In the matter of clothing some precautions can be taken, such as the wearing of proper mosquito-proof boots and stockings. Mosquitoes are specially fond of the shades under a dining-table, where they may pursue their depredations unchecked.

The continuous use of quinine, though backed by such great names as Koch and Manson, is open to many objections, and is a method of prophylaxis unlikely, alone, to attain such great results as the former evidently expects.

Preeminent above all other methods of prevention stands *segregation*, advocated first by the first expedition to West Africa, and since supported so strongly by the researches of Koch and in the published work of the Royal Society Commission.

Native habitations have already been referred to as the source from which Anopheles obtains its parasites; native huts, ill-ventilated and overcrowded, are the hotbed in which the Hæmamœbidæ luxuriate.

In tropical countries Europeans pitch their temporary camps, and often live permanently, within a few yards of such native hovels; given, then, a full supply of Anopheles and a swarm of native children, 80 per cent. of whom are infected with Hæmamœbidæ, it is not surprising, with our present knowledge, that an epidemic of malaria soon starts among the white men.

The pitching of camps near native villages, or living in close proximity to native huts, is flying in the face of all recent scientific research, and suicidal in its results. This cannot be too often nor too emphatically reiterated.

R. FIELDING-OULD.

THE NEW STAR IN PERSEUS.

THE HARVARD OBSERVATIONS.

PROF. PICKERING, the Director of the Harvard College Observatory, in a *Circular* No. 56, has detailed the observations of the new star made there soon after its discovery by Dr. Anderson. This *Circular* we print *in extenso*:—

The cable message announcing the discovery of a new star in the constellation Perseus, by the Rev. T. D. Anderson, was received at the Observatory early in the evening of February 22, 1901. Owing to clouds, the new star was only occasionally visible, and twice it was necessary to cover the instruments on account of falling snow. During the intervals, however, various observations were made, which have a value owing to their early date. Numerous comparisons by Miss Cannon, with α Aurigæ, magnitude 0·21, α Orionis, magnitude 0·92, and α Tauri, magnitude 1·06, showed that the magnitude of the star was about 0·9. Photometric comparisons, by Prof. Wendell with the 15-inch telescope, of the Nova with the star +43°·732, magnitude 7·25, at 14h. 0m. and at 17h. 25m., Greenwich Mean Time, gave the magnitudes 0·35 and 0·39 respectively.

Meanwhile, an examination was being made, by Mrs. Fleming, of the photographs of the region obtained here earlier in the month, with the various instruments. Although photographs are taken with the transit photometer throughout every clear night, yet owing to twilight they cannot be taken as early in the evening as this star culminates. Fortunately, for some weeks the work of the transit photometer, which only photographs objects near the meridian, has been supplemented by photographs with Cooke and Ross-Zeiss Anastigmat lenses. With these instruments an attempt is made to cover the entire sky, both east and west of the meridian, at short intervals. The completeness with which this has been done is shown by the fact that we have photographs of the region of the Nova with the Cooke lens on February 8, 18 and 19, and with the Ross-Zeiss lens on February 2, 6, 18 and 19. The photograph taken with the Cooke lens on February 19 had an exposure of 66m., beginning at 11h. 18m. Greenwich Mean Time. While this photograph showed not only the faintest stars contained in the Durchmusterung, but also stars as faint as the eleventh magnitude, no trace of the Nova was seen. This result was confirmed by the other plates mentioned above. A general examination of the large number of earlier plates of this region did not seem to be necessary. Plates taken with the 8-inch Bache telescope as early as November 6, November 8 and December 12, 1887, fail to show the Nova, although the spectra of stars as faint as the eighth magnitude are clearly visible on all, and those of the ninth magnitude on the plate taken on November 6. A photograph taken with the 24-inch Bruce telescope on October 18, 1894, with an exposure of 15m., shows no trace of this object, although stars as faint as the magnitude 12·5 are well seen.

On this same evening, February 22, eighteen photographs were taken with various instruments, under the direction of Mr. Edward S. King. They showed that, photographically, the Nova was 0·3 fainter than α Aurigæ. The general appearance of the photographic spectrum resembled that of the Orion type and was very unlike that of other new stars, in which the bright lines are the most conspicuous feature. This star had a strong continuous spectrum traversed by thirty-three dark lines. The approximate wave-lengths, as derived by Hartmann's formula from the measures of Hε, Hγ and Hβ, are given below. Each is followed by its relative intensity, and by the difference found by subtracting it from the wave-length of the corresponding line, if any, in the spectrum of β Orionis. As the lines having greater wave-length than 5000 have thus been determined by extrapolation, they may be subject to large systematic errors.

3894, 10, Hζ, −5; 3970, 20, Hε, 0; 4026, 3, 0; 4077, 2, −1; 4102, 30, Hδ, 0; 4126, 5, +2; 4151, 1, −4; 4266, 2, +1; 4341, 40, Hγ, 0; 4366, 1, +1; 4388, 2, 0; 4415, 1; 4435, 1, +3; 4470, 2, +2; 4481, 20, 0; 4510, 2, −2; 4530, 2; 4552, 2; 4572, 1; 4616, 1; 4643, 1; 4665, 3; 4714, 3, −1; 4862, 40, Hβ, 0; 4885, 2; 4922, 2, 0; 5325, 1; 5399, 1; 5431, 1; 5677, 2; 5695, 7; 5719, 5; and 5761, 1. On careful examination the lines 3970, 4102, 4341, 4481 and 4862 were seen to be bright on the edge of greater wave-length. The line 4665 was bright on the edge of shorter wave-length, or there was a bright line whose approximate wave-length was 4660. The line 4026 was not measured, but identified from its position.

FIG. 2.—Hut with mosquito cage round door, which is itself mosquito proof (as suggested by Celli). Reproduced from a photograph lent by the Sanitary Institute.

On February 23 the clouds were so dense that few observations could be made. The star appeared to be brighter and bluer than α Aurigæ and to have the approximate magnitude 0·0. The spectrum was photographed faintly and showed no marked change except that the line K, which was absent on the previous evening, was present and nearly as intense as Hε.

On February 24 it became clear soon after noon, and at 1 o'clock the Nova was seen with the 6-inch Equatorial, and also with the 2-inch finder, in strong sunlight. In the evening the magnitude, according to visual comparisons, was 0·54, from measures with the 15-inch Equatorial, 0·59, and with the meridian photometer, in strong daylight, 0·28. Photographically it was 0·4 or 0·5 fainter than α Aurigæ. The spectrum showed a remarkable change. It was traversed by numerous bright and dark bands, and closely resembled that of Nova Aurigæ. The principal lines were dark with accompanying bright