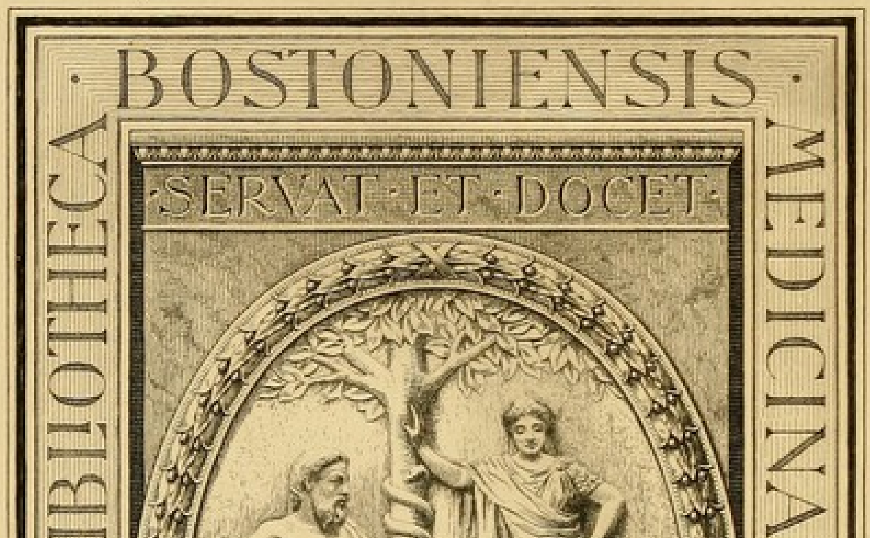
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CLIMATE AND HEALTH
IN
HOT COUNTRIES
AND
THE OUTLINES OF TROPICAL CLIMATOLOGY

A Popular Treatise on Personal Hygiene in the Hotter Parts of the World, and on the Climates that will be met with within them

BY

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NEW YORK
WILLIAM WOOD AND COMPANY
MDCCCCV

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INTRODUCTION.

A HUNDRED years ago a prolonged residence in the Tropics was regarded with well-founded horror. The best the white settler in the lands of the sun dared hope for was "a short life and a merry one," but too often the merriment was sadly lacking.

When Clive's father made interest to get his son a writership under "Old John Company," and packed off the troublesome lad to India, he probably regarded it as a last resource, and felt much as if he had signed the youth's doom; but an age that hanged for sheep-stealing, or less, was like to be stern in its dealings with its children.

We know now that what the father took for vice was but evidence of the superabundant vitality of a genius, and being one, Clive naturally possessed the originality to modify his habits to his new surroundings, and so survived to become an Empire-builder and hero. Nor was the case exceptional, for looking back on the history of our great Indian dependency, one cannot fail to be struck with the high average ability of the few who survived to attain leading positions.

Furlough to Europe was almost impossible, and the hills were unknown, but in spite of this, many of these seasoned veterans who had learned their lesson lived, in the land of their adoption, to a green old age. But the rank and file, who could not or would not learn, died off like rotten sheep; and to this day it is the young and inexperienced, who have as yet not learned to adapt and protect themselves, who fall the readiest victims. At home it is, I believe, generally recognised that at the age of 26 a man is rather past his best from the athletic point of view, and it is hardly to be supposed that he is not equally at his fittest before that age, simply because he has shifted his domicile a couple of thousand miles to the south ; but so fatal is the want of caution and intolerance of precaution inherent in early manhood, that most authorities recommend that, if possible, emigration to a hot climate should be postponed till the age of 25. This obstinate determination to carry to tropical parts habits of life suitable only to the more temperate parts of Europe was carried in old times to an almost incredible extent.

Now and again, in the guest-chamber of some native noble's house, one may come across quaint old paintings and engravings which show our great grandfathers fighting or playing cricket in exactly the same costume as their contemporaries at home. No alteration whatever was made in the soldier's dress, and his officers duelled, drank, and gambled in the same old Ramillies wigs that led such portentous gravity to those charming discussions with the enemy as to who should "fire first." Even the earlier files of the *Illustrated London News* show the same things, and looking at these old pictures, the wonder is not so much that many succumbed as that any survived. Even in Europe the conditions of military service were terribly unhealthy, and when transplanted to the Tropics the mortality was such as to give to India and other hot countries an evil reputation which they have not yet lived down.

The dire struggle of the Indian Mutiny led to the first attempts to clothe and treat the soldier in a somewhat more rational fashion, and since then great improvements have been effected; but a great deal more remains to be done, especially in the matter of utilising our recently gained knowlege of the causation of malaria, before our military statistics can be expected to show how little this evil reputation is due to the climate itself, and how much has really been caused by human misdirection. No amount of sanitary improvement can be expected to render Bombay a comfortable place of residence in the dog days, and apart from localities at considerable elevations, where the climate is really temperate, it is hopeless to expect that anything in the way of actual colonisation can succeed in the climates with which we are dealing; but with due care and attention to sanitary laws, as modified by the altered conditions, there is no reason why the rates of sickness and mortality should be much more formidable than elsewhere.

In the following pages the writer has endeavoured to put into popular form the principal points of personal hygiene as applied to hot countries, and as they are intended mainly for the non-professional reader, all technical terms have been, as far as possible, avoided, and words in popular use, such as germs, &c., have been substituted for the more exact nomenclature of science. Should any of his medical colleagues care to read a merely popular work, they can easily supply for themselves, in place of these vague, popular words, the more precise terminology in use amongst ourselves.

The climates of the hotter parts of the world vary even more widely than those of the temperate zone, so that it is often impossible to offer suggestions applicable to all of them; and on this account it is extremely important that the intending resident or visitor to them should be able to ascertain what is the exact nature of the climatic conditions with which he will have to cope, so that it is absolutely essential to include within the scope of a work like the present some account of the climates of the various countries included in the enormous area under consideration. On this account the little book has been divided into two distinct parts, the first of which is devoted to personal tropical hygiene, while the second, which deals with climate, is necessarily mainly a dry mass of tabulated information, of which only the few pages devoted to the country he proposes to visit is likely to interest the individual reader.

The inclusion of information of the sort is, however, quite essential, as it is by no means easily accessible, and, as a matter of fact, scarcely exists, except in the form of the official records of the various meteorological observatories, so that when collecting data for the compilation of this second part, or appendix, on tropical climates, the writer was a good deal surprised to find that he was engaged in the preparation of what is really a pioneer work on the subject in the English language.

This being the case, it has been thought well to publish these outlines of tropical climatology also in a separate form for the use of the professional reader who may not care to be burdened with a booklet on health treated from the popular point of view; a step which has further necessitated that the paging and indexing of the two parts should be kept separate from each other, a plan which, in view of the moderate dimensions of the book, might otherwise have appeared rather superfluous.

LIST OF DRUGS, &c., MENTIONED IN THE TEXT.

Bicarbonate of soda.

Bismuthi salicyl., in tabuloids of grains x. each.

Book of litmus paper.

Boracic acid, in powder.

Calomel, in tabuloids of ½ grain each.

Carbolic acid, with sufficient glycerine added to keep it in a fluid condition.

Castor oil.

Castor oil with resorcin :—

℞. Ol. ricini ... ... ℥viii.
Resorcin ... ... ʒii.

Mix, and dissolve the resorcin by standing the bottle in hot water.

Citrate of potash.

Easton's syrup, put up in a bottle marked to its dosage.

Ether sulphuric. This drug is too volatile for storage in the ordinary way in the Tropics and so should be put up in glass capsules each holding a drachm.

"*Fever*" *or diaphoretic mixture :—*

℞. Liq. ammon. acetatis fortior, B.P., 1885 ... ʒss.
Sp. eth. nitrosi ... ... ♏xx.
Potas. nitratis ... ... gr. i.
Water ... ... to ʒii. for each dose.

Dose.—To be put up in a bottle graduated to that dosage containing 8 oz. of the mixture, and taken diluted with four or five times its quantity of water.

Goa ointment :—

Goa powder ... ... } āā ʒss.
Acid salicylic... ... }
Lanolin ... ... ad ℥i.

Gregory's powder.

Hydrochloric acid, preferably in the dilute form.

Opium, in tabuloids of 1 grain each.

The "Patna" drug is preferable as a sedative before the administration of ipecacuanha.

Paint for "Dhobi's itch" :—

Liquor iodi fortior ... }
Pure carbolic acid ... } *partes æquales ad* ℥ii.
Glycerine ... ... }

Perchloride of mercury, in tabuloids :—

$\left.\begin{array}{l}\frac{1}{40} \text{ grain} \\ \frac{1}{64} \text{ grain}\end{array}\right\}$ for internal administration.

$2\frac{1}{2}$ grain "soloids" for compounding an antiseptic solution.

Permanganate of potash, put up in packets of 2 oz. each, wrapped in water-proof paper, for disinfecting wells.

Phenacetin ; tabuloids of grains v. each.

Phenyle, "Little's soluble."

Pills for hill diarrhœa and similar disturbances of the bowel :—

$\left.\begin{array}{lll}\text{℞.} & \text{Euonymini} & \ldots \quad \ldots \\ & \text{Pil. hydrargyri} & \ldots \\ & \text{Pulv. ipecac.} & \ldots\end{array}\right\}$ āā grain i.

Pulv. hydrargyri cum creta, popularly known as grey powder.

Pulv. ipecacuanhæ, in tabuloids of 5 grains each.

Quinine sulphate (or hydrochloride) *in powder.* The cork should be fitted with a small wooden cup, to measure 5 grains approximately.

Resorcin, in tabuloids of grains v. each.

Thymol, in tabuloids of grains x. each.

Tinct. camphoræ composita, popularly known as "paregoric elixir."

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PART I.

CLIMATE AND HEALTH IN HOT COUNTRIES.

Climate and Health in Hot Countries.

PART I.

CHAPTER I.

On Housing and Domestic Architecture.

In hot climates, as elsewhere, people are rarely in a position to exercise much choice in their selection of a habitation, as its site must usually depend on considerations of business, and in the majority of cases, the number of available dwellings is limited. Oftener still, it is a matter of "Hobson's choice," and one must needs occupy the house that has served one's predecessors in the work in which one may happen to be engaged. On this account it will be superfluous to do more than generally indicate the general principles on which it is desirable, that houses designed to afford shelter in hot climates, should be placed and constructed.

In the matter of choice of site, the same general considerations as to soil and configuration of the ground that determine our choice in temperate climates, as a rule, hold good. A gravelly or sandy soil, and gradients favourable to natural drainage, are even greater desiderata in the Tropics than in Europe, and this is especially the case in climates characterised by a heavy rainfall; but ideal sites are rare in all countries, and as a rule, one must be content to make the best of less favourably placed spots. In the countries which we are at present considering, the especial danger against which we have to guard is always that of malaria, and hence, in choosing the site for a house or station, the great point is to select one, which is, as far as possible, free from natural or artificial collections of water, within a radius of a quarter of a mile; or at any rate, including such only as can be easily filled in, drained, or otherwise dealt with. The site should also be sufficiently raised above the level of some natural watercourse to afford an adequate outfall for its surface drainage.

For a single house, no better position can be selected than the summit of a mound, whether natural or artificial; and such situations are generally to be preferred to the slope of a hill, even where the latter affords a considerably greater elevation. On the sea coast, and not unfrequently in the neighbourhood of some of the great rivers, sand dunes, where sufficiently clad with vegetation to afford a sufficiently stable foundation, form excellent sites for single houses, good examples of which are to be found in Chittagong, where nearly every European residence has its own little hill, on which it is perched by itself; and it is doubtless to this circumstance that the comparative healthiness of the European population of the town, under otherwise unfavourable surroundings, is mainly due. The neighbourhood of jungle, and even of trees, should be as far as possible avoided, for trees undoubtedly harbour mosquitoes, and their presence is generally equivalent to that of malaria: moreover, the appearance of coolness, associated with trees, is deceptive rather than real. As a rule, even when numerous and thickly set, they throw no actual shade on the walls of the house, which hence receives as fully the power of the sun as it would in an open plain, and added to this they obstruct the breeze and generally impede ventilation; so that a house placed in the midst of a glaring, treeless space is often really far cooler than one surrounded with fine timber. Even a garden is by no means too desirable an adjunct to a tropical residence, for unless there is abundant labour to keep it in a condition of perfect neatness, and constant intelligent supervision to ensure that the cultivation of flowers and vegetables be not associated with the breeding of mosquitoes, it is only too likely to originate fever of a luxuriance at least equalling that of its roses and salads.

It must not of course be forgotten, that the provision of a free supply of good vegetables is everywhere an essential to health, and is in many localities obtainable in no other way than by the maintenance of a garden, and that under such circumstances, it is probably safest to keep their cultivation under personal supervision; but where such an accessory is indispensable, its attendant dangers should always be carefully borne in mind, and care should be taken that the garden should be so worked as to avoid its becoming a breeding place for mosquitoes. A house for example, such as that shown in the subjoined sketch,

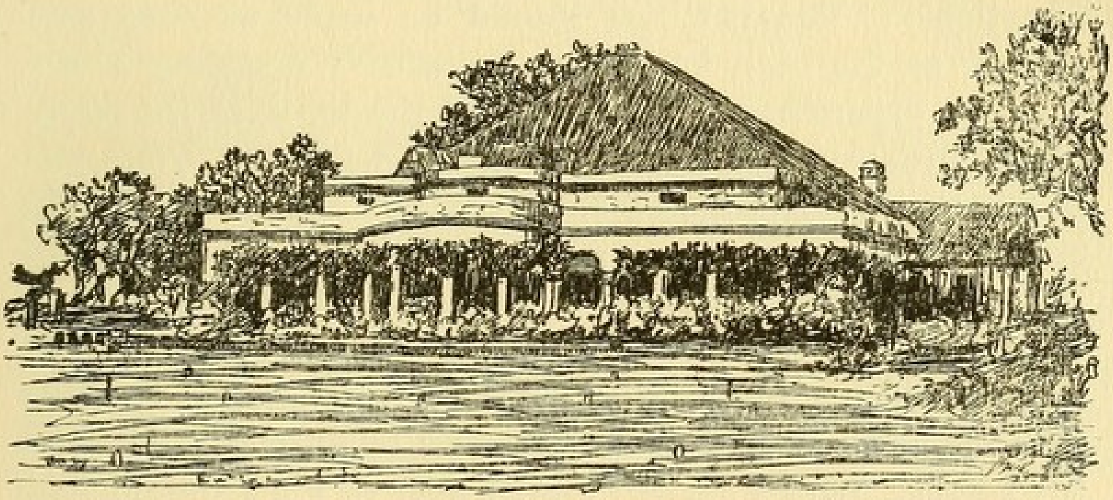

FIG. 1.—A Regular Mosquito-trap Bungalow.

makes, doubtless, a very inviting picture, but when lived in, it would be found that the fine trees almost completely cut off the breeze, that the beautiful creepers render the verandahs and the rooms behind them "stuffy," and that the wealth of vegetation, combined with the arrangements for irrigation, render it a veritable paradise of mosquitoes.

Coming now to questions of general plan, one of the first essentials is that the floor level should be well raised above that of the surrounding ground. In most localities this object is attained by simply forming a platform of earth dug from some situation hard by, so as to form a plinth; and too often, the excavations for the purpose are made absolutely without plan or method, and result in the production of a number of irregular depressions, close by the habitation; which during rainy weather are always full of water, and form ideal breeding places for mosquitoes, besides too often serving as depositories for refuse. The earth for forming the plinth should, however, never be allowed to be obtained in this way, but previously to laying out the plan of the house or station, a careful survey of the levels and contours of the site should be made, and the alignment of a series of deep cuttings, so designed as to form an efficient system of surface drains extending from the site to the nearest natural effluent, should be laid out, so that the spoil wherewith to form plinths should be taken in a systematic manner in the digging of these cuttings, and from no other situations. The cuttings should be made as deep and narrow as they can be without expensive revetting of the sides, as experience has shown that the larvæ of the really dangerous species of mosquitoes, the *Anopheletes*, avoid collections of water shielded from the sun and light. As the station develops, it may perhaps become possible to pave these channels with some permanent material, such as brick or concrete, but as a rule the expense of such a proceeding is prohibitory. When, however, a certain amount of money is available for this purpose, it should be devoted to paving the smaller shallow surface drains close to the dwelling, and the deeper distant cuttings close to the effluent left to the last. No house should ever be allowed to be constructed with a plinth of less than one foot, and provided the material be obtainable without making undesirable excavations, it cannot well be too high, a fact well understood by the earlier European residents in India, whose fine old houses, however wanting their work may be in the matter of finish, form an admirable contrast, in this and many others of the essentials of a healthy residence, to the cramped, low-lying heat traps of admirably pointed brickwork in which the occupant of a "sealed pattern" government quarter is now doomed to live.

The writer is personally strongly of opinion that all tropical residences should be at least two storied, so that the sleeping apartments should be raised at least some 12 or 15 feet above the ground, and of course, where this is the case, the provision of a high plinth is less essential, but in any case, the minimum of at least a foot should be insisted upon.

In regions such as Assam and Burmah, where the rains are so heavy as to reduce the entire country to a chronic condition of flooding, any adequate plinth would be so costly that both natives and settlers build their houses perched up on poles, and the numerous sanitary advantages of the plan are undeniable; which is also, I understand, adopted in Honduras.

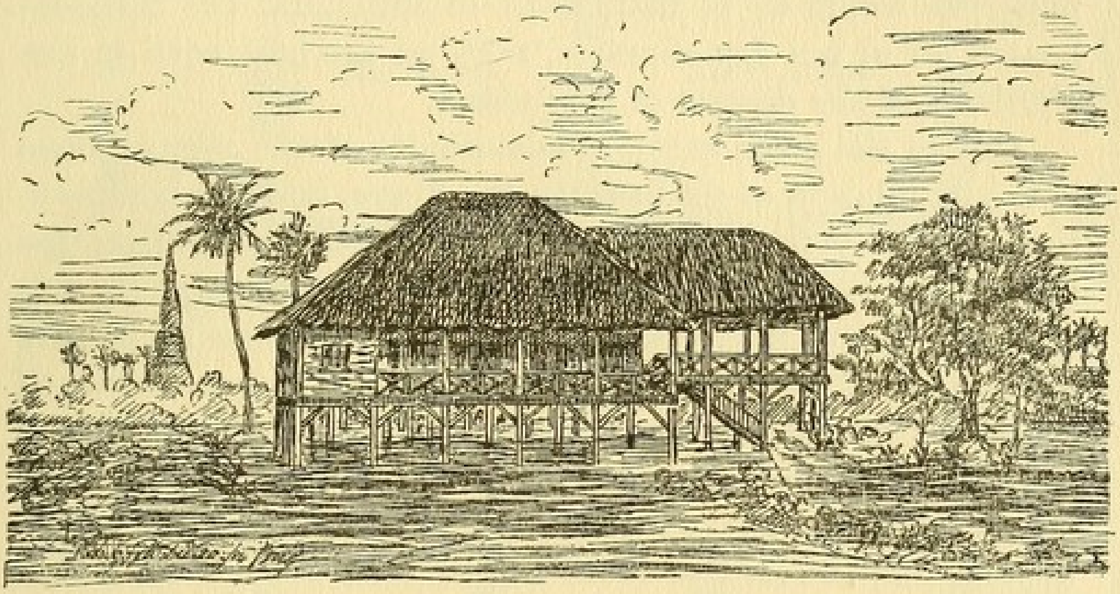

FIG. 2.—In the above sketch of an ordinary Anglo-Burman bungalow, it will be noticed that the large projecting porch is raised higher than the rest of the house so as to admit of a carriage being driven beneath it to the foot of the steps to the platform of the house. These porches form a sort of open-air sitting room, and are more usually on the same level as the rest of the house. They form a most attractive feature of most Burmese bungalows, but it would be very difficult to protect them against mosquitoes by means of wire gauze.

The general characteristics of these "*chang*" houses may be gathered from the above sketch. In the cottages of the peasantry the "*chang*," or platform, is rarely raised more than 4 or 5 feet above the ground, but 10, or even 15 feet is no uncommon height in the case of the houses of people of means and position. Even in the case of houses occupied by planters and officials, the walls are largely composed of bamboo matting, while in those of the populace, the floor itself is formed of a stouter variety of the same material; and on account of the growing cost of timber of a class that will resist white ants, I have little doubt that ere long steel girders will replace the wooden framework and corrugated iron will take the place of the picturesque thatched roof, at any rate in the coast towns. A *chang* of concrete carried on stout corrugated iron, 8-inch walls of the "Elizabethan" pattern, and a double corrugated iron roof, with a large intervening air space, would form a most comfortable, if not very beautiful, residence, for the combination of heat and moisture with the evils of which the *chang* house is intended to cope; but walls of such flimsy materials would be of little avail to withstand the furnace-heated air of hot dry climates, such as are met with in the Punjab and the deserts of Rajputana.

One of the great sanitary advantages of the *chang* house is the circulation of air beneath the floors, and the comparative immunity from vermin secured by its isolation on the top of high posts, and though there is no objection to the storing beneath it of carriages and other articles frequently moved, because in daily request, the covered space beneath the house should on no account be allowed to degenerate into a lumber room, as not only will lumber attract dangerous vermin, but with the inevitable numerous native dependants, the lumber room will soon develop into a refuse heap, or worse. Although there is no need to construct a regular plinth, the ground below the *chang* should always be slightly raised by laying down a layer of gravel, as any collection of water would be obviously unhealthy; besides which, if kept in proper order, the large shady space forms an excellent playground for children, where such charming encumbrances form part of the household.

In actually desert climates, a plinth is less essential, but there are comparatively few countries in which heavy rain does not occur at some time of the year, and any dampness of the soil immediately underlying a house is always unhealthy.

The second great desideratum of a tropical house is free ventilation, to secure which at least one, and preferably two, sides of each room should be in free communication with the outer air by means of doors or windows, and some at least of these should extend to the floor level or near it.

Many Indian houses are spoilt by want of attention to this point, especially those of long standing; for though the original plan may have been fairly sound, the desire for

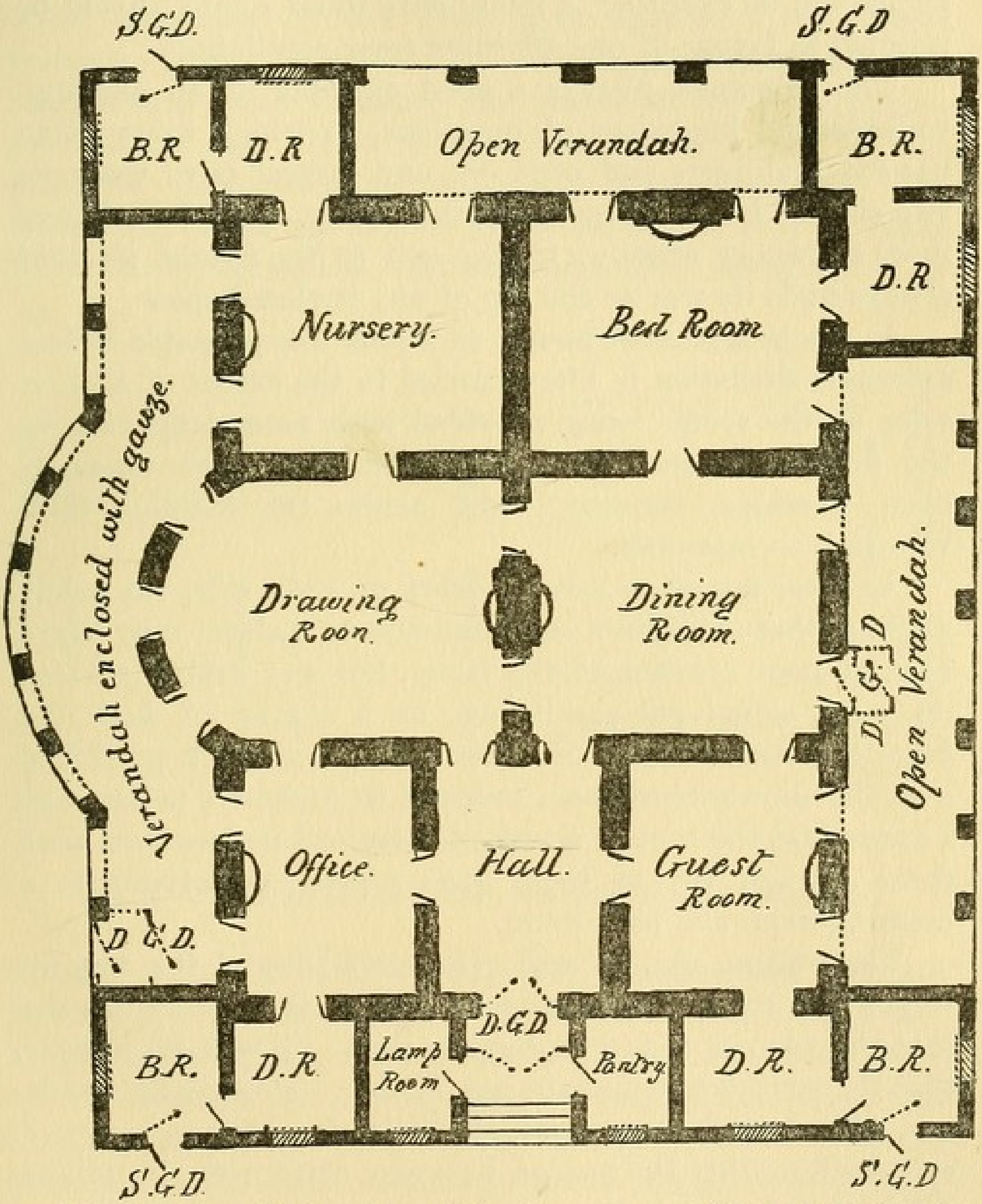

FIG. 3.—Ground plan of an existing "up-country" Indian Bungalow, in which the doors and windows are well placed. (The dotted lines represent wire gauze screens.) Scale, 18′ = 1″.

additional accommodation generally, in course of time, leads to additions, and especially to the enclosure of verandahs, whereby rooms, originally light and airy, are quite cut off from all exterior ventilation. Many of these enclosed rooms have small dormer or clerestory windows, close up to the roof; but openings of this sort are no real substitute for proper windows and doors in the usual position, and where choice can be exercised, a house with inner rooms should be rejected in favour of one affording freer ventilation.

The subjoined plan is a good example of an existing, well-planned bungalow of one floor, in which every room has external doors and windows, and several have them on two sides. It should be added that every room has one or more clerestory windows to give exit to the heated air that always finds its way to the top of any enclosed space.

In the best class of houses in Persia this principle of free external ventilation is often carried to the extent of all four sides of the rooms being provided with several openings—the different rooms being separated from each other by open passages, running right across the building from verandah to verandah.

As there are often several doors on each side, one easily realises that Aladdin's hundred-doored palace may have been no mere creation of the fancy, but was probably based on some actual palace—indeed, as a matter of fact, the Subsabad Residency at Bushire has, I believe, a good deal over the allowance of doors assigned to Aladdin's palace, and I know that the room I occupied there had no less than nine doors, though two of them gave access respectively to a dressing-room and bath-room.

The outline (fig. 4) will give some idea of the way in which the rooms are arranged; but it is needless to say that the plan is a very expensive one. It will be noticed that the southern verandahs are double. Practically speaking, indeed, a Persian house is little else than a series of colonnades, with the spaces between certain of the pillars filled in with door frames, so that it would be an expensive business to fortify one against the invasion of mosquitoes.

Houses of this type are well suited to climates usually blessed with a good breeze, and in which the heat during the day does not reach such a degree as to necessitate shutting it out, and are specially adapted to places where, from scarcity of labour, there is a difficulty about the pulling of punkahs. When, however, the midday heat reaches into the nineties, such a plan of building becomes unsuitable, and it is necessary to adopt the thick-walled type of house, with comparatively few floor level openings; the object being to keep imprisoned the cooler night air, so that the interior may never approach the maximum shade temperature of the day. It is obvious that the adoption of this principle quite precludes all proper ventilation, and that unless the rooms are exceptionally large and lofty it must be positively unhealthy. At the same time, heat beyond a

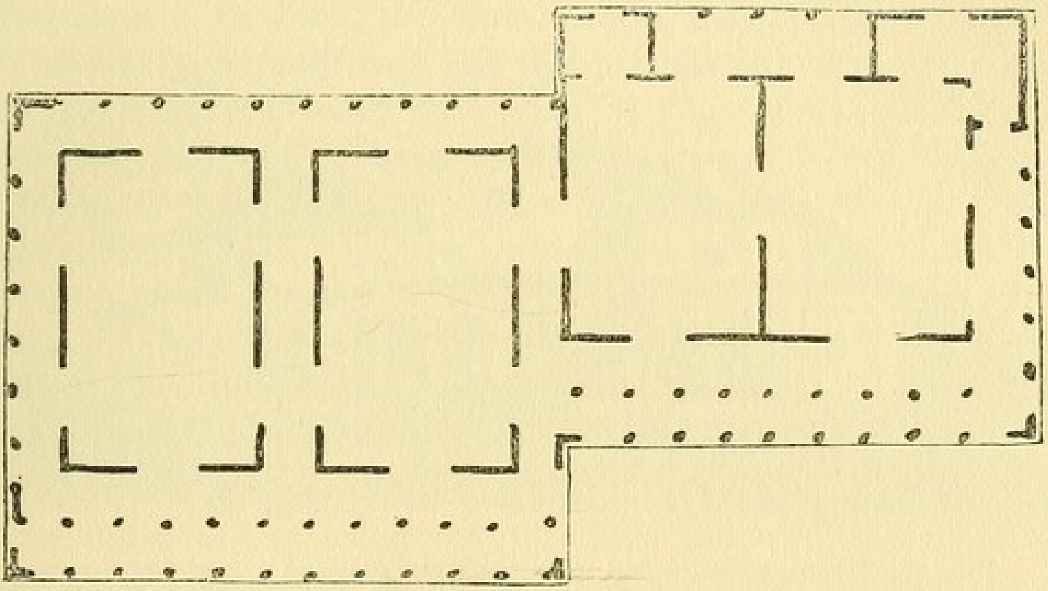

FIG. 4.—Rough ground plan of an European Bungalow in Persia.

certain degree induces such severe nervous and physical prostration that the adoption of this course is almost unavoidable during the worst hours of the day in such climates as the Punjab; but the shorter the period the better, and as the same reasons that render the house cooler than the outer air in the day, make it hotter at night; it is always well to compensate for the lack of ventilation during the day by sleeping absolutely in the open at night.

Too often, not only the air, but the light is shut out, a course of action which is as pernicious as it is futile, for unless the sun be shining directly into the room its temperature will be in no way raised by admitting an ample amount of light.

There can be no doubt that this baneful practice of keeping children shut up in darkened rooms is one of the principal causes of the blanched and enfeebled little ones so often met with in India; for they suffer promptly from deprivation of light, though they are wonderfully tolerant of heat, and if unchecked by their anxious mothers, will follow their own wholesome instincts, and be found romping and tumbling about with the servants and orderlies in the verandah, at temperatures that make their parents devote anxious consideration to the question of crossing a room.

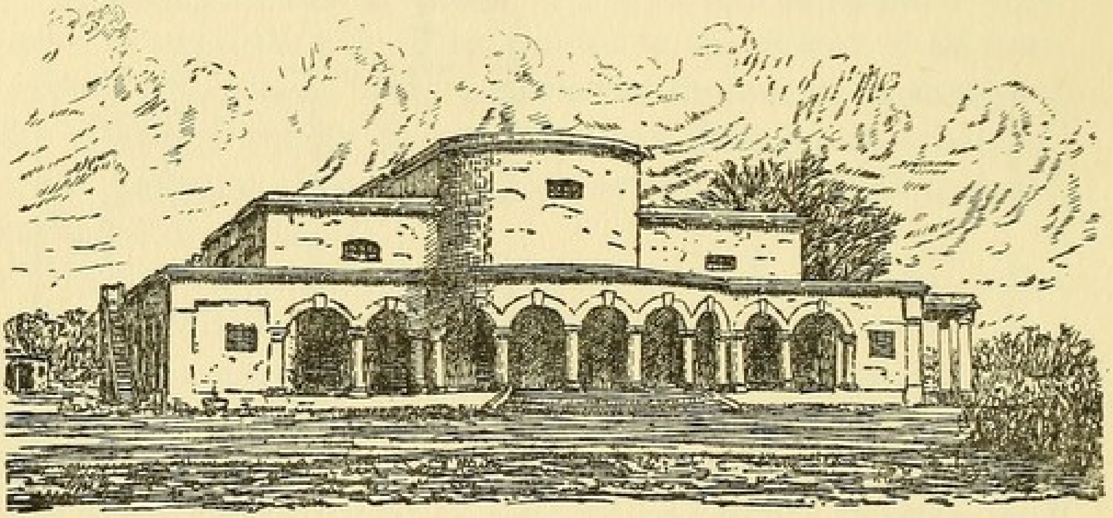

FIG. 5.—Sketch of bungalow with terraced roof, of a type very common in the Punjab and United Provinces in India. Speaking generally, this bungalow is well planned. Its faults are that the verandah is too low-pitched, leaving a needlessly large proportion of the external walls exposed to the full power of the sun. The dormer or ventilating windows also are too low down, as they leave several feet of confined "dead" air at the top of the rooms. They should have been placed close up to the cornice.

The third important consideration in planning a good tropical house is that the outer walls should, as far as possible, be shielded from the direct rays of the sun by ample verandahs. Objects exposed to the full glare of the sun soon become so hot that it is difficult to handle them, reaching a temperature 40° or 50° F. higher than that of the air, and though building materials conduct heat but slowly, they do so very surely, so that the air within any building with extensive unshielded sunward walls cannot fail to be considerably hotter than that of one so planned that as small an area of wall as possible is directly exposed. Within the true Tropics, the sun must necessarily come to the northward of any localities for a longer or shorter portion of the year, and in such low latitudes it is desirable that the verandah should extend all round the house ; but outside the equatorial zone the side looking away from the noon-day sun may be left unprotected as far as the coolness of the house is concerned ; though a northern verandah is still desirable, as affording the most eligible position for an open air lounge during the day. Within practicable limits, a verandah can hardly be too wide, and as one of its main functions is to shield the main wall, it is also important that it should be high pitched, but this point is too often lost sight of, although the additional cost of constructing a higher-pitched verandah is very small, as the supports of these structures cost but little, in comparison with the roof. Of course the oblique rays of the sun will search into a high verandah for a longer time than they can in a low one, but this defect is easily obviated by closing the upper part of the colonade with wooden jalousies or with mats, but in this case openings should be provided in the roof to give exit to what must be almost dead air. Verandahs of less than six feet width are of comparatively little use, and 10 feet may be considered to be a fair average standard, but 15 feet is by no means excessive, if it can be afforded, and as shown in the diagram on page 9, double verandahs, consisting of two colonnades, each about 12 feet wide, are by no means uncommon in Persia.

To attain an equivalent standard of comfort, the rooms of a tropical house require to be much higher pitched than is needful in temperate climates, but it is quite possible to carry this to excess, as over a certain height, the pendulum swing of the punkah is too slow ; and it is well known to students of ventilation that spaces of dead air, unsearched by the currents normally circulating through the room, are very apt to be found in too lofty appartments. From 16 to 18 feet is a good average standard, and if the height be carried many feet above the higher figure, it is desirable that a strong beam should be carried across the room, at about that level, to carry the punkah. As far as ventilation is concerned, there is probably little advantage in any height of ceiling above 13 feet, but this does not give an adequate swing for a punkah.

As already incidentally mentioned, the writer holds a strong preference for houses of two or more floors. While residents of Calcutta or Bombay will never, if they can avoid it, live on the ground floor, there is a general but quite unfounded idea, amongst up-country residents in India, that upper floors are necessarily hotter.

It is needless to say that the reverse is actually the case, and that other things being equal, upper storey rooms are necessarily cooler and more healthy, on account of their better exposure to the breeze and their being to a great extent raised above dust and other more subtle emanations from the soil. The reason for this misapprehension is that, outside the Presidency towns, upper rooms are almost universally makeshift additions, with no proper verandah protection, and often flimsy roofs. Now it is obvious that to gain the full advantage of an upper storey, all verandahs should be carried right up, so that except in being elevated above the soil, the upper rooms are exact reproductions of those below them. I cannot recall, however, a single instance of a properly planned two-storied house "up-country," and it is absurd to expect that a room with thin brick walls, exposed directly to the sun's rays, can be as comfortable as one with massive walls and broad verandahs. It may be admitted that during the day, when the doors are shut to keep out the heat, the upper rooms of a two-storied house will be hotter than the lower ones, because one has but a single roof overhead in place of two, but they will be cooler than the lower ones would be, assuming the upper story to be removed.

It is also extremely desirable that the plan of the house should include a stair giving access to the roof, as during the hot dry season, there can be no doubt that it is by far the healthiest plan to sleep there.

A small area of thatched roof supported on four pillars should be erected on the roof to protect the sleeper from dew, and to prevent his being worried by the glare of the moon, which to say the least of it makes it very difficult to sleep. Whether there is any truth in the belief that exposure to the moon's rays may cause blindness or not, I cannot say, but I certainly have met with a number of cases of temporary blindness for which it was, to say the least of it, extremely difficult to find any plausible explanation other than the popular one. Moreover, as we are quite in the dark as to the *modus operandi* of true sunstroke, it seems unscientific to deny that over-stimulation of the retina by the moon's rays can be capable of producing the symptoms in question, and at any rate it is preferable to act on the assumption that "moon-blindness" may be a possible contingency.

It is, further, a matter of great importance that the upper limits of the air-space included within a room should be ventilated by means of openings placed close up to the ceiling, as otherwise a stratum of impure, heated air will lodge there, which can only be removed by the slow action of diffusion. In one-storied houses this is usually effected by means of small windows, and in order to admit of a sufficient number of these being provided, it is a common expedient to carry the walls of rooms situated in the interior of the house above those of the lateral rooms, as shown in fig. 4. There should, however, be no necessity for doing this, as no room should be ever built with no external wall; and though upper openings on more sides than one may be desirable, this is not so essential as to warrant the large increase of cost involved in building in this way. Where a house has an upper storey, the top ventilation of the lower rooms is usually effected by openings into the verandahs; but this is by no means a satisfactory outlet, and it would be far preferable to effect the purpose by means of shafts carried up in the thickness of the walls to the roof, the long column of air within which would favour the production of a good current.

In certain parts of the East, subterranean chambers (*taikhana*) are used as a refuge during periods of extreme heat, and are occasionally to be met with in very old European bungalows, though I have never seen one in actual use. Good examples are to be seen in the ruins of the historical Residency at Lucknow; and it was within them that many of the women and children were sheltered during the memorable siege. They can, of course, be ventilated only from above; but there can be no doubt that they are cooler than rooms above ground, and it is possible that the principle might be adopted with advantage under certain extreme climatic conditions.

The materials appropriate for house-building necessarily vary according to the character of the climate, but it is desirable to consider briefly the advantages and disadvantages of those in most common use. Taking first the structure of the walls, it may be noted that in rainy climates near the coast, where very high temperatures are seldom registered, the materials can hardly be too flimsy and permeable; but as one recedes from the coast and meets with the extreme climates characteristic of the interior of continents, it will be found that the buildings become progressively more massive; so that while the Bengali or Malay inhabits a shanty formed of thatch and matting, the peasant of the Punjab shelters himself within mud halls some two feet thick. These differences in domestic architecture are the necessary outcome of differing environment, and to be comfortable, European houses must be built of very much the same materials as those of the natives around them.

In dry climates, sun-dried bricks make an excellent wall, which resists heat even better than one of burnt brick, and provided it be protected from rain, it is wonderfully permanent and much stronger than would be expected; so that heavy, terraced roofs are easily carried by a two-feet thickness of this material, and they are even quite adequate to sustain a second story of lighter materials. The great drawback of the material is that it forms a favourite haunt for white ants, which tunnel it in all directions; but this can easily be obviated by introducing, just at the floor level, a single course of some damp and insect-proof material, such as burnt brick, laid on cement and tarred. Owing to its extreme cheapness a large house can be built for the same expenditure as a small one of burned brick, and as air space is of the greatest importance in hot climates, it is unfortunate that this material is not more utilised in Government buildings.

Flooring.—The most suitable material is stone flagging, marble, of course, being preferable. After these come hard tiles, brick on edge, and cement, in order of desirability. Besides these there are, of course, various special modern inventions, but they hardly come into practical consideration, outside large seaports. Wooden floors should be generally avoided, as owing to decay and the attacks of insects, they are apt to become dangerous, and may give way unexpectedly at any time. For upper floors, by far the most suitable material is the narrow brick arch supported on steel girders, which are now so generally obtainable and cheap, that they can be economically substituted for wooden beams in any locality tolerably accessible from a railway.

One great advantage of this form of construction of flooring and terraced roofs, is the entire absence of nooks and crannies which can harbour vermin, for even the equally massive roofs of concrete, laid on flat tiles supported by a system of beams and battens, afford most dangerous refuges for disagreeable intruders, and I well remember an inmate of my house being put to intense suffering on two successive nights by vermin that fell from such a roof; the first disturber of our rest being an enormous centipede, and the second a hornet. For the same reason, all cornices and similar architectural adornments are distinctly to be deprecated.

The roofing materials generally employed in tropical countries are thatch, tiling, terraced constructions, and corrugated iron. Thatch is, from many points of view, an excellent material, as while it favours ventilation by being extremely pervious to air, it gives excellent shelter from rain, and is quite unequalled as a protection against the sun; in addition to which it does not, to any appreciable extent, throw out into the house during the night the heat absorbed during the day.

With all this, it has great and, it is to be feared, preponderating disadvantages, the principal of which is that it forms a perfectly ideal refuge for vermin of all sorts, vertebrate and invertebrate. As a rule, owing to the high pitch necessary in this form of roofing, the lower edge of the roof is rarely more than a few feet from the ground, and owing to the usual existence of creepers, trellises and similar facilities, is usually easily accessible to any animal endowed with the most moderate powers of climbing. Owing to this, such roofs are usually honey-combed with the nests of squirrels, rats, civet cats, and half wild domestic cats, to say nothing of snakes, and birds and other flying things. The large empty space between the ceilings and the rafters is usually alive with bats, and as all this extensive population is quite without any system of conservancy, an old thatched roof is simply permeated with guano; and the emanations from this necessarily find their way into the house, and indeed are always plainly perceptible in a thatched house that, for any reason, has been shut up for any length of time.

Besides this, the substance of the thatching is always slowly decomposing under the slow action of mildew, and this adds further musty exhalations to the bouquet. Hence, if used at all, the thatch should be completely renewed at frequent intervals, and its employment should be confined to situations which cannot be scaled by large vertebrate vermin.

Where it is used, the interior of the rooms should be completely cut off from the cavity of the roof by some fairly impervious ceiling, such as one formed of match-boarding, and not, as is commonly the case, by a "ceiling cloth" of ill-stretched canvas.

These "ceiling cloths" are utter abominations, and, even when their untidy appearance is ameliorated by sub-dividing the cloth into a number of small panels, the improvement is purely one of appearance, and in no way diminishes their sanitary defects, so that no effort should be spared to induce landlords to replace them with match-boarding or any material that will shut out the emanations from the thatch and its inhabitants.

For some reason, the lath-and-plaster ceilings and partitions, so commonly used in Europe, are never employed in Indian house-building. It is difficult to understand why this is so, as the natives are skilful plasterers, and there would be no difficulty whatever in teaching them this particular application of their trade, which would be a valuable and inexpensive expedient in this and a number of other cases.

Tiles of the old-fashioned sort present few of the advantages of thatch, and most of its disadvantages, besides numerous special objections of their own, but these remarks do not apply to roofs formed of large tiles of European patterns laid on a properly graded framework of squared battens. To these latter the only objection is that they let in too much heat unless they are supplemented with a tolerably substantial ceiling; and the same remarks apply even more to corrugated iron, but both these materials, and especially tiles, are excellent materials for verandahs, especially those of upper stories, where weight is a consideration.

Corrugated iron, however, is scarcely tolerable in extreme climates unless it is actually doubled, and the most scientific way of doing this is to form a ceiling of corrugated iron of a thin gauge screwed *up* to light joists and painted white below. On the upper surface, should be spread about an inch of dry sand, to retain which it is necessary that any ventilation openings should be protected with a wooden edging. The outer roof should be of stouter gauge, and must of course be pitched at an appropriate slope, and it is of the first importance that the space between the two roofs should be freely ventilated by large openings placed at the apices of the gables, but these openings should be secured against the entry of birds and cats by means of wire netting, and all other openings by which they can enter should be carefully closed with plaster. The coolness of a roof so planned depends largely on the thickness of the layer of dry sand, and, provided the joists that carry the sheets are fairly strong, there is no difficulty in raising this to even a couple of inches. The preceding materials all have the disadvantage that they must be pitched at a considerable slope, and hence cannot be used as a platform for sleeping on.

All considered, however, a terraced roof, formed of brick arches supported on steel girders, covered with concrete, is by far the best for most tropical climates. It forms an excellent protection against sun and rain, and the smooth finish of both its upper and lower surfaces offers absolutely no hiding place for even insects; besides which it forms an excellent elevated platform on which to sleep during periods of intense dry heat. Its one disadvantage is that a great deal of the heat absorbed during the day is radiated into the rooms at night, and that it generally is inferior as a non-conductor either to thatch, or to double roofs of any description.

Another form of terraced roof commonly found in dry climates consists of a considerable thickness of beaten clay, spread on mats supported on a system of beams and battens.

Owing to their great thickness and the fact that the clay conducts heat much less easily than burnt bricks, such roofs are very cool, and they form a good sleeping platform; but they give endless trouble during periods of rain, as they *always* leak at the beginning of one, and vermin are apt to harbour amongst the matting and battens that carry the mud. Owing to their immense weight, too, they are not free from danger, especially as they are usually found in combination with walls of unburnt brick, which offer no obstacle whatever to the tunnelling of white ants, which thus can readily reach the beams, the interior of which may be entirely eaten away by these mischievous insects without any sign of the mischief appearing externally.

All the above considerations appear at first sight tolerably obvious and would, one would think, be adopted wherever not rendered impracticable by consideration of cost, and yet it is perfectly wonderful to notice how frequently every consideration of common-sense sanitation and comfort is ignored in buildings, on which neither space nor expense have been stinted.

Quite recently the writer halted in a large hotel which illustrated this point in a most pitiable manner. The masonry was admirable, being worthy almost of an Egyptian monument, and speaking generally, it was obvious that expense had been almost disregarded by the enterprising proprietors. The management showed every desire to secure the comfort of their guests, and the cuisine was excellent. In spite of this the bulk of the rooms were scarcely habitable, as they seemed contrived to give a tropical sun the best possible chance to make itself felt. Save for a verandah of paltry width to the magnificent dining-room, these indispensable adjuncts of a tropical residence were absolutely wanting.

Moreover, this omission was clearly not due to any desire or necessity for economising space, for the area absolutely wasted in the form of corridors was astonishing, and could not have fallen short of half the space occupied by the sleeping rooms, though these were exceptionally spacious. Facing south-east, the full glare of the sun and the dazzling reflection from the sea glared directly into the windows of the most desirably placed rooms, without even the protection of an ordinary "jalousie," while the magnificent view was shut out by windows of granulated greenish glass, the sashes being pivoted in such a way as to make it difficult to enjoy either the breeze or the prospect, even when they were opened. Apart from these latter details, the building would be admirably adapted for the accommodation of winter visitors in Italy, where the sun is made to do duty for artificial heat, and the whole is a striking example of the way in which the most lavish expenditure may be rendered futile by a want of due appreciation of the principles that should govern tropical domestic architecture. I give this instance mainly to show that, however self-evident the principles described above may appear, they are far from being generally appreciated.

These principles may be briefly epitomised as follows:—

(1) Through ventilation of all rooms.

(2) The elevation of all rooms, and especially of sleeping chambers, to as great a height as practicable above the ground.

(3) The selection of appropriate building materials which cannot harbour vermin.

(4) The shielding of outer walls from becoming heated by the direct rays of the sun by the provision of adequate verandahs.

(5) The application of the same principle to the construction of roofs by planning them so as to secure a well-ventilated air space between the actual roof and a fairly substantial ceiling, or by constructing them of massive materials, if single.

(6) The admission of sufficient light.

In the case of a house of moderate dimensions, these principles might be carried out as follows :—

Basement of brick arches ten feet high, including a low plinth and thickness of floor. These arches would be utilised for the accommodation of the kitchen, cook room, pantry, lamp room, store room, coach house, and well house, the well being placed beneath the house, and so well protected from any neighbouring fouling of the soil. The platform of the house supported on these arches would be pierced only by a concealed staircase for the use of the sweeper, but this would not be in communication with the other offices, though a hand lift might advantageously be arranged between kitchen and dining room. First floor 18 feet high—dining room, drawing room, office, and one or more bedrooms with dressing and bathrooms communicating with them, if large accommodation is required. Verandah all round not less than 10 feet wide. Second floor, 17 feet in height—principal bedrooms with dressing and bathrooms, some of the central rooms provided with terraced roof; the rest, together with the verandahs, with tiles of good pattern, the rooms having substantial ceilings. On terraced roof—large iron water-tank, with windmill to work force pump from well; small sleeping shelter, and protected with corrugated iron roof, supported on pillars.

It would be well to have the southern verandahs (in the northern hemispheres) of greater width than the others, and to place in them the stairs giving access to the second storey and to the roof.

The first floor would be reached by means of a flight of steps leading from the carriage drive, which might, if desired, be protected by a sloping porch. Such a house would, of course, be somewhat costly, but not much more so than one of equal accommodation constructed on the ordinary plan, and would undoubtedly be far more healthy than those of the usual type.

It is needless to remark that this imaginary residence would be completely protected against mosquitoes by means of metallic gauze, but the point is not dealt with here, as it is fully considered in the chapter on the prevention of malaria.

CHAPTER II.

On Clothing.

THE principles that should guide us in the contrivance of tropical costume may be epitomised in a single sentence. Keep the head cool and the abdomen warm:—and most of the costumes of the more civilised tropical races usually meet these requirements.

It is of course generally true that it is well in matters of costume to take as a general guide the habits of the inhabitants of the country we are visiting; but the recommendation cannot be taken too literally, as, apart from questions of cut and fashion, a too slavish imitation might be as hazardous to health as it would be fatal to decency, as there are places where the Paris fashions consist only of a hoop of cane or a liberal smearing of clay. Nor can the question be lightly solved by simply adopting lighter materials, as, in addition to adaptation to altered meteorological conditions, our dress should be so contrived as to afford protection against certain other dangers which are only indirectly the outcome of climatic conditions, notably against the attacks of mosquitoes, which are now known to be no mere irritating annoyances, but to undoubtedly serve as the carriers of several of the most deadly of tropical diseases.

Moreover, although very pleasant, it is by no means safe to knock about the house bare-footed in countries where scorpions and centipedes, to say nothing of poisonous snakes, are every-day vermin.

The "flannel next the skin" doctrine, too, is applicable only to those blessed with hides sufficiently phlegmatic to tolerate the material; and enthusiasts in its favour are apt to forget that our powers of resistance to extreme heat depend entirely on the healthy action of the skin, so that, if that important portion of our anatomy be kept in a condition of chronic inflammation by "prickly heat," it must necessarily be more or less incapacitated from performing its proper functions.

The substratum of truth that underlies most doctrines, good, bad and indifferent, depends in this case on the fact that in hot climates it is especially important that clothing should be absorbent and porous; but, provided this be secured by the plan of manufacture, the nature of the fibre used is of little moment.

It must be admitted that the well-known Jaeger materials are in all respects admirable for all but the higher grades of atmospheric temperature, but when the thermometer gets up in the nineties, unadulterated wool becomes too irritating for the majority, and an admixture of silk, as in the so-called "Anglo-Indian gauze," is preferable. Pure silk gets too easily sodden with perspiration, and in that state is too good a conductor of heat to form by itself a desirable material, but the combination of the two fibres forms an ideal material for wear during periods of excessive heat.

This material is necessarily rather costly, though it is surprisingly strong in proportion to its weight, and with ordinary care in washing lasts a long time, whereas the cheaper material of mixed cotton and wool is apt to shrink, and hence requires to be frequently replaced.

All materials into the composition of which wool enters, require great care in washing if they are to retain the properties which render them, in one form or another, so valuable in all climates. It need hardly be pointed out that they are at once hopelessly spoiled by a short immersion in boiling, or even very hot water. For the frequently changed garments of European residents of the Tropics little else is required than immersion and rinsing about in luke-warm or cold soap and water, and there is rarely need to guard against their being spoiled by heat, as neither soap nor hot water are much used by persons following the trade of washing in semi-civilised lands; but the severe beating and manipulation to which they subject everything that comes into their hands is almost as effectual in felting and spoiling woollen goods as great heat. It is pretty well impossible to induce a native to so alter his methods as to wash such articles in the orthodox European fashion, unless, indeed, one were disposed to occupy one's time in personally superintending the process; but by cautioning against rough and excessive manipulation, and steadily refusing to pay for articles spoiled, it is generally possible to minimise the evil.

While touching on the subject of the washing of clothes, it may be well to remark, that although personal superintendence of the process may be out of the question, it is certainly important to find out and inspect the place where the washing is done, which in such countries as India and China, and doubtless elsewhere, will too often be found to be some filthy stagnant pool, redolent with the accumulated dirt of all classes of the population. But for the powerful germ-killing powers of the tropical sun to which the articles are subjected in the process of drying, there can be no doubt that disease would be spread in this way much more frequently than is actually the case, but it will not do to trust this natural disinfection too far, and without counting suspected instances of the transmission of really serious diseases, there can be no doubt that the troublesome skin disease known as "dhobie's itch," is often contracted by Europeans in this way. The policy of sparing the imagination by shutting the eyes is, in this case again, a fallacy which may lead to considerable personal inconvenience and perhaps to danger.

If, as is not unfrequently the case, all the public washing places are undesirable, it is well worth while providing the simple arrangements required by natives following this calling within one's own enclosure.

All that is required is a masonry platform about 6 feet square, connected by a channel with the well and enclosed with walls about a foot high, the whole being lined with cement. A short length of metal pipe, capable of being closed with a wooden plug, must be built into the wall at the lowest edge of the platform, so as to admit of the dirty water being drained off. A piece of smoothly-worked plank, about 4 feet by 2 feet, with rounded corrugations athwart it, formed like those of corrugated iron roofing on a smaller scale, is all the additional apparatus required, and I feel sure that these simple appliances would be found much more frequently within our compounds than they are, if Anglo-Indians in general had any idea of the filthy conditions under which their clothing is commonly washed. Of course, such a matter as the cleanliness of public washing places ought to be a matter of superintendence and regulation by the authorities, but as yet everything is usually left to individual initiative, and those who wish to protect themselves must take their own precautions.

A not uncommon mistake of persons making their first sally into these warm climates is to leave behind them all their everyday European apparel, under which circumstances the one or two old suits that were taken to see them through the chops of the Channel and "Bay" become most treasured possessions, for there are very few parts of the world where, at some season or another, our ordinary English outfit will not be found convenient and suitable. Even the "Equatorial Rowing Club" probably find it well to put on their sweaters on returning to Singapore, after a spurt along "the line."

Within intertropical limits no doubt, the occasions on which the garb of temperate climates is required are rare, but everywhere outside them there are ample opportunities of comfortably wearing out clothing adapted to life in Europe. In the Northern Punjab one's heaviest English clothing is required for two or three months in the year, while in South Africa the diurnal range of temperature is so great that a light overcoat is required after sunfall in the hottest time of the year, and even in the Persian Gulf stout woollen clothing is required from December to early March. A glance at the meteorological data furnished in the second part of the book devoted to climate, will give the best idea of what will be required, as it may be taken as certain that in any case where the mean monthly temperature approximates at any season to that of our native island, clothing appropriate to the corresponding season of the year will be desirable.

In choosing a costume for really hot weather it must be remembered that any material requiring to be starched is about as suitable for the purpose as mackintosh sheeting, because linen and cotton fabrics, starched and ironed, are, as long as they retain their appearance, quite as impervious to transpiration. After they have lost their stiffness their appearance is most objectionable and disgusting, and it is a fortunate circumstance that they become so soon sodden, as there can be no doubt, that but for this, their use would be clung to by the conservative Briton, far more than he is able to do.

For this reason the loss of popularity of late years of the old-fashioned white "American drill" clothing, once universally adopted, is hardly to be regretted. Without a considerable amount of starching they never looked fresh after an hour or two's wear, and with it the material ceased to be suitable. It is, indeed, a mistake to provide oneself with clothing of this sort in England, as even "American drill" of the right sort, cannot be obtained, and the light cotton tweeds and checks which are now in use in India do not appear to be found in the home market. It is, of course, necessary to obtain two or three suits for use on the outward voyage, but to obtain more than this, is only to burden oneself with what will, as likely as not, prove to be useless, and perhaps noticeably out of the fashion of the country.

A few shirts of soft cotton "twilled lining," made with turned down collars, like a cricketing shirt, perhaps three pairs of white drill trousers (the material used by merchant seamen and known as "Dungaree" is the most suitable) and an alpaca coat and waistcoat will suffice. Unless one belongs to the clerical profession, the alpaca should be fawn-coloured, or, at any rate, not black, as in this colour the material is a sort of badge of missionary enterprise, and it is embarrassing to be asked to conduct service on the main deck, under false pretences. For the sub-tropical portion of the voyage, light flannel suits, made with as little lining as possible, are most suitable, and will prove useful, in any warm climate, at certain seasons of the year.

In really hot weather, however, if thin enough to be cool, flannel becomes too flimsy to serve for outer garments, and one is practically restricted to cotton fabrics. Of late years a variety of cotton materials have been made in India in imitation of the woollen tweeds in general use in Europe, and have the great advantage that the little deception is all the better maintained if they are kept unstarched.

Without desiring to furnish a gratuitous advertisement to any individual enterprise, missionary or otherwise, I see no harm in mentioning that I have met with no fabrics so suitable for tropical wear as those manufactured by the admirable Basel Mission at Cannanore, and though their energies are presumably mostly confined to the Indian market, I have little doubt they would export parcels if asked to do so.

They have shown great ingenuity in contriving light porous materials, almost indistinguishable at a short distance from those to which we are accustomed at home, and there can be no doubt that the short-fibred Indian cotton possesses certain properties that cause materials manufactured from it to be softer and more absorbent than those made from the harder and longer American fibre. At any rate I can account in no other way for the marked difference that exists between the fabric known as "twilled lining," manufactured in Cawnpore, and what appears to the eye the same article obtained in England, though the latter is by no means to be despised.

It is but ten or twelve years since some bold innovator made the discovery that the cheap and despised "twilled lining" formed an admirable underwear for hot climates, and whoever he may have been, he was certainly a great benefactor to the Anglo-tropical community, for none of the numerous expensive patent materials that have from time to time been brought out, combine the same good qualities to anything like the same degree. It absorbs moisture quite as well as flannel of the same substance, and can be comfortably tolerated by the most irritable skin, while I doubt if it exposes one to greater danger of chilling than any other material of like weight. It can be safely worn next the skin without the intervention of a vest, which is indispensable with the ordinary starched linen shirt, and is, all considered, the best material for shirts, and for pyjamas for night wear, as various striped patterns are made specially suitable for the latter purpose. While speaking of night clothes, it may be well to remark that the ordinary pattern of short coat, commonly worn with pyjamas, is a distinctly dangerous garment, as it is very liable to ruck up during sleep, and so leave exposed the abdominal organs, which are of all parts of the body the most vulnerable to chill. To leave any portion of the abdomen exposed for even a short time while at rest is an extremely hazardous matter, so that in place of the usual coat it is far better to wear a shirt which can be safely tucked into the pyjamas.

I was glad to hear, during a recent visit to India, that the rational and cleanly custom of adopting white for evening dress was again coming into vogue, for even the lightest cloth clothing is undesirably hot, and the idea of wearing, night after night, garments which cannot be washed, in a climate so productive of perspiration, is, to say the least of it, somewhat repulsive.

It is, I understand, now the custom to have them cut after the pattern of the now almost universal "dress jacket," but it is probably better to have them made by an English tailor of white drill, when fitting out, as the cut of the native workman is hardly to be relied on, though he may be trusted fairly well for nether garments. A broad silk sash or kamarband is usually substituted for the waistcoat; and to protect the ankles from the attacks of mosquitoes, which bite easily through a thin sock, it is a good anti-malarial precaution to have the trousers fitted with straps.

For riding, either stout khaki drill or the admirable cotton cords made at Cannanore are most suitable, and they are best cut after the pattern of the very handy "Puttialla" breeches, in which the breeches are prolonged below the knee into a closely fitting extension formed like a gaiter, as this does away with the necessity of wearing the very hot and unsanitary long boot. These garments would also be very useful, either at the Cape on account of ticks, or in parts of Burmah and Assam as a protection against leeches, as in both these, and no doubt in many other localities, these pests swarm so amongst the herbage that it is impossible to go abroad in ordinary trousers unless they be tucked into the socks. It is true that knickerbockers and long stockings will serve the same purpose, but few can bear the irritation caused by stockings thick enough to be worn in this way, in climates of this sort.

Another very suitable class of material for outer garments is to be found in the coarse wild silk that is met with and manufactured in parts of India, under the name of Tussur serge, and I have no doubt that many other parts of the world produce materials equally adaptable to our needs.

The matter of head covering requires special consideration, as there is a quite unaccountable difference as to the risk of sunstroke in climates which, as judged by the thermometer and the brilliancy of the sunlight, appear quite similar.

Accidents of this sort are almost unknown at the Cape of Good Hope; even as far north as Natal, and throughout our colonies there, and I believe also in America and Australia, a broad-leaved felt hat appears to afford quite adequate protection, always provided that it be not looped up in the idiotic "smartness" of an Imperial yeoman's headgear. It is wonderful, too, how European officers contrive to go about in Egypt in the singularly unpractical "fez," which, save as a protection for the bald within the house, appears about the most ill-contrived headgear yet contrived.

To wear one in June in most parts of India, would be certain death to the majority of Europeans, and few could venture to wear it at any time of the year.

For India, however, and other climates where sunstroke is common, a good sun-hat is indispensable, and there is undoubtedly no material that at all equals pith or *solah* for the purpose; and the bigger, the thicker, and uglier, the better it is for the purpose. Thick stiffened felt also answers very well, but is not reliable under extreme conditions, unless made double with an intervening air space throughout. Whatever the material, it is essential that the interior should be well ventilated, and this is most efficiently secured by the hat itself being attached to a comparatively narrow band that encircles the head, by the means of a few widely separated pieces of cork; no lining or other material being allowed to obstruct the passage of air.

The ordinary brass bound eyelet holes and squat top ventilator, so often seen in home-made "helmets," are generally, for all practical purposes, absolutely useless.

Of the various shapes of solah hat in use, I am inclined to think the "Cawnpore tent club hat" is the best. This is made with the brim almost horizontal in front so as not to interfere with vision, and well sloped elsewhere, and is quite comfortable to ride, shoot, or work in. It has been adopted for the troops for tropical field service, but is I notice, already commencing to undergo evolution in the direction of smart inefficiency so dear to the heart of the military milliner.

Constructed as they are of strips of pith glued together, solah hats naturally go to pieces in rainy weather, but this can be obviated by covering with some waterproof material instead of the alpaca, or brown holland, usually used. The padded and quilted coverings to solah hats sometimes seen are absurd, as quilted cotton is far inferior as a non-conductor of heat to a similar thickness of pith, and the padding greatly increases the weight of the head gear.

In case of emergency, the oriental pugaree or turban is a very fair protection, though it requires a good deal of practice to tie it properly. Five or six yards of coarse muslin can, however, be got even in small native towns, and such accidents as one's hat blowing out of a railway carriage, or off the head into a river, may occur to any one, so that the expedient may obviate one's either incurring considerable risk, or submitting to the alternative of returning with one's errand unperformed.

Many persons are well nigh as sensitive to insolation of the spine as of the brain, and suffer at once from the exposure of the back to the sun's rays. I have never personally experienced inconvenience on this score, but know that many find that the sun playing on this part of the person causes a dull, heavy aching :—an oppression rather than pain. Persons subject to such symptoms should wear a broad pad of the same material as the coat, thickly padded with cotton wool. The pad should not form part of the coat, but be made separately to button on, as it is cooler worn thus. Turning to the opposite extremity of the body, it must be admitted that, owing to the entire want of ventilation, our European foot gear is very unsuited for use in hot climates. Every one knows the discomfort that is caused by boots that "draw" the feet, and these symptoms are entirely caused by the comparative imperviousness of leather, as is clearly shown by the greater discomfort caused by patent leather, which is practically air-proof. On this account, shoes are more generally useful than boots, though the latter are required for shooting, or work in the jungle; as shoes do not sufficiently protect the ankle from thorns, or the possible attacks of a snake. During the hot weather, the most comfortable form of foot-gear is a canvas shoe, but as made by the ordinary English shoemaker with leather lining and elaborate leather toe-caps and cross straps, they present no real advantages over an ordinary leather shoe. They should be made of stout but open woven canvas, with no lining except over the stiffener at the heel, and quite without toe-caps or other ornamentation; though the sole should be as stout as that of an ordinary walking shoe, and it is better to choose a brown canvas, as the "blanco" used for giving a clean appearance to white canvas, soon fills up the pores of the fabric and makes it almost as impervious as leather. The Persians wear a sort of ankle boot, the upper of which is formed of knitted twine, and these "málikis," made up on an European last, form ideal "uppers" for hot climates, for they are admirably porous, though so strong that they will outlast half-a-dozen leather "uppers." Can not our European manufacturers devise something similar? In hot wet weather, it is a mistake to try to keep the water out, as the sock, if enclosed in a water-tight boot, will very soon become so saturated with perspiration that one has simply subjected oneself to heat and discomfort to no purpose. Whether for rainy weather, or for wading after snipe, or when fishing, the only desideratum is that the water should be able to run out as easily as it gets in. Provided that clothing is changed as soon as one gets into shelter, no harm need be feared from getting either clothing or the feet wet, as long as one is on the move, in the climates with which we have to do. For the same reason the advantages of a waterproof are very doubtful, the fact being that, with a combination of heat and rain, one is bound to get wet anyhow, and whether the moisture comes from the outside or the inside of our garments is a matter of little moment. One other point in connection with foot-gear remains to be noticed, and that is that as one's feet and hands become a full size larger under tropical conditions, it is necessary that those included in our outfit should be full large; for a shoe so loose as to be almost slipshod in England, will be found to be quite tight when tried on in India. The best way is not to confuse your shoemaker with directions, but to put on a couple of pairs of thick woollen socks and get measured over them.

At night, the main object is to have as little in contact with the skin as possible, so that mattresses of all sorts are best put aside during the hot months and a smooth mat substituted. Most tropical races actually prefer to sleep on a hard surface, such as the floor, during periods of heat, and though few Europeans can habituate themselves to so hard a couch, the majority prefer a cot formed of tightly strained cordage or webbing to the more modern spring bed of woven wire, the yielding character of which causes the surface laid upon to follow too closely the curves of the body. Personally, I prefer the woven wire, covered only with a loosely-made reed mat. Costing only a few pence, such mats may be frequently renewed, and they are far cooler than the fine and closely-woven "China" mats, which are rather costly, and in the finest quality almost impervious to air.

Assuming that one is properly protected against mosquitoes, the feet and chest may be left bare, but a light blanket or rug, folded to about 2 feet wide, should be thrown across the abdomen, as nothing is more dangerous than chill to this portion of the body.

Ladies' costume lends itself more readily to coolness than that of the sterner sex, though its advantages are usually thrown away, by their obstinate adherence to the corset, a garment which is even more pernicious in hot climates than elsewhere. Apart from this, their most common mistake is to err on the side of over-coolness, and medical men who practise in the Tropics are constantly meeting with serious and obstinate cases arising from inadequate protection to the abdominal and pelvic organs.

Ladies too often expose the head to the sun in a most foolhardy way. It may be admitted that a safe sun-hat is not particularly becoming to either sex, but in the presence of the girl graduate, often surpassing her male competitors, no one can doubt that a substratum of brains underlies the golden hair, and this being admitted, it is clearly morally incumbent on ladies not only to make themselves attractive, but to take proper care of thinking organs of such high quality. Besides, a woman with a headache is seldom charming, and a very genuine one—no mere boredom—is too often contracted by the conscientious performance of the quasi-religious duty of paying calls at noon in a picture hat.

Even where a covered conveyance is available—and many of us do not run to anything more ambitious than a dog-cart in the East—it is quite possible to contract a headache in crossing a pavement, and when a lady drives herself, it is almost impossible for her groom to so hold an umbrella over her as to afford protection, without obstructing her view. On this account, it is better that on such expeditions she should submit to be driven, so that she may have her hands free to carry an umbrella or sunshade; and it is well to remember that a fairly large sunshade with a padded cover is really more efficient than the largest single umbrella, or even one provided with the customary thin outer white cover.

Mothers have a general tendency to overclothe their children. Provided that the abdomen be properly protected by a flannel "binder," the less they are hampered during the day the better. A child's extremities rapidly become clammy if it be inadequately clothed, and as long as these feel comfortably warm, nothing but harm can result from stifling them with coverings which cause prickly heat, with attendant loss of rest and all the evils that result from chronic nervous irritation. Above all things, the face should never be covered, even with a handkerchief, in the case of the youngest of infants; as this pernicious fad of nurses and mothers necessarily leads to the rebreathing of air already rendered impure by passing through the lungs, than which few things are more destructive to health, even in adults, let alone in an infant, where the rapid chemical changes involved in growth and development demand a supply of oxygen proportionately far in excess of that required by a grown-up person.

In children much troubled with prickly heat, who have reached the age of intelligence, a pair of silk drawers should be worn under the binder; and during the day, and at night under the mosquito net, nothing more than this is really required. At dusk, when they go out for their airing, and at any time when mosquitoes are in evidence, their costume should be contrived so as to protect them from the attacks of the insects as far as possible.

In countries where ophthalmia is common, protection from flies during the day is almost as essential as against mosquitoes at night, and if the child falls asleep it should at once be placed under a mosquito net, as the eyes of children seem to have a peculiar attraction for flies, and there can be no doubt that these insects are often instrumental in carrying infectious matter from the eyes of the diseased to those of the healthy.

CHAPTER III.

On Water and Food.

THE importance of attention to personal hygiene in the matter of what to eat, drink and avoid, may be judged by the fact that three of the greatest scourges of tropical life—cholera, dysentery, and typhoid fever—are conveyed exclusively by the agency of germs that find their way into the body along with ordinary articles of diet; and even putting aside diseases of so dramatically striking a character, bad food, careless cooking, and impure water may set up such minor troubles as dyspepsia, with all its prolonged attendant miseries of body and mind. Those who do not die from an attack of cholera or typhoid usually recover fairly completely, but he who has once suffered from a bad attack of dysentery is as truly lamed for life as if he had suffered mutilation of a limb.

Accidents will, of course, occur, whereby the most careful precautions are frustrated, but putting aside such contingencies, it is quite possible to guard oneself against either of the above diseases by proper care and attention; and those who know how to take care of themselves may carry on their duty, with but little apprehension, while encamped in the midst of a cholera epidemic, which makes it no uncommon occurrence to find in the morning several pilgrims dead of the disease within a few yards of one's tent. On one occasion, my camp arriving after dusk, I found in the morning that my tent had actually been pitched over a new-made grave; but cholera cannot be caught by promixity to either the dead or dying, but only by the fouling of what enters the mouth, so that I was more disgusted than alarmed at the gruesome discovery; whereas I should have been decidedly uneasy for the next day or so, had I discovered that I had unwittingly swallowed either water or food that had not been rendered harmless by cooking. There is one point, moreover, about the necessary precautions, and that is that they must be carried out, or at least superintended, personally; for neither natives nor even the lower class of Europeans can be trusted to carry them out, because, not understanding the reason of them, they are too apt to scamp the business; and, as a matter of fact, neglect that would discredit a native dairyman has more than once, to the writer's knowledge, occurred in regimental dairies, where every operation was supposed to be either conducted or superintended by European soldiers.

One of these little incidents, due to sheer laziness and direct neglect of duty, cost nearly fifty lives, for it more than decimated the wing of the corps in which it occurred. The method in which this terrible catastrophe was brought about is worthy of record, as an instance of the way in which lives are sacrificed by a lack of attention to such details.

The water supply of the station was excellent and all water used in the dairy was supposed to be drawn from a standpost. Unfortunately, there was a well on the dairy premises, and the soldiers in charge were too lazy to prevent its being used. One of the native dairymen lived in a village which was attacked with cholera, and like all Hindoos, had a special vessel for drinking water. This vessel he used, of course, at home, and also during the day, to get himself a drink from the well in the dairy. He remained himself free from disease, but the germs of cholera were carried, adhering to his lotah, or drinking cup, from the infected village well, to the dairy well, and this, in its turn, infected the milk stored in vessels which had been washed in the well water, with the terrible results already described.

The remote fault, of course, in this case lay with the authorities, who should have seen that no alternative, and more easily obtained, water supply was available; for no one who knew much about either the native, or Tommy Atkins would have any doubt of the less laborious source of water supply being used the moment the eye of authority was off them. As a matter of fact, the quality of the well water was usually excellent, and its only fault, that it was not guarded against contamination, so that not understanding the subtle mechanism of infection, both soldier and native naturally regarded the journey to the more distant stand-post as a mere unreasonable infliction.

The piped water supply ought, of course, to have been brought into every room of the dairy, but "spoiling the ship for a pennorth of paint" is a very common cause of failure in attempts at sanitary reform in India.

I have given this incident at some length, because it affords a good example of the way in which lives are sacrificed by a want of attention to the details of sanitary management, and because, although it occurred in a public institution, and the fatality was on a correspondingly large scale, it is an equally good illustration of the way in which infection finds its way into private households.

Let us now proceed to the consideration of the various articles of supply, commencing with water.

As a rule, in our dependencies and settlements, water supply is of a private character, as only a few of the larger towns enjoy the advantages of public waterworks. Even where this is the case too, it is not always safe to trust entirely to its purity, as in many places the arrangements are not such as to ensure safety, and it is only in towns where the waterworks are large modern instalments, with proper filter-beds, under the constant supervision of an adequate European staff, that it is safe to forego the systematic sterilising of the water. In India, for instance, while the supply of Allahabad, Cawnpore, Lucknow, and most of the other large towns is probably a great deal above the European average, the mere fact of the supply being laid on in pipes is by no means a guarantee of purity. In Naini Thal, a considerable hill station, for example, the supply is pumped directly from a lake without filtering, close to the spot at which the drainage of a filthy native bazaar is allowed to flow into it. When living, then, in a place where there is a piped water supply, it is well to ascertain if filtration is properly carried out, and if not, to treat the water with the same suspicion as that derived from any other doubtful source.

Where water of undeniable purity is laid on, all that has to be attended to is the method of transport from the nearest standpost to the house, for it is as yet extremely exceptional for pipes to be carried right into buildings as is the practice in Europe, so that a special servant as a water-carrier is still a necessity in India, even in large towns. In this case, and indeed whatever may be the source of supply, it is of the greatest importance that nothing but metal vessels, so constructed as to be easily cleaned, should on any account be used. In all Mahomedan countries, water is conveyed in a goat or calf skin, stripped from the animal entire, with the legs tied up, and filled from the neck, which is secured with a thong for transport; and it is a most unfortunate circumstance that it has become traditional for Europeans to employ the Mahomedan *bhisti* with his *mashak* instead of the more cleanly Hindu kahar with his easily cleansed iron water vessel, for the Mahomedan water-skin or *mashak* is an abomination that cannot be too strongly condemned. Few will, it is thought, deny that if a piece of half-tanned hide were found lying in water intended for domestic uses, they would at once reject it; and apart from the objectionable character of the material of the *mashak*, it must be remembered that from its construction it is absolutely impossible to clean the interior; and this must necessarily become foul in the course of a few days' use, even if it were constructed of silver instead of half-dressed hide. Added to this, it has been ascertained, by actual experiment, that disease germs, deposited on the outside of a water-skin, are capable of growing into and working through it, and so continuously contaminating the contained water. Anyone who knows the ways of the *bhisti* must be familiar with the careless way in which his *mashak* is laid down on the ground anywhere that may come handy, so that it cannot fail to get frequently fouled with germs of all sorts, which, owing to the vessel being composed of organic material, find themselves at once placed on a "culture medium" as congenial to their growth as if prepared in a laboratory.

The above reasons, it is thought, should suffice to show that no leather vessel should on any account be tolerated in connection with our water supply, and it may be added that there is no difficulty whatever in substituting cleanly metal buckets for the abominable filth trap that has just been described.

While the Hindu holds the wholesome belief that contact with leather means utter defilement to water, and would very probably die at the stake rather than drink from a *mashak;* the use of the latter by the Mahomedan is purely a matter of custom, in no way connected with religious sanction, so that in hospitals too small to afford a double establishment, a Hindu water-man alone is entertained, because no Mahomedan can object on the score of religion to taking water from any cleanly vessel or from any one's hands, so that though a bhisti can serve the Mahomedan alone, a *kahar* can serve both castes.

For many years before leaving India the writer insisted on the use of metal buckets for carrying his household water, a pair being carried slung from the ends of a bamboo balanced on the shoulder; and it never became necessary to dismiss the Mahomedan water-carrier, as he always proved ready to adopt the change, as soon as he discovered one was in earnest in the matter, and that any infraction of the rules meant instant dismissal.

There are no more hard-working and better servants in India than the *bhistis,* who are deservedly, as a body, great favourites with the European community, ever ready to put their hand to anything. One who once served me for several years used often to act as factotum on short expeditions, cooking my food and waiting at table, and finally, as no groom was available at the last moment, marched one of my horses from one end of the Punjab to the other by himself, and brought it in in good condition. With willing and obliging men of this sort, it is naturally easy, by a little insistence, to ensure the adoption of any plan that does not actually clash with their religious beliefs—and I can assure my Anglo-Indian readers that they, too, will meet with no difficulty in introducing this important reform, provided they show clearly from the first that they mean to be obeyed. It is rarely even necessary to threaten to entertain a Hindoo *paniwalla* in the *bhisti's* place, for as a race they are of the most amenable.

Putting aside public water supplies, the usual sources are wells, rivers and springs. Of these, the first are, in most parts of the world, the most common form of private water supply, and, speaking generally, they are by far the most reliable, for save in most exceptional cases, the pollution of a well always takes place from above. It is, of course, most desirable that the upper part of the well tube should be lined with impervious cement, but provided a reasonable amount of care be taken to prevent the surface of the ground near the well becoming fouled, little danger is to be apprehended from dirty surface water gaining admission to the well, for there are few better filters than a few feet of ordinary soil. The ordinary filter, employed in large waterworks, consists of nothing more than a few feet of sand, and it is well known that, when in good working order, such filters rival even the Pasteur biscuit porcelain filter in their power of excluding germs.

Now to reach the interior of a well by any other route than through its mouth, water must needs pass through a much greater thickness of soil than is ever used for the filtration of water on a large scale, and hence, provided the mouth of a well be protected, its water may be used with the greatest confidence.

At first sight, it appears that nothing should be easier than to provide the well with a water-tight cover of some sort, and draw all water by means of a pump; and wherever the water lies sufficiently near the surface, and the means of keeping a pump in repair are at hand, there can be no doubt that there can be no better plan. Very often, however, wells are so deep as to necessitate the use of a force pump, in which case, unless long connecting rods are used, which are very apt to get out of order, the pumper has to work half-way down the well, a necessity which introduces new difficulties and dangers.

In places where pumps cannot be readily repaired, it is useless to attempt the adoption of this method of raising water, and one must trust to other means of protecting the supply. The mouth of the well should be raised a foot or two above the level of the ground by building a masonry drum, wide enough for the person drawing water to stand on, and well sloped, so that slopped water runs off, and not back into the well.

It is further highly important to protect the well from drifting leaves and dust, and also from being used by strangers and passers-by. This is most easily effected by building a well-house over the mouth of the well, provided with a door, for even if this is not kept always locked, it at least serves as an intimation to outsiders that the well is not public property, which will probably be generally respected. As the well-house may be of the simplest material and construction, the cost of one need be no bar to the adoption of the plan; for the shelter will always be of small dimensions, and can be built with walls of sun-dried brick and a thatched roof, or even of grass screens throughout.

A single metal vessel and rope should be provided, which should never be removed from the well-house, and no other vessel should be permitted to be lowered into the well on any pretence; for the practice of each person carrying about his own drinking vessel and string provides the mechanism whereby cholera is carried from one place to another in the majority of outbreaks of that disease in India. If possible, only a single servant should be employed to draw water, and he should be provided with a padlock and instructed to keep the door locked. Very probably the door will often be left open, but it is something gained if it be locked for some hours in the day, as the fact of finding the door even sometimes locked will serve to show outsiders that the use of the well by them is regarded as a trespass.

Provided that the entry of leaves and other even more objectionable matters be prevented in this way, a well should require but little attention, though it may be useful to occasionally purify it, especially if it has been out of use for some time, by treatment with permanganate of potash in manner described below.

Where a well is persistently foul, it may be taken as certain that this is due to prolonged neglect and insufficient cleansing; for when, as is usually the case, no attempt is made to guard a well, so much dust and rubbish of all sorts gain admission that it requires to be emptied and thoroughly cleaned out, down to the soil in which it is excavated, at least once a year, and the expense of doing this will be found to be at least as great as the construction of a well-house of inexpensive materials. When the water of a well has been obviously offensive, the actual soil at the bottom of the well should be dug out for two or three feet, and fresh, clean river sand substituted. After the well has refilled, it should be treated once or twice with permanganate, and the water will then usually be found to be restored to good condition.

To purify a well by means of permanganate of potassium, take from 2 to 4 ounces of the chemical, according to the size of the well, the larger quantity being required only in the case of the enormous wells 10 to 12 feet wide that are occasionally met with; draw a bucketful of water and dissolve the permanganate in its contents by stirring with a stick. Lower the solution into the well, and flounce the bucket about in the water till the permanganate is thoroughly mixed. Permanganate attacks the organic matter present in the water, on which the disease germs and other micro-organisms feed, and so kills them by starvation, besides which the brown precipitate which is formed carries down with it much suspended matter. This process is of especial value in destroying the cholera microbe, and when moving about in camp, it is an excellent precaution to send on a man two days in advance to disinfect in this way the wells that will be used in each camp. If the amount of permanganate used be sufficient, the water should still retain a faint pink tinge after twenty-hours, and should have another day's rest to settle before being again taken into use. The purer the water, the longer will the pink tinge persist, while on the other hand, the rapid disappearance of the colour is an indication of great foulness, and of the necessity for the application of a further supply of permanganate.

The water of large rivers is usually fairly reliable, provided the water be got from the full current and not from a backwater, but is often very turbid from fine sand and other mineral matter. In such cases, the water may be cleared by stirring it round with a crystal of alum; after which the suspended mineral matter will sink to the bottom in the course of an hour or so. The manner in which the alum acts is not clearly understood, as the amount dissolved is so small as to be insufficient to affect the taste of the water or to do any harm, even if it be consumed for a long period. The action of the alum, too, is far more efficient than that of any ordinary filter, completely clearing glacier-fed water turbid with particles of such extreme fineness that they will pass anything except the biscuit-porcelain, or Pasteur, filter. Alum may also be used for disinfecting wells when permanganate is not obtainable, about twice the weight of alum being used, but it is not as reliable; and in case of need, lime may be used, 40 or 50 lbs. of well-slaked lime being thrown into the well, and thoroughly mixed with the water by keeping it disturbed for some time.

The water of small pools and marshes should be avoided, and even springs should be regarded with suspicion, unless some idea can be formed as to the origin of the water. If this be from a deep source, it may of course, be safely used, but care must be taken not to mistake surface drainage that has oozed a short distance under ground for a true deep spring. Caution in this matter is especially necessary in hill country; and in doubtful cases it is well to get water analysed by an expert before adopting it as a permanent supply, for it is noteworthy that some springs of the highest reputation have been shown to be extremely impure, the sparkle of their waters being really due to their being charged with the gases of decomposition.

Not unfrequently, however, the tropical sojourner has no choice as to his water supply, and must make the best of perhaps a very bad source. Under such circumstances, all water used for drinking, or in the preparation of food, must be specially treated so as to remove or destroy any of the germs of disease which it may contain. It is desirable, though very difficult, to treat water used for bathing in the same way, but as a rule, one has to be content with taking every precaution against such water entering the mouth.

Ordinary filters, it must be clearly understood, are not only useless, but even worse; for the moist filtering agent, clogged as it is with the coarse organic and inorganic *débris* that it has strained out of the water, is quite capable of acting as a cultivating medium for microbes, on which they can multiply so enormously that however clear the water may appear to the eye when it issues, its really dangerous impurity, so far from being diminished, has been enormously increased. There is only one form of filter that can be trusted to remove the minute organisms that are the active agents in the progagation of disease, and that is that in which the water has to pass through a piece of biscuit porcelain, the pores of which are so excessively minute that even the smallest of the bacteria are excluded. The employment of such filters on a domestic scale is, however, extremely difficult, for they naturally act so slowly that a very large appliance must be used to secure an adequate supply. Added to this, their efficiency depends on the perfection of a number of rubber connections, a material which deteriorates very rapidly in hot climates, and except by the increased rapidity of flow, it is not very easy to detect the fault. In any case, they should never be used except under constant personal care, and one way and another, they require a good deal of attention; besides which they are heavy, and quite unsuitable for camp or travelling. On the other hand, boiling for a few minutes gives a security quite sufficient for practical purposes, and requires no more formidable appliances than an ordinary kettle or saucepan, which are available everywhere. I am perfectly aware that certain spores will sometimes survive the treatment recommended, but the objection is rather academical than real, and so far as I know, in the actual practice of daily life no instance of the conveyance of disease has ever been traced to the use of boiled water, so that I have always been accustomed to recommend the adoption of this plan in preference to all others, in all cases where the water supply is not absolutely above suspicion.

One caution, however, is necessary: always personally to see that the water boils; for, apart from absolute deception, servants often really do not know when water has actually reached the boil, as most housewives know from experience of the spoiling of their "dish of tea."

There is no need to stand over the man and watch the process however. A portable stove should be brought into the verandah, and the servant should be instructed to let one know when it is boiling, so that a moment's inspection suffices to satisfy one of the fact, which, after all, is not a very formidable addition to the day's work.

The water should be covered so as to protect it from dust and insects, and put aside to cool. If a *sorhai*, or porous water bottle, be used for cooling, it should be frequently washed out with strong permanganate solution and occasionally boiled, as it is difficult to keep the interior of these vessels clean, on account of their rough surface, and impossible to see whether they are so or not. It should be remembered, too, that it is as essential to have pure water on the toilet table for cleaning the teeth, as it is for drinking purposes, as the quantity of poison introduced into the system is of comparatively little importance, in the case of the virus of infective diseases, which have the power of multiplying within the system.

When travelling, it is a good plan to have an ample supply of tea brought for the early morning meal, usually taken before dressing; and to use what is left for cleansing the mouth instead of water. After standing as it thus has, the tea contains a good deal of tannin, and so forms an excellent mild astringent mouth wash, which makes it in some respects an improvement on plain water.

By far the greater proportion of the water consumed by Europeans in hot countries is, however, drunk in the form of aerated waters, and very frequently little or no care is taken in their manufacture, even when it is carried out by European firms in a large way of business. There can be no doubt that where the business is conducted on a large commercial scale, the water used should have been passed through suitable bacteria-proof filters; but in one of the few instances I have met with where this was even professed to be done, the filtering plant was obviously absurdly inadequate to filter more than a small percentage of the supply turned out by the firm. If such is the case with large and responsible European concerns, the character of the article turned out by the small native factories can easily be imagined. It would be hopeless to expect much improvement from the latter, but if consumers insisted on a guarantee that the water had been sterilised, in the case of the European factories, there can be little doubt that, before long, a safe supply would be put on the market to meet the demand.

Of late years the practice of aerated waters being manufactured by clubs and regimental institutions has enormously increased, but it must be remembered that, except as regards the avoidance of the coarser grades of filth, there is little or no advantage in this, unless the water supply of the factory be religiously guarded against pollution. As in the case of small institutions the amount of European supervision that can be given is but small, it may be doubted if much is likely to be gained by any attempts to sterilise the water either by filtration through biscuit porcelain or by boiling. The difficulty of cooling the water is an insuperable obstacle to the adoption of the latter expedient on even as large a scale as is required for a small club, for to make good aerated beverages the water must be as cool as possible. Quite recently the writer went over a station factory to try and ascertain why the "soda" was so feeble. Installed in a corner was a bath warmer capable of warming some forty or fifty gallons of water sufficiently for bathing purposes, but quite incapable of boiling so large a quantity under any circumstances, and indeed, not constructed with the view of doing so. This appliance had been installed by some previous zealous reformer, with the view of sterilising the drinks of the station, but he had never been at the pains of ascertaining if it was really capable of bringing its contents to the boiling point.

The murder was out:—the club soda had been systematically made of luke-warm fluid, tainted with the indescribable flavour of half cooked water. At the well a number of *bhistis* were chattering with a wandering *faqir;* and if his *lotah* had not been let down, the last time it was used, into a cholera-infected well, it was no fault of the arrangements. As the health of the entire European community depends on the purity of this well it should surely be worth while to make some attempt to secure its purity. It is quite true that the building of a well-house with a locked door might not ensure the absolute exclusion of unauthorised intruders, but an occasional surprise visit would go far to ensure a very general, if not complete, obedience to orders; especially after detection of neglect on some occasion had been followed by prompt dismissal of the responsible servant, and after the prompt destruction of any unauthorised water skins found in the well house. It is no more difficult to secure the locking up of a well, than it is to check peculations of club stores, provided that equal attention be devoted to the matter. No one expects absolute success in either task, but there can be no doubt that ill-gotten gains are successfully reduced to a minimum in most well-managed institutions; and surely our lives are as important as the curtailing of our club bills to the extent of a few shillings per mensem. Besides, to put it on a mere commercial basis, an attack of typhoid is a most expensive luxury, even apart from its dangers. After all, a doctor and two trained nurses for a month, followed up by an unostentatious funeral, cost something, and a very small proportion of the energy that is devoted by zealous honorary secretaries to thwarting the efforts of the club "bearer" to appropriate kerosine would go far to keep a well free from pollution. In places where no reliable aerated water is obtainable, there is no longer any necessity of drinking the more than doubtful fluids bottled in some dirty corner of the bazaar, as there is no longer any necessity for any complicated plant for the purpose.

At the present day, carbonic acid, compressed in steel cylinders, can be obtained at all large centres, and the attachment for filling bottles costs so little, and the method of using it is so simple that there is no difficulty whatever in making aerated waters at home, no skill whatever being required in the process.

The germs of certain diseases, such as cholera, are killed by the prolonged action of carbonic acid under pressure, and on this account, it is a good plan to keep a stock of aerated waters for a week before using them, but it must be understood that this is no protection against many other diseases, the majority of their germs being unaffected by carbonic acid.

In the matter of food supply, the main points that require attention are that it should be not only well, but also thoroughly, cooked, as only in this way can the destruction of disease germs be secured. Further, cooked food put aside for subsequent consumption should always be carefully protected from the access of insects. No one who has noticed how flies are attracted by filth of all sorts, and their omnivorous liking for food of every kind, can doubt that they must necessarily occasionally befoul food with the filth on which they have been battening but a few moments before; and in all probability both cholera and typhoid fever are not unfrequently conveyed in this way. Many articles of food, such as soups, jellies, and milk puddings, form ideal "cultivating media" for disease germs, as their composition is practically the same as the materials that are artificially prepared for the purpose in the bacteriological laboratories; so that if food of this sort be accidentally inoculated by an insect fresh from feeding on some dangerous form of filth, it may, in a few hours, become a teeming mass of microbes of the most virulent character. On this account a liberal supply of wire gauze dish covers should always be provided by the careful housekeeper in the tropics, and no cold food should ever be put aside without being covered in this way, unless it be placed in a large safe constructed of the same material, of which one or two should form a part of the furnishing of every tropical house. For camp use, receptacles formed of strong, closely-meshed, hand-made cotton netting, kept extended by means of hoops of cane, are very useful, as they collapse and occupy little or no space on the march. It is almost needless to remark that a cool airy spot should be selected for the larder, and that all safes, covers, &c., should be scrubbed out at frequent intervals with soap and water, to which a little boracic acid may advantageously be added.

After these preliminary remarks it will be preferable to consider separately the selection and treatment of the principal articles of food.

Milk.—Owing to the fact that, apart from the question of deliberate adulteration, a certain amount of the water used for cleansing and rinsing vessels, &c., generally gains access to milk, it is always open to contamination in the same way as the water supply; and as milk forms an excellent cultivating medium for many sorts of bacteria, their multiplication to a dangerous extent is a very easy matter, so that there is probably no article of food which is so often concerned in the transmission of disease.

The conditions under which cattle are stalled and the milk collected, in the more or less imperfectly civilised countries with which we are concerned, are usually filthy to a degree; and hence it may be laid down as an universal rule that unless one's dairy is under one's own personal supervision milk should always be either boiled or systematically "sterilised" before using. There are a number of excellent appliances in the market for sterilising milk, and as directions for their employment always accompany them, it is unnecessary to occupy space with any instructions as to their use.

Unfortunately it is by no means certain that boiled or sterilised milk is as wholesome and digestible as the natural untreated article, and that there is a distinct, and slightly disagreeable, alteration of taste cannot be denied. It has been asserted that infants fed exclusively on sterilised milk are liable to be attacked by a form of scurvy, though it does not appear quite established that the possible sophistication of the milk in other ways has been excluded in the instances that have been reported, and it is undeniable that large numbers of infants thrive excellently on milk so treated. In any case, the risks of harm accruing to either infants or adults from the use of sterilised milk are absurdly small in comparison with those with which they are threatened by the consumption of milk, produced under conditions over which no supervision can be exercised.

Apart, moreover, from the dangers of filth and infection, the milk supplied by native cow-keepers is nearly always of poor quality owing to niggardliness and ignorance in the feeding of the animals, which are either kept stalled under foully unsanitary conditions, or, on the other hand, may be left to wander about and pick up a living as best they can. When pressed by hunger, there is no fouler feeder than a cow, and it is a dismal fact that, in the polity of an Indian village, the cattle rival the pigs in their efficiency as scavengers, so that from the mere point of nicety it is well, whenever possible, to keep one's own milch cattle. Cattle kept for milking should always be as carefully groomed and bedded down as one's most valued horses, and before milking the udders and the hands of the milker should be carefully washed. When it is impossible to keep cows, there is often no difficulty in keeping goats, one or two of which will easily supply sufficient milk for use with tea, in which alone the altered flavour of boiled milk becomes disagreeably perceptible. Goats are extremely hardy, and being naturally clean feeders, require far less attention than cows, while the flavour of their milk in tea is preferred by many to that of cow's milk. They stand marching well too, and are therefore better suited for use in camp; and as their favourite food is the leaves of bushes they may be trusted to find their living to a great extent as they trot along on their way from camp to camp. Usually their milk agrees excellently with infants, but there can be little doubt that asses' milk is superior for this purpose.

It is quite a mistake to imagine that it is a sufficient precaution to have a cow brought to the house and milked in one's presence. Various expedients are known to all cowkeepers whereby the richest part of the milk can be reserved for butter making, and apart from the knowledge of physiological facts which enables this to be done, the native cowkeeper is capable of performing certain small feats of legerdemain by which the milk may be pretty freely diluted under the very eyes of his European customer.

Well aware of the "sahibs'" absurd fad for cleanliness, a native cowkeeper I met with utilised our weakness in that respect to perform a very clever trick. He always brought with him a bowl of clean water, with which he ostentatiously washed the udders of the cow, and while milking, on the pretext that a cool hand was necessary for the process, he occasionally dipped his really well washed hands into the bowl. Hidden in the palm, however, was a piece of sponge, which was squeezed against the udder in the action of milking, so that its contents mingled with the milk as it jetted into the can, and by frequently repeating the cooling process, he was able to dilute the milk to a very profitable extent. It is well, therefore, to occasionally test the quality of milk, and this is better done by noting the depth of cream that rises in a given long, narrow glass, than by any of the so-called lactometers, as they really only test the specific gravity of the milk, as they affords no sure index of the amount of fatty matter present, and it is on this that the main nutritive properties of milk depends.

For the use of infants on voyages, unconcentrated sterilised milk should always be used, as it is much less altered by the process than is the case with the "condensed" article, even when the latter is honestly and carefully prepared. This, however, is far from being even generally the case, as very often the milk has been skimmed before concentration, and large numbers of cases of malnutrition among infants are due to this cause, as the material lends itself easily to the perpetration of despicable frauds of this sort, which appear to be sometimes practised even by large and much advertised concerns. In the case of unconcentrated sterilised milk on the other hand, the substitution of skim milk can be detected at a glance.

Butter.—Containing as it does a considerable proportion of unaltered milk and whey, butter is open to the same dangers as the milk from which it is prepared, and it is therefore equally risky to obtain it from uncertain sources, so that, where these are doubtful, it is better to have it made in the house.

Butter can be easily made on a small scale, by shaking cream in a wide-mouthed bottle, or by beating it with a fork, and as it tastes none the worse for being made from boiled milk, and the poorness or otherwise of the latter only affects the yield of butter, there is no need of any great caution as to the source of supply for this purpose. It should be needless to remark that all vessels used for setting the cream and for other purposes in the process should be kept scrupulously clean, and be frequently scalded, as success is impossible without minute precautions in this respect.

Buffalo milk is nearly twice as rich as the milk of even the best humped cattle, and is therefore to be preferred for the purpose of making butter. There is a silly prejudice against the use of buffalo milk among Europeans in India, but it is really far superior to that supplied by the local breeds of cattle, even when well fed and carefully kept, and the only objection that can be fairly raised to butter made from it, is its absolute whiteness, which, however, is easily modified by the addition of a little harmless colouring matter. I have often been much amused at guests remarking on the excellence of the butter they were eating, who were convinced they could detect the least taste of "that nasty buffalo butter," which in reality they were consuming with the greatest gusto all the while. In spite of her uncouth appearance, the buffalo cow is a nicer feeder than are the Indian humped cattle, and it is well known that the flavour of milk is greatly affected by the character of the animal's food.

Tinned butter is generally quite wholesome, but is, strictly speaking, not butter at all, but *ghi*, as the material is necessarily melted in the process of tinning.

Cheese.—I cannot recall any instance of cheese being incriminated as a carrier of disease. This product is really the result of the action of certain special microbes on milk; and it is probable that any micro-organisms of a dangerous character that may chance to be present in the milk employed in its manufacture, are crowded out and destroyed during the vegetative changes that determine the production of cheese. Tinned cheese, though often of inferior flavour, is usually quite wholesome, and is quite good enough for made dishes. Used as cheese is by the Italian housewife as a flavouring agent rather than a food, it may be used in the concoction of a great variety of dishes having macaroni, rice, or vegetables as their basis, and is invaluable used in this way to impart a variety to the rather scanty menu available during the hotter months, when eatable meat is often almost unobtainable; and from considerations of health, it is desirable to reduce the amount of this form of nourishment.

Meat.—The meat obtainable in hot countries is usually greatly inferior to what we are accustomed to in England, although it may be doubted if it be any worse than the average supplies of most parts of Europe.

The animals are much smaller, a cleaned carcase of mutton weighing often no more than 30 lbs. in the East; and the same remark applies, in a smaller degree, to beef. Prime meat, such as alone satisfies the English market, can only be produced by careful stall feeding, which is an expensive process in any part of the world; and it is a mistake to suppose that such meat can be produced very much more cheaply in one part of the world than in another, as its cost depends on that of grain, which in these days of rapid communication, has a tendency to equalise itself throughout the world. The meat supply, available in the local markets, is usually simply grass-fed, and none too well nourished at that, so that it is usually stringy and of poor flavour, though very cheap as compared with European prices; and people are apt to grumble at the much higher price demanded for specially grain-fed meat; but the better article is well worth the extra cost from the health point of view, so that when local enterprise fails, it is very desirable that European residents should combine to supply themselves.

In India co-operations of this sort are usual in the smaller stations, and are known as "Mutton Clubs." To get the animals into anything like good condition, they must be grain-fed for at least four or five months, so that the club must start with at least forty to fifty sheep for each four members, and this number must be kept up by fresh purchases as soon as killing is commenced; it being usual for each member to be apportioned a quarter twice a week. A shepherd has, of course, to be entertained, and the butcher paid for slaughtering and preparing the meat, so that the cost seldom falls far short of the best English meat; but mutton thus fattened can hardly be surpassed, and it must not be forgotten that wholesome food is no less essential to health than pure water, so that the plan might with advantage be adopted in other similarly situated communities.

Neither veal nor lamb are, as a rule, very satisfactory, as the condition of the parental animals is rarely good enough to enable them to get their progeny into plump condition, and pork should certainly be avoided, except in the highly salted and smoked form of imported ham and bacon. Even in temperate climates pork is very liable to those peculiar forms of decomposition, barely perceptible to the nose or eye, which give rise to ptomaine poisoning; and the risk of accidents of this sort is obviously much greater in hot latitudes.

Poultry, like meat, in the countries with which we have to deal, nearly always requires to be fed up at home before killing, and there is as a rule no difficulty in doing so, as space is usually ample, and the birds require but little attention. It should not be forgotten that scraps from the table are invaluable for fattening poultry of all sorts—odds and ends of meat being specially valuable.

It is important that meat should be hung long enough for it to become tender before cooking, and as the changes that bring about the wholesome softening of meat are quite distinct from the operations of the bacteria that are concerned in ordinary decomposition, it is possible to do this even in the hottest weather provided that means are taken to suspend bacterial action.

"Wyvern" in his invaluable "Culinary Jottings from Madras,"[1] a book which should be possessed and carefully

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[1] Calcutta: Thacker, Spink and Co., 1885.

studied by every tropical housewife, concludes with what he terms "The last and most worthy recipe of all." "It is not generally known that the fumes of sulphur prevent the rapid decomposition of animal matter and that tender meat can be had, in the hottest weather, by exposing the joint to the fumes of burning pastiles in an air-tight box for two or three hours after being brought from market. A joint thus treated will keep perfectly for thirty-six hours, even in Madras, and will be found deliciously tender the day after it is purchased. Take—sulphur, 2 lbs., powdered charcoal, 1½ oz., saltpetre, 2 oz.* Mix, and add just enough gum water to shape them into pastiles of conical form. A roomy tin-lined packing case, fitted with hooks to suspend the meat, and with a well-fitting door, which can be easily made air-tight by means of strips of felt nailed round the edge, is all that is required. Suspend the meat, place two or three pastiles below it, light them, close the door securely and leave well alone." The writer has personally tested this plan, and can answer for its excellence; and also that, once the appliance has been obtained, its use involves, practically speaking, no trouble whatever, as it is just as easy to store the meat in this way as in an ordinary safe.

Under the debilitating influences of prolonged heat the digestive powers are never too strong, so that it is taxing them too far to ask of them to digest the quasi leather that has to pass for meat in tropical weather, unless measures of this sort be adopted; and health, it must be remembered, depends largely upon good digestion.

In the countries with which we are concerned, meat should always be thoroughly cooked, no portion being left showing the red of unaltered blood, as the persistence of the red colour shows that the meat has not been raised to a temperature sufficiently high to kill internal worms. Out of the many hundreds of carcases that I have examined in India and at the Cape, I cannot recall finding even one absolutely free from the encysted parasites that develop in man into tapeworms; and it is well-known that the same is the case in Australia and most other warm countries;

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* These pastiles can be made up by any chemist, and used to be stocked by Waldie and Co., of Cawnpore.

besides which it is very doubtful if meat is really more nutritious or digestible, when eaten "raw." All parasites of this class however, are killed by a temperature of 140° F., and as the blood contained in the meat turns brown at this heat, no risk is run, provided it has lost its pink colour.

Eggs, whether consumed raw or cooked, are perfectly safe as long as they remain in good condition; and so may be relied upon greatly where supplies are of doubtful quality. It is useful to remember that they keep much longer if the shells be well smeared with oil.

Fish.—On account of its easy digestibility, fish forms a very desirable article of food for the tropical resident, but it is almost needless to say that the greatest care is necessary to secure its being brought to the table in the freshest condition. On this account fish transported for long distances in ice in such climates should always be regarded with suspicion, for most medical men who have practised long "up country" must recall cases where disagreeable consequences have resulted from its use. I cannot say that I have always found myself able to resist the temptations of ice-carried *pomfret* from Bombay, but would give this hint that fish so transported should never be eaten in the form of "made dishes," but always either plainly boiled or fried; under which circumstances the first mouthful can hardly fail to make apparent the least sign of commencing decomposition. It is safer, however, in inland places to rely on river fish; and in their case the muddy flavour, which so often renders plainly cooked fish unacceptable, may often be masked by cooking them with tomatoes or other vegetables, or by boning them and serving up as a curry, only please consult "Wyvern," or some other competent authority, before instructing your *chef*; for a curry is not mulligatawny soup with scraps of food floating in it, as so many people who have not lived in India appear to imagine, and fish curried *a l'Anglais* is most uninviting.

Vegetables.—A free supply of these is essential to healthy nutrition in all climates, and especially so in the Tropics, where it is desirable to restrict the amount of meat consumed. English folk might with great advantage take lessons from our neighbours across the channel, by introducing to their tables *plats* of vegetables served up alone, and flavoured with some tasty stock, or with simply a little butter. Well cooked, and served piping hot, such dishes are most tempting and wholesome, and may most advantageously take the place of meat dishes at the mid-day meal in hot climates; besides which it is as great a mistake to mask the delicate flavour of early peas and French beans by eating them with meat, as it would be to try to appreciate the flavour of a vintage claret under like circumstances. Where vegetables are scarce, it is well to investigate the dietary of the native races amongst whom one lives, as even in long-settled colonies it is astonishing how often excellent articles of food are entirely neglected by European residents. Served up as *haricots verts*, the soy bean (*Glycine soja*) or the lablab bean (*Dolichos lablab*) cut at the same stage of maturity, as is customary with the ordinary French bean, are excellent and are specially valuable, as they come on at a time when little else is obtainable; but in spite of this, they are very rarely eaten by Europeans. Then too a great variety of succulent leaf plants form an excellent substitute for spinach, and a variety of herbs, wild or cultivated, suitable for serving up in this way, are usually known to the indigenous inhabitants of any country; the very young tops of gram (*Cicer arietinaum*), for example, are excellent eating. During the Cgaleka campaign, the troops were often for long periods quite without vegetables, and one day the writer, wandering among the kraals near the camp, found some Kaffir women busily gathering a wild plant with small succulent leaves. On discovering that they were picking it for food, a basketful was purchased from them, and when cooked, furnished an excellent dish, almost indistinguishable from genuine spinach. Arrangements were then made to supply the entire detachment once or twice a week; and the men remained throughout the year entirely free from scurvy, a disease which has nearly always given rise to a certain amount of trouble in prolonged military operations in that part of the world, and notably in the Boer concentration camps during the late war.

Many vegetables, too, are excellent when cut very young, which are scarcely eatable when mature. This is especially the case with the bhindi, one of the commonest of the few hot weather Indian vegetables; but your native gardener likes to see them "large and fine," and will never cut them young enough unless this is insisted upon by his customer. Many vegetables such as pumpkins, onions and tomatoes, may be kept a long time if hung up in an airy place so that they do not come in contact with each other; and where the plan is not practised by those who supply the market, it is well to bear this point in mind, so as to lay by a timely supply against the "rainy day" when vegetables will be scarce. There can be little doubt that the inclusion of a certain amount of uncooked vegetable food in the dietary is always desirable, but salads are too often a dangerous luxury, owing to the very obvious danger from the fertilisers that may have been used in their cultivation, and on this account it is better to avoid them, unless one is absolutely certain as to the conditions under which they are grown; the more as an adequate supply of vegetable acids and salts can usually be taken in the form of fruit. Cucumbers and tomatoes, which can be peeled, need not of course be included in this general law against leaf salads, but tomatoes should always be peeled, as the skin is extremely indigestible, and is a frequent cause of diarrhœa. By dipping it for an instant in boiling water, the skin may be removed with the greatest ease without crushing the tomato.

Fruit.—The remarks that have been made as to the avoidance of raw vegetables that cannot be peeled apply necessarily to fruit, and those in which this is impossible should always be cooked. Provided the fruit be sound—neither over nor under ripe—a certain amount may always be taken by most persons with advantage, but during hot weather, when the digestive organs are feeble and irritable, it is well to avoid fruit such as apples, which are naturally rather hard of digestion, even when in the best condition. For the same reason, the harder portion of a melon near the skin should be avoided, as hard melons, like any other indigestible matter, may cause looseness; but it is a mistake to imagine that they can cause cholera, a superstition which leads many people to deny themselves the indulgence in this very wholesome and delicious fruit. The origin of this fallacy is no doubt to be found in the fact that cholera is usually at its worst during the melon season, but there is no causal connection between these merely coincident facts.

Bread.—When manufactured by the unsuperintended native, the conditions under which this almost indispensable article of food is prepared are too often unspeakably nasty; but a good deal more might be done to ameliorate this than is usually attempted, by the occasional unofficial superintendence of customers, and by the boycotting of such bakers as refuse to maintain a decent standard of cleanliness. It is quite possible that the result of such a visit may lead the enquirer to "cry off" bazaar-made bread for the rest of his life, for it is an absolute fact that a surprise visit of this sort once revealed the fact that several lepers were employed in kneading the European bread supply; but it is surely undesirable that such enormities should be perpetrated unchecked, and there can be no doubt that at least some improvement might be secured if people would but interest themselves in the matter. When good bread cannot be obtained, it should be remembered that it is quite possible for it to be made at home with baking powder, by the use of which the trouble and uncertainty involved in the use of yeast may be avoided.

Investigations conducted under the Food and Drugs Act have, however, shown that the acid ingredient of many baking powders is alum, which is injurious, if taken for any time in so large a quantity as is required to raise bread, so that perhaps it is safer to use cream of tartar and bicarbonate of soda, mixed separately with the flour in the proportion of 16 by weight of the former to 7 of the latter; a bare teaspoonful of the tartar, to an eggspoon of soda, for each nine tablespoons of flour, is the housewife's way of getting a sufficiently near approach to chemical accuracy.

Other foodstuffs.—Most Oriental nations depend largely for their supply of nitrogenous or proteid food on pulses of various sorts, and, weight for weight, many of these are far more nutritious even than meat. No doubt religious and economical considerations have had much to say in the development of this preference, but, on the other hand, the minute regulations to be found in many religious codes are very often based on really sound sanitary notions that have grown up as the result of traditional experience, and it is probable that the repugnance of the Hindu for meat food, though doubtless carried too far, is based on something more than a mere whim of ritual, and that the introduction of pulses into our dietary as a partial substitute for meat would be advantageous, at any rate during the great heats. At such seasons, the kidneys have all they can do to clear off the waste materials that naturally result from the work of the body, and as meat always contains a large amount of these same waste materials that have originated in the work of the animal that furnished the meat, it is obvious that its extensive use must throw an additional strain on already over-taxed organs. Caution in this matter is, of course, doubly necessary in persons who suffer from either gouty or rheumatic tendencies. The two most palatable among the commoner pulses are lentils (*Lens esculenta*) and thur dal. (*Cajanus Indicus*), the latter of which often finds its way to Anglo-Indian tables, but might be more extensively eaten with advantage. All pulses require very thorough cooking, and should be reduced to an absolute pulp by the process; for under other circumstances, they are apt to prove extremely indigestible, whereas when properly treated they are absorbed with the greatest facility.

Rice should be so cooked that the grains, though thoroughly softened, lie quite separate, but it is seldom or never met with cooked to perfection out of India, and by no means always there. The stodgy, sticky mass turned out by the ordinary English cook, or French *chef*, obstinately resists admixture with the gastric juice, and instead of being the lightest, is converted into a very heavy article of food.

The secret, I understand, consists in putting the well-washed rice into boiling water to which a crystal of alum has been added, and completing the cooking in this. The alum water is then washed off with several changes of cold water, the rice drained, and finally warmed up over a very gentle fire.

Tinned provisions.—A good many familiar home luxuries can only reach our distant possessions in the form of tinned stores, but there is a tendency to rely too much on them. At their very best they cannot approach well-cooked fresh food in wholesomeness and palatability; and frugality in their employment may be always regarded as one of the distinguishing marks of a good housekeeper, for, speaking generally, the less tins are used the better.

The various classes of food, however, vary greatly in the extent of deterioration produced by the process of tinning. Most vegetables and fruits preserve well in this way, and at any rate I cannot recall any instance of their having been proved to do harm. Meat and fish that have been highly smoked or salted, as well as fish preserved in oil, also appear fairly safe; but tinned fresh meat, and fish of all sorts are luxuries that should be avoided by prudent persons, unless driven to their consumption by scarcity. Tinned soups, containing as they usually do a considerable amount of salt, appear generally safe; and are better in the case of emergencies than the so-called meat extracts, which at best merely act as stimulants. Despite all that specious advertisements and uninformed testimonials may blazon forth to the contrary, it is an impossible feat to pack a cow in a cup, and, though there is a considerable concentration of undesirable excrementitious matter, the actual nutritive value of these preparations is less than that of an equal bulk of the meat from which they are produced.[1] They, of

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[1] *Vide* "Patent Foods and Patent Medicines," by Robert Hutchison, M.D. (John Bale, Sons, and Danielsson, price 1s.). Although written mainly for the medical profession, this very able little pamphlet might be widely read by the too easily gullible general public with great advantage. The writer shows that some of the expensive "meat juices" are nothing more than diluted white of egg, and that even when genuine, their nutritive value is no higher than the fraudulently substituted egg albumen. Dr. Hutchison's recipe for "meat" juice is not only amusing, but is well worthy of reproduction for its practical value, as it may save people from wasting many of the half crowns which they now contribute

course, have their uses, but must not be depended upon for nourishment in prolonged cases, where they are in every way inferior to properly made beef tea. In ordinary cookery their use is quite indefensible, on account of the strain thrown upon the excretory organs in the elimination of the excrementitious matters of which they are so largely composed.

The Question of Alcohol does not, I think, need any special treatment here, as I doubt if its bearings are in any way altered by a chânge of latitude. Equally in the tropics and on polar expeditions, the majority of persons are, to say the least of it, none the worse for total abstinence; but excess is neither more nor less fatal in the one than in the other locality, and you will everywhere find a few to whom alcohol in strict moderation is useful. One would hesitate to say that this minority would be actually harmed by abstinence, but I am, on the other hand, equally sceptical as to the harmfulness of strict moderation; for, despite the very strong evidence of insurance statistics as to the superior longevity of total abstainers, it must be remembered that the so-called moderate drinkers must necessarily include a considerable number of those who would define moderation as the avoidance of getting drunk, and that the teetotaller is, *ipso facto*, usually one who is inclined to take more than usual care of his health.

Cooking and kitchen management.—In the first place, the rule may be generally laid down that it is a false economy to be niggardly in the matter of the cook's wages.

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to enable the manufacturers of puffed rubbish to make the hoardings and country-side hideous with their advertisements.

"You can manufacture 'meat juice' yourself at a very low cost. Here is a bottle of it which I made this morning. Take the white of egg, add an equal quantity of water, and strain through muslin, then flavour the mixture with any quantity of Liebig's extract dissolved in a little warm water which you think suitable. By that means you get a preparation extremely rich in coagulable albumen which you can produce at one penny per ounce; and it is one of which the patient can swallow a pailful, if he can get it down, without it doing him any harm. So I see no necessity to buy any of the juices in the market so long as hens exist. That which you make in this way is as good as what you buy, for egg albumen is as nutritious as meat albumen, and it is vastly inferior to it in price."

The desirability of good cooking is far from being a mere matter of the gratification of the tastes, but is undoubtedly also a matter of the first hygienic importance. Added to this, a skilful operator can turn a wholesome and appetising dish out of comparatively inferior materials, while a bad one will turn the best into indigestible nastiness; and it will be generally found that those who economise on this detail of expenditure, pay for it over and over again by an excessive expenditure on ready cooked, and tinned foods.

A second point of at least equal importance is the insistence of cleanliness in the kitchen, and in all the operations of cookery, but to secure this adequate appliances must be supplied; for it is useless to expect either good cookery or decent cleanliness without an adequate outfit of "pots and pans," and proper appliances for cleaning them. At the same time it is a mistake to suppose that the utensils in use among English people will serve equally well in other hands, so that it is generally better to purchase locally what is needed. The heavy English iron saucepan is, *e.g.*, quite unsuited for use on charcoal fires, and an Indian generally lacks the strength of wrist to manipulate it with its clumsy and ill-contrived handle. Speaking generally, aluminium cooking vessels will be found most suitable for charcoal or wood fires, but they should be, if possible, fashioned in the forms to which the local cook is accustomed. Their great advantages are that they lend themselves well to cleansing with sand or ashes, which comes natural to races to whom soap is an unaccustomed luxury; while, unlike copper utensils, they do not require periodical tinning, and so are free from the risk of causing metallic poisoning. Most English housekeepers will probably admit that, even with a home establishment, a certain amount of superintendence of affairs below-stairs can hardly be dispensed with; and if this be so, how very much more must such scrutiny be necessary in places where the workers belong to races to whom cleanliness in such matters is an exotic curiosity. Too often, however, people are apt to let these matters drift, and try to comfort themselves with the reflection that the heart need not imagine what the eye has not seen, but those who do so expose themselves to the certainty of consuming unspeakable nastiness.

I remember well how our mess committee decided that each week a couple of officers in turn should inspect the officers' kitchen. Being the first on the roster, the senior major and myself proceeded to make our first inspection.

As we were expected, a very salutary, and probably much needed, clean up had been effected, and we found little to criticise till we turned to go away; when making for the door, the kindly major, who could never resist the sight of a child, espied sitting behind the door the brown but cherubic form of the butler's little boy, dressed in the national costume for children of his age of a piece of string. So he strolled towards the child with the intention of gratifying his little friend with some coppers to purchase sweets, when the urchin respectfully sprang to his feet and revealed the fact that the stool on which he was sitting was a huge round of spiced beef, which had figured on the sideboard at breakfast, and was meant to reappear at lunch. Now we all know that our food must necessarily be more or less handled, but, on the whole, most of us would prefer it not to be sat upon; and our visit resulted in the provision of a proper safe for cold provisions, which, as a matter of fact, was wanting.

This is hardly the place for any detailed consideration of culinary matters, but I would commend to the careful consideration of every tropical housekeeper "Wyvern's" excellent article on "Our Kitchens in India," in his book already quoted. There is only one point on which the writer would be disposed to disagree with his authority, and that is as to his recommendation of coal and English kitchen ranges; for whatever may be the case in Madras, this would, for many reasons, be in most places impracticable. Charcoal is a fuel which, no doubt, requires a great deal of attention, but native cooks are quite accustomed to this, and, trouble apart, its cleanliness and freedom from smoke makes it an ideal fuel for cooking, and the antiseptic properties of the charcoal dust in the kitchen are not to be despised.

CHAPTER IV.

The Tropical Day.

THERE is a southern proverb that, between the hours of two and four in the afternoon, only Englishmen and dogs are to be found abroad; and there is doubtless a good deal of truth in this as regards our countrymen, though the *dictum* is perhaps rather hard on the dog.

Whether this impeachment be libellous or not, it is undoubtedly the universal custom of all races inhabiting sunny lands to devote these hours to rest, and it is hardly likely that the visitor from northern Europe is wise in refusing to accommodate himself to new conditions. From "ten to four" may suit the business conditions of the City of London excellently, but it does not follow this is equally adapted to Calcutta, and the attempt to do so doubles the strain on nerve and constitution. Apart from this, work done under such trying conditions can never be of the same quality as that which would be accomplished at more suitable hours. Even in busy modern Rome, which is a good deal to the northward of any portion of India, it is quite common for commercial establishments to close during these hours; and it is absurd to reply that this is a mere evidence of sloth and want of business energy, as in spite of this interval of rest, the shops open so much earlier and close so much later that the total of working hours is greater than it is in London. I believe, then, that English folks settled in the Tropics would be wise to adopt an arrangement of the working hours which is the outcome of centuries of experience of life under a vertical sun; and rest when not only our fellow-men, but all animated nature seeks repose; for in those hours, beside a few vagabond crows and those objectionable insects, the flies, a sign of life is hardly to be found abroad to disturb the stillness of the tropical noon.

Unless rest be taken in the afternoon the tropical resident is apt to suffer from want of sleep, for even if he goes to bed at ten o'clock he must needs be astir at five a.m., as exercise can only be comfortably taken in the very early morning and in the dusk of the evening, and seven hours' sleep, even assuming it to be sound and restful, is quite an inadequate allowance under such trying conditions. Too often however, the night's sleep is neither sound nor refreshing, and much of the time is passed in rolling from side to side in the vain effort to find some portion of one's anatomy which the pins and needles of "prickly heat" will cease to trouble. For certain kinds of work, such as travelling, it is indeed necessary to "turn the night into day," and get through the business during the hours of darkness; for neither men nor horses can perform any work involving muscular exertion, once the sun is well above the horizon, without rapid exhaustion.

It is usually the custom to commence the day with a very light meal, consisting of a cup of tea or coffee and a scrap of toast, which is usually brought to the bedside; but, if one's work is of a character to keep one away from home for the greater part of the morning, it is better to supplement this with something more substantial, such as an egg, and to eat this after dressing, instead of before. Those whose work takes them into the open had best go straight to it, and trust for morning exercise to the riding and walking that are involved in the superintendence of the work under their charge; but those whose occupations are of a sedentary character, will come to them all the fresher for half an hour's canter, or a spin on the ever useful "bike." Exercise at this time of the day should never, however, be carried to the extent of producing fatigue, or the quality of the work done after it will be sure to suffer.

At one time it was a very common custom, on coming in from the morning ride, to have a plunge in the swimming bath, and the writer has pleasant memories of the *al fresco* meal of fruit and hot tea beside the big station bath, in company with most of the assembled male members of the post. A very pleasant custom it undoubtedly was, but I suspect we did ourselves more harm than good, for the first feeling of freshness was very apt to be succeeded by one of increased fatigue; and I believe this is generally recognised in India; for the fine old swimming baths are everywhere going to ruin from disuse, and this would hardly be the case if they were found as beneficial as they undoubtedly are pleasant. If a plunge bath be taken at all, the best time of the day is probably after the evening game of racquets or tennis—not immediately, of course, but after having given oneself time to cool down somewhat.

If practicable, the backbone of the day's work should be broken by noon, and this is the time adopted by probably the majority for a meal, which is generally, but rather inappropriately, called breakfast; after which it is a very comforting and, the writer believes, healthy custom to make up for the short, and perhaps disturbed night, by what sailors call a "dog's snooze"[1] of a couple of hours, after which and a bath, a couple of hours more work can be got in before the sun is low enough to admit of sallying forth, on exercise and recreation bent. After this perhaps another bath, dinner, and bed.

This programme, it will be observed, admits of an eight hours' working day, and if anyone is asked to work more than this in a hot climate, the most appropriate advice that can be given them, of course strictly from the point of view of hygiene, is—to strike. This arrangement of meal times is of course very much that obtaining on the Continent, and on this account many find it difficult to accustom themselves to it, and retain the nine o'clock English breakfast and early afternoon luncheon, but this breaks up the morning's work awkwardly, and makes the number of substantial meals too large to suit most people under the altered conditions of life. Comparatively few people find it advisable to persevere in the use of the cold bath in hot climates, for,

[1] The "dog watches" at sea last two hours.

strange as it may appear, but few people find it "agree" with them as well as is commonly the case in Europe. This is especially so in the case of those who have suffered much from malarial fever, as most residents of any standing have; for in such persons any sudden shock is apt to give an opportunity to the germs of the disease lying latent in the system, and so to bring about a relapse of fever. Personal experience can of course alone serve as a guide in such a matter, but those who have recently suffered from a malarious attack will do well to be cautious.

With regard to the question of light and ventilation of the house; in places on the coast, where really excessive heat is rarely experienced, all that is necessary is to get as much air as possible without admitting the direct rays of the sun. Inland, however, where the thermometer may stand in or above the nineties for months together, a certain amount of management is required to keep the heat inside the house down as much as possible. To effect this, it is above all essential that every door and opening should be thrown open at night so that the cooler air may get the best possible chance to reduce the temperature of the heated walls. Unfortunately, owing to the uniform peccability of human nature, it is not always practicable to do this, if one wishes to retain one's ownership of movable property; as in most parts of the world, it is scarcely possible to keep all doors and windows open unless they are protected with bars, a precaution which lends a very forbidding and prison-like aspect to a house. Fortunately, as a rule the native burglar is not a very desperate character; and prefers to work by stealth to attempting to get through any obstacle that might make a noise in the opening. But for this, and the fact that a certain awe usually attaches to the person of an European, robberies could hardly fail to be much more common than they are, for as a rule the bolts and bars of a tropical villa are contrived with a child-like simplicity, which would raise a smile on the face of Mr. William Sykes and his pals.

Here again is another direction in which the adoption of the system of metallic gauze protection against mosquitoes will tend to make tropical life more tolerable; for the stuff is much stronger than it looks, and would form a quite adequate protection against ordinary thieves; besides which, the gauze, for those troubled with nerves, might be easily strengthened by supplementing it with a layer of the strong wire netting used for fowl runs, &c., without making the place look like a jail, or appreciably diminishing the freedom of ventilation. It would be easy, too, by attaching to some part of the frames, inaccessible from the outside, bells hung on springs such as used to be used in houses before the adoption of the electric mechanism, to render the frames a very difficult obstacle to open without rousing the inmates, even for light-fingered gentry much more skilful than those with whom one has usually to deal. An obstruction that will keep out a mosquito may easily be modified to exclude men, and only those who have passed a hot weather in towns where it is dangerous to sleep with open doors, can appreciate what a benefit it would be to be able to dispense with the use of solid doors and sashes. Strengthened with wire netting, the gauze would form a far more formidable obstacle than any ordinary window, for a little reflection will convince anyone that even the gauze alone would be far more difficult to dispose of than the simple panes of thin glass on which we have been accustomed to rely. Usually the house may be kept open with advantage until eight or nine in the morning; but after this the thermometer begins to rise rapidly, and it becomes necessary to close up everything, while in very extreme climates it may be desirable to supplement the doors by the addition of thick, wadded curtains, but this should never be carried to the extent of making the rooms difficult to see in, for a fair amount of light is absolutely essential to health. Besides this various other expedients may be adopted, a very useful one being the sprinkling of the verandahs with a watering can as soon as the heat of the day is over, a process which may be very advantageously extended to the roof, where this is of the terraced form, always assuming that cheap labour is available. The coolness produced by the evaporation of water is also utilised by means of "tatties," as well as in a machine known as the thermantidote.

Tatties are thick, loosely-woven mats, made by binding a thatch formed of short lengths of a scented grass (known as *khaskhas*) to a frame-work of bamboo, which are constructed to fit the frames of the windward doors and windows, and are kept constantly wet by a man, who goes from one to the other throwing water on them. Their efficiency depends entirely on the amount of wind, and to maintain a good current it is of course necessary that one or more of the leeward doors should be also kept open, a fact of which it is often difficult to convince the ladies, who, in their intense eagerness to shut out the heat at all costs, not unfrequently succeed in shutting it in instead. Given a fairly good breeze, and a waterman who does his work well, it is possible to produce a very marked amelioration of the temperature; and the free passage of air through the room goes far to neutralise the dangers of dampness. Of course neither these appliances, nor the thermantidote, can act except in dry heat, so that their usefulness is quite confined to the dry months of inland climates.

The thermantidote, in its usual form, is a large wooden drum, within which revolves a system of fans, one of the upper quadrants of its circumference being removed and replaced by a horizontal tube, which projects through an opening in a temporary screen into the room to be cooled. The sides of the drum, through which the axle projects, are replaced, in the middle, by small tatties, and the effect of driving the fans (which work like those of a paddle boat, and not on the principle of the screw) is to draw air through these small wet mats and drive it into the room. Some of the more elaborate sort are provided with a miniature pump, which delivers water on to the mats from a trough below, the pump being driven from the same multiplying wheel as the fan. In thoroughly dry weather, it is quite possible to reduce the temperature of a room by fully ten degrees by means of these machines, but they are treacherous arrangements, especially for those who allow themselves to be tempted to sit in the full force of the current, and are responsible for a great number of chills and rheumatic twinges of all sorts, so that I believe it is better to endure the heat without them. The labour of driving them, too, is rather severe, so that relays of strong young coolies must be entertained if they are to be worked efficiently; whereas in the case of the punkah a certain knack is required, rather than mere brute strength and stupidity, so that the work is very suitable for men who are past their prime. The best punkah wallah I ever had was an old blind man, and the work seems particularly suitable for the blind, as sight is in no way required, but, in the East, these unfortunates generally prefer to resort to their traditional employment of mendicancy. The little art of pulling a punkah lies in never checking it as it swings away from you; and in making the pull just as it begins to lose way on its return; but simple as this may appear, the men often requires a good deal of training before they do it well. The original punkah is said to have been invented by a bored clerk in a Calcutta office, over whose head, it happened, the spare leaf of a table had been hung to keep it out of the way of the white ants. In an idle moment he began to make the suspended plank swing to and fro, and finding the resulting breeze very comforting, proceeded to make fast a cord, and set a coolie to pull it. The contrivance, at any rate, dates only from the English occupation of India, and the original flat plank has never been improved on, as the less unsightly pole punkah and frill is in every way inferior to it. The broad, flat punkah of course is usually also fitted with a frill, but a light, single cloth, about the substance of a bath towel, really acts far better than the usual heavy frill, as it gives a peculiar flick at the top of its stroke which is extremely effectual.

It is a not uncommon misapprehension to imagine that a punkah cools the air within a room, though this, of course, is an obvious impossibility, but the current of air produced by it promotes the rapid evaporation of the moisture of the skin, and the body is thereby cooled, which for practical purposes is much the same thing.

Ladies who make up their minds to face the hot weather do well to strive to compass a certain amount of exercise in the open air, for their occupations tend to keep them in the house more than their worse halves. It is a great mistake to picture the Anglo-Indian lady as passing her time in sloth and idleness. Civilisation has not reached the same pitch in the Tropics that it has in temperate climates, and those who migrate there must be prepared to live two centuries behind Europe; with the result that a multitude of the details of household economy have to be done in the house which, at home, would be managed by the tradesman. On this account, the *memsahib* finds herself back in the days of domestic dairies and still rooms, and must busy herself with the superintending of a score of details undreamt of in a modern English housewife's philosophy. To realise how much she has to do and how well she does it, one has only to put up for a few days in a bachelor's *ménage*, and reflect how much better the "singly blessed" fare west of Suez.

Whether ladies really suffer more from the strain of hot climates than persons of the male persuasion, is very difficult to say, as it is probably mainly the more robust who elect to share the burden and heat of the day in the plains with the mere man; but it is probably more a question of will power than of physical strength that determines the question; for as often as not it is the big Du Maurier type of girl that leads the rout to the hills, while some fragile-looking piece of bottled energy remains to be the life of the parching station below. Those who do stay, as a rule, do not appear to suffer any more than their husbands; but no one is any the better for a hot weather in the plains, and whether the strain of such surroundings is well or ill borne, is probably more a question of individual temperament than of either sex or physical strength.

The writer has met with ladies who had passed many consecutive years in the plains of India with apparently no very noticeable bad effects, but these have been mainly such as, owing either to inclination or the nature of their occupation, were a good deal out and about, in spite of the heat, and so got a fair amount of exercise, and did not shut themselves up for all the daylight hours in stifling and depressing semi-darkness.

CHAPTER V.

Hints on the Management of Children in Hot Climates.

Owing to the circumstance that it is more convenient to deal with the subject of the feeding of infants in connection with that of the prevention of infantile diarrhœa, but little of a nature special to hot climates remains to be noticed in connection with the management of young infants, for being concerned with little else than the assimilation of nourishment, their well-being or otherwise is governed almost entirely by the state of their digestion.

Putting aside the special danger of infantile diarrhœa, young infants generally do well in hot climates, which are in many ways suitable to their low powers of resistance to cold. Some writers, very competent to speak on the subject, are indeed of opinion that very young infants do better in India than in cold or temperate climates; and perhaps this may be the case as regards breast-fed children, for, the air temperature being but little below that of the body, they are almost entirely protected from the coughs and colds of all sorts that do so much damage at home, and lead to the poor children being confined to a stuffy atmosphere instead of enjoying the enormous advantage of unlimited fresh air, of which an infant requires proportionately even more than an adult. On this account never allow, a nurse, however experienced she may be in her own conceit, to cover a child's face with a handkerchief even out of doors, as the re-breathing of air already polluted by passing through the lungs is one of the most frequent causes of illness in human beings of all ages, and if the air outside be really so cold as to be harmful, the child will be better indoors, in a well-warmed and ventilated room, than outside, if half stifled in this silly fashion.

If she has any lingering doubts on the matter, let the mother borrow an ambulance, and try how much fresh air can be got, lying flat on the back, with a handkerchief spread over the face, and a fussy old woman in attendance to replace it should it chance to get disarranged.

The dangers of that abomination, the "baby's comforter," are elsewhere adverted to, but to show that the writer is by no means singular in his opinion, the following extract from *Science Siftings* may be read with advantage:—

"Most expert observers of the infectious nature of consumption have stated that the bacilli almost invariably enter the system through the nose or mouth, the respiratory system, in fact. Yet there are others who state that the milk drunk by infants is a chief cause of infection. But a new and deeply interesting theory is put forward by Drs. J. O. Symes and T. Fisher in the *British Medical Journal*. All day long, they write, babies are sucking an indiarubber comforter, and it no sooner drops on to the dirty floor than it is hastily picked up and thrust again into the mouth of the infant. Older children also, as they crawl, take up every article they can lay hold of and put it into their mouths, to the danger of which their dirt-begrimed cheeks bear witness. The moral is obvious."

Native attendants are especially fond of the contrivance, and hence it is desirable to emphasise its dangers in a work on the present subject.

It should be needless in these days to warn mothers that all "soothing syrups" are extremely harmful and even dangerous preparations; but there is another preparation in almost universal use, which, in a smaller way, does a great deal of harm. I allude to the abuse of dill water and similar pungent stomachics. The usual pretext for its administration is that the baby has got what is popularly termed "wind in the stomach," which may mean merely indigestion, due, in all probability, to the use of some patented abomination in the way of "infants' foods," containing farinaceous material; or that, as evidenced by belching, there really is gas in stomach produced by fermentation, or by sucking in air from the use of a "comforter."

Now the dill water will no doubt temporarily relieve the pain, but it will rather aggravate the malady than cure the condition that causes it; as the remedy is of exactly the same character as the nip of gin which Mrs. Gamp found so useful in soothing her "spasms," and is probably even less suited for babies than the gin was to the good lady so inimitably portrayed by Dickens.

It is astonishing how mothers, who would exclaim with horror at a few wholesome grains of pepper to season the breakfast egg of a child of five or six, will go on giving a new-born baby dose after dose of what is much the same thing as a very pungent liqueur. Should the pain be really due to "wind," as shown by belching, some unirritating antiseptic such as a grain or two of resorcin will rapidly check the fermentation that is producing the gas, and so cure the disease. Though comparatively little used for this purpose, the writer has found this drug most useful in these little troubles, and has found that even infants of but a few days old tolerate it perfectly. If, on the other hand, the pain be due to indigestion, the trouble is probably caused by the character of the food, and an effort should be made to find something that agrees better. Probably the commonest cause of these disorders is the use of the numerous much-advertised "infants' foods," most of which contain farinaceous material of some sort. Now young infants cannot digest starchy matter of any kind, and the only proper food for them is milk. When the milk of the lower animals is used it is of course desirable to modify it, so that its composition may be made to more closely resemble that of human milk; and this in the case of cow's milk is effected by diluting the milk and adding a little sugar, preferably milk sugar. Again the tendency of cow's milk to clot in large mass has to be neutralised by the addition of some material that will prevent this, and the general ban against farinaceous materials need not extend to the use of the deservedly popular barley water for this purpose, as the amount of starchy matter it contains is too small to be harmful.

When goats' milk is used, the goat should be kept tied up and its food gathered for it, as although a clean feeder, it is apt, if left at freedom, to eat acrid leaves which may affect the milk. Goats' milk requires somewhat less dilution than that of the cow, and may agree in cases where cows' milk fails.

In proportion as the heat is greater, so should the milk be more freely diluted, as otherwise thirst may lead to the child taking more food than is good for it; and if at such times the child craves too frequently for food, a few teaspoonfuls of plain water should be given; as the craving is merely an indication that the child, like larger people, is thirsty. The water can do no harm, but irregular feeding is always injurious. As the child grows older, the milk can be given less diluted, and after eight or nine months the yolk of a raw egg beaten up with the milk may be occasionally given, if the child appears to require more nourishment; but this should not be overdone, as such food is apt to cause "biliousness." In the second year milk puddings and bread and gravy may be given occasionally, and after the third the child should be encouraged to eat plenty of well-cooked vegetables, but stewed fruits should be given with caution.

In the case of older children brought up in hot climates, it must be remembered that their appetite, like that of their elders, is apt to suffer at trying times of the year, and hence it is important to introduce as much variety as possible into the *menu*. A dish nearly always much appreciated, and I believe perfectly wholesome, is a curry;—not too highly spiced of course, but still a curry. The writer had at one time, as a sole charge, the care of some five hundred children, varying from four to seventeen years of age, in a large school. For many years, on two days in the week, a curry had formed the dinner for the children of all ages in this institution. That of the "infants" had even less pepper in it than what was supplied to the elder boys and girls, but was still distinctly appetising. Now no item of the dietary was as thoroughly relished and finished with as hearty an appetite as this; and there never appeared the least reason for suspecting it was anything but useful and wholesome. Children are often much to be pitied on account of the fads of their parents in the matter of diet, for the poor little souls are continuously placed in the position of Sancho Panza, when they made him governor of Barataria, and the court physician would allow him nothing decent to eat. When children have passed the stage of early infancy, and nature has furnished them with teeth, one may be pretty sure that what is bad for them is equally deleterious to oneself, and it is well, instead of denying them all sorts of things on mere suspicion, to give a small quantity and notice if it causes any discomfort. Otherwise, as likely as not you are denying them things that may suit them excellently, and forcing them to eat insipid traditional children's dishes, which very possibly, do not really suit them. Milk should of course be always given freely to all growing children, but apart from this too great monotony is sure to be harmful. There are some children, of course, to whom even small quantities of usually wholesome articles of food seem to act as absolute poisons. This is especially the case with sugar, extremely small quantities of which will, in such peculiarly constituted children, bring out an attack of nettle-rash. The skin is always abnormally irritable under great heat; and hence such cases show themselves more commonly in European children brought up in the Tropics than in those living in temperate climates.

When, therefore, a child is greatly troubled with nettle-rash it is well to suspend sugar, and should this fail, experiment with the stopping of other articles of its dietary.

A very common mistake on the part of anxious mothers is to cut up a child's food too small. As soon as a child's digestive organs have so far developed as to be capable of digesting solid food at all, as shown by its having come into the possession of a full set of first teeth, it is very important that nothing should be swallowed without thorough mastication; and the mincing of the food not only renders it possible for the food to be swallowed without chewing, but actually makes it difficult for the child to do otherwise, as anyone may convince himself by trying to masticate any minced dish.

Now mincing is in no sense a substitute for chewing, and as it is disagreeable to swallow a large piece of food without proper mastication, it is better to err on the side of cutting too large than too small. Moreover, the cutting up of the food too finely actually trains the child to bolt its meals, and this causes it to acquire a most harmful habit, of which it will be very difficult for him to break himself in after life.

On the other hand, many children take up the almost equally injurious habit of churning their food about in the mouth for an unreasonable time. This habit is a very common one with Anglo-Indian children and should always be checked, as the prolonged mumbling of each mouthful stimulates an undue flow of saliva, and produces dyspepsia by flooding the stomach with it. It is really, I believe, due to want of appetite, and is generally caused by the monotonous and insipid diet to which children are often confined, while they watch their parents consuming appetising dishes which they are not allowed to touch. Surely it is hard to expect the child to swallow a stodgy mass of boiled flour and milk, with the savour of crisply fried bacon under its nose; and why should a child whom Nature has already provided with a full set of teeth be less able to digest a simple wholesome article of food, such as this, than an adult? No one would suggest the giving of large quantities of such delicacies, of which, indeed, adults very commonly consume a good deal more than is good for them; but some bread and butter with a few scraps of bacon and some bread crisply fried in the fat, eaten with a relish that stimulates the proper flow of the digestive secretions, is surely more likely to be properly assimilated than some insipid mess, eaten under compulsion, with difficulty and loathing.

It is often impossible to find any good reason for popular maternal notions as to what children should eat, drink and avoid, but the broad principle underlying it appears to be that anything nice is necessarily harmful. "Children should be given only simple food." Doubtless!—but what is "simple food"? Food, I take it, which it is a simple job to digest. But it is quite a mistake to imagine that every insipid mess is easy, and every tasty relish difficult, of digestion. Some insipid foods are easily digestible and some not, and some tasty foods are indigestible and some digestible. The taste and savour are in fact no guide whatever. To pursue our particular example:—bacon fat is an exceptionally easily assimilated form of fatty matter, rivalling cod liver oil in that respect; and every whit as useful in the treatment of malnutrition.

Again, the method of preparation makes all the difference as to digestibility. Cheese, for instance, of the cheaper varieties, is proverbially hard to digest, for the obvious reason that it is difficult for the digestive organs to dissolve its rather leathery substance, but a crumbling Stilton taken in reasonable quantities is far from being so; and even less expensive cheeses, if grated and cooked, are quite harmless, so that a dish of macaroni just flavoured with a little grated cheese is a far more suitable food for a child than the pasty gruel that passes under the style of oatmeal porridge southward of the Tweed.

The hardy Italian peasant children are as regularly brought up on the dish I have just described as the young Scot on oatmeal porridge; and as, unless given all day and every day, both are perfectly suited to young digestions, there is no good reason why both should not take their turn in the nursery cuisine.

A great deal that has been said is no doubt equally applicable to temperate climates, but in these healthy children rarely suffer from want of appetite, whereas in the trying time of the year in the Tropics there is often a strong temptation to eat too little to keep up the needs of the system, and hence this exhortation to the adoption for children of a varied and tempting diet is especially applicable to those brought up in hot countries.

A separate work would be required to deal adequately with the subject of the present chapter, so that it is impossible to do more than offer a few general hints on the subject, and it accordingly remains only to consider the question of the necessity, or otherwise, of children being sent off to a hill station during the worst part of the tropical year. To do so is often a terrible tax on the financial resources of the parents, and there can be no doubt that the advantages of the hill climates over those of the plains, though no doubt very real, are much over-rated; for the hills have special dangers of their own. Some years ago I had occasion to compare the sick rates of a number of the largest Indian boarding schools, and was much astonished to find that the justly celebrated "La Martiniere," at Lucknow, had a somewhat smaller sick rate than the great Laurence Military Asylum for soldiers' children, which was then under my care. Now if the difference in favour of the hill climate were as great as is popularly supposed, this could hardly be the case; as Lucknow is by no means an exceptionally healthy plains station, and the site of the La Martiniere leaves much to be desired. Yet the hill school would have been counted a healthy one anywhere, for in two years we had but two deaths among the whole half-thousand boys and girls. Apart from the mere question of personal comfort, the main advantage of the hill climates are their freedom from malaria, but this ought to be guarded against in the plains by proper metallic gauze protection of the nursery; while, on the other hand, hill climates are extremely treacherous for children during the rains. Assuming the adoption of rational precautions against malaria, I believe that whatever may be the case during the dry, hot season, the majority of children would be better in the plains than on the hills during rains. Part of this is perhaps due to the increased sanitary difficulties; for typhoid fever is endemic in almost all hill stations; but the bulk of it is due to the raw, clammy chills of a sodden atmosphere, and given an equal number of children, it is a matter of common experience with medical officers that the doctor's visiting book will often show an enormously larger number of calls in these sanitaria (?) than in the much maligned stations below.

Hence, while in no way counselling the retention of children in the plains during the hot, dry season, by those who can well afford to send them away, I trust that the facts adduced may tend to the comfort of those whose finances do not admit of such a luxury, and the question whether great sacrifices should be made to do so should be determined by the comparative healthiness, or otherwise, of the locality in the plains where they may be stationed.

The amount of sickness, both of a serious and trifling character, on most hill stations is perfectly alarming, and there cannot be the least doubt that there are a great many stations in the plains that are far less unhealthy for Europeans the whole year round, so what is gained by resorting to the hills is, in most cases, not health, but personal comfort.

Another caution:—do not always jump to the conclusion that a child is necessarily suffering from malaria when it becomes feverish. The temperature-regulating mechanism of a child is much more delicate than that of an adult, so that very little suffices to put it out of gear; and an indiscretion in diet which would show its effects in an adult merely in the form of a bad head and a worse temper, will perhaps send a child's temperature up to 104° F. or over. Such cases are almost as common in Europe, but unlike the Anglo-tropical matron, the English mother does not usually go about with a clinical thermometer in her pocket, and they usually pass undetected, as far as the element of temperature is concerned, and are ascribed to their true cause of some upset of the digestive organs, which yields easily to some mild laxative. More than half the cases of so-called fever are of this nature, and as the diagnosis of malaria can only be made, even by a doctor, by a careful examination of the patient's blood under a powerful microscope, it is wise in his absence to try the effect of such simple measures as a dose of "Gregory" or grey powder before needlessly drugging the child with quinine.

Lastly, and most important of all, do not always go rushing off to your medicine cupboard because the dear child "looks so pale," or is protesting more vociferously than usual at the crumpling of some of the rose leaves of its couch. Anyway, it is no good emptying drugs down the interior of the poor child's neck till you feel pretty sure of your reason for doing so. It is very natural and excusable that a mother should be so anxious to "do something"; but unless sure of your reasons for acting, the something done is too apt to be something wrong. The amount of needless drugging of children that goes on is cruel, even when it is not harmful; and I cannot help thinking the little ones would be a good deal better on the whole if mothers would make a rule of swallowing a duplicate spoonful of nastiness for every one they are so anxious to administer to their progeny.

CHAPTER VI.

Hints on the Construction of Tents and on Camp Sanitation.

In many hot countries Europeans of all classes pass a considerable portion of their time under canvas, and though it is not proposed to refer in any way to military operations, some reference to the management of small private camps is desirable.

In pioneering life in the colonies, permanent encampments necessarily have to serve in place of houses, often for long periods, and in such colonies as South Africa whole families are often "on the trek" for months together; whilst in India most officials must pass much of the cold season under canvas as a part of their routine duty, and it is quite common for an official to be accompanied on these long tours by his family and entire establishment.

Now in spite of its apparent inconveniences, tent-life is, if fairly well managed, extremely healthy, and there can be no doubt that in India these cold weather tours under canvas form the saving clause in the description of an official's life; so that it is extremely desirable that, wherever practicable, the ladies and children of a family should share in its advantages. In a well-ordered Indian cold weather tour in tents, the hardships are indeed so purely nominal that there is no difficulty whatever in taking even the youngest children, not only without any increase in the risks of life, but with enormous advantage to health.

Tents should, as a rule, be obtained on the spot, as those manufactured in any given country will generally be better planned to meet special local exigencies than those obtainable elsewhere, and in any case it is a mistake to obtain an outfit of this description in Europe, as tent-life is so foreign to the habits of settled countries, that our manufacturers are utterly ignorant of the proper plan of construction, or of the most suitable materials to choose. The English service bell-tent, for example, seems contrived to combine all possible disadvantages that a tent can possess, every other consideration being sacrificed to the idea of supporting it by means of a single pole; though the advantages of this are more than neutralised by the employment of a spar, better suited to serve as the mizen-mast of a small cruiser than for the purpose for which it is intended. In India, on the other hand, the manufacture of tents has been an extensive industry for centuries, and the intending explorer or colonist who is likely to have to pass prolonged periods under canvas cannot do better than obtain what he requires from some of the large manufacturers in Cawnpore or Lahore.

In the first place, it may be laid down as an absolute rule, that tents with single "flies" or roofs, are quite unsuitable to any climate, and should never be used except under the absolute compulsion of restricted transport. Such tents are insufferably hot in warm climates, bitterly cold in chilly ones, and damp and unwholesome in rainy weather in either. On the other hand, the use of waterproofed material is, as a rule, a mistake, and should at any rate never be adopted for the inner fly, as to do so would make any tent of moderate dimensions intolerably "stuffy." In very rainy climates, there might be no harm in selecting light milrained canvas as the material for the outer fly; but there is no real necessity for this, as a tent should be so planned as to throw off the water by virtue of the slope of the roof, and not by the character of its materials.

A second point to be remembered, is that two or more layers of comparatively light material will afford far greater protection against either heat or cold than the same weight of material woven as a single heavy cloth, and on this account the canvas universally used in Europe for work of this sort is absolutely unsuited for the purpose.

Each fly of an Indian tent is usually formed of two or three layers of cloth, the outer layer being formed of what is generally known as "American" cotton drill, though it is usually of local manufacture; and it would be hard to find a material better suited for the purpose. Where only two layers of cloth are used, the inner layer should be a deep red, as this colour cuts off the largest proportion of the chemical rays of the sun, which exercise such a powerful effect on the human economy. With three layers the middle one should be red, and the undermost deep indigo. In the case of the inner fly, for the middle layer of cloth, where there is one, a deep red should also be selected, but the inner lining should be a pale yellow chintz, as a sombre cloth makes a tent uncomfortably dark. The poles should be so constructed that a space of free air, of not less than a foot, should intervene between the two flies, even in the smallest tents, and if the outer fly be properly planned, it should be impossible for rain to reach the inner fly, even under the worst conditions of weather; though this proviso need not extend to verandahs and bath-rooms, which are not intended for prolonged occupation, and so may be formed by the outer fly only. When weight is a serious consideration, as in the case of exploring parties, it would be difficult to find a better form than that known as the "Kabul tent," which, with poles, mallet and pegs, weighs but 80 lbs., while the somewhat larger "Field Officer's Kabul," weighing, with verandah and bath-room complete, 120 lbs., forms about as comfortable a little residence as can be desired for such purposes. For Indian family use, and for permanent encampments, where a tent has to serve in place of a house, the best form is probably that known as the "Swiss Cottage Tent," which, however, weighs, according to size, from 4 to 6 cwt., and is therefore only useful for a moving camp, where ample wheeled transport is available.

People unaccustomed to living in tents are apt to think that they are necessarily draughty and uncomfortable, but this is so far from being the case that it is quite as necessary to attend to their ventilation as that of a house; and this is especially true of large tents, the gable part of which is rarely sufficiently ventilated to allow of the escape of foul and heated air. All that is provided for this purpose by manufacturers are a few brass eyelet holes, the total area of which is far too small to have any appreciable effect whatever. Those who possess large tents will do well, therefore, to have made in the uppermost part of the gable of the inner fly of a Swiss Cottage, or near the apex of the pyramidal single pole tent, a small window measuring some 8 in. or 10 in. square. It is easy to arrange a curtain for this, capable of being closed with strings from below, but in practice it will be found that it is never necessary to close the opening, which may merely, therefore, be filled in with strong twine netting, so as to maintain the strength of the tent. The gain in coolness effected by this little modification will be astonishing to those who have not tried it, and it is equally necessary where a stove is used for heating a tent.

Having mentioned this point of the warming of tents, it may be well to point out that on no account should the common native plan of using an open charcoal brazier be adopted, as it is quite a mistake to imagine that a tent is not quite capable of sufficiently retaining the poisonous charcoal fumes to cause harmful, and even serious, effects.

The writer has met with attempts to copy the Indian patterns in tents manufactured in England; but the inveterate attachment of our tent-makers to flies formed of a single heavy waterproof cloth has rendered the best of them next door to useless, and though very pretty, none were fit to be put up anywhere outside a colonial outfitter's show-room; so that unless the necessary delay of a couple of months be an absolute bar to doing so, novices fitting themselves out for camp life will do well to get what they require from India, or some other country where camp life is a practical everyday contingency.

When used for a living room during the day a tent can not well be too lofty, but for sleeping purposes, tents with the ridge of the inner fly not more than 8 ft. or 10 ft. high present many advantages over larger ones, as not only are they warmer and snugger, but it is far easier to keep them free from flies, which if once they gain admission, render rest during the day impossible.

It is wonderful how free a small tent of this sort can be kept from these pests, provided the chicks or blinds formed of split bamboo be kept always closed. Every night when the flies have become sluggish and sleepy as many as possible should be killed by striking at them with a towel or duster; and then the lamp should be put outside the tent door and the chicks and flies raised, while the flies are kept from settling by flecking and shaking the interior. Attracted by the light, in a very short time, all insects will be coaxed out of the tent, and the chicks and curtains being then replaced, one starts the next day with the tent free from these intruders. The same plan may be also used with large tents, but cannot so effectually be carried out, as it is difficult to reach insects that have settled in the uppermost part of the tent, but vigorous shaking will usually suffice to dislodge most of them.

Mosquito-nets for camp use should be shaped like a miniature tent, with a ridge and gable-shaped ends, so that they can be easily and quickly suspended from the tent poles by means of strings fitted to each end of the ridge, which should be strengthened with a stout piece of tape.

In selecting a site for camp, it is well to keep as far as possible from native villages, but as a rule one is obliged to pitch tolerably near them, on account of the difficulty of bringing supplies to a greater distance. In any case, however, the site chosen should be to the windward of the village, and sufficiently removed to be clear of the results of its primitive notions on the subject of conservancy. Conservancy, indeed, is always a difficulty in camp, and renders the prolonged occupation of any one camp extremely undesirable. In private marching camps and even in the tolerably large caravans of exploring parties, it may be taken for granted that any attempt at the establishment of regular latrines is doomed to failure; so that the utmost that can be done is to fix a limit of distance, within which cleanliness is enforced by punishing any detected infraction of the rule as sharply as may be practicable. Where, however, tents are pitched in standing camp, as a temporary substitute for a permanent habitation, trenches should always be established, and their use insisted upon, as otherwise it will be absolutely necessary to periodically shift the camp to a clean site.

In the matter of water supply, it should be needless to point out that its sources are always necessarily of doubtful purity, and that more than common care is therefore essential to secure that it is properly sterilised by boiling. As already remarked, it is a good plan, where possible, to send on and get the wells in advance disinfected by treatment with permanganate of potash, and this precaution is, of course, especially important in the presence of cholera.

In the sort of camp life under consideration, regular camp beds are assumed to be carried, so that there is no need to burden oneself with heavy ground sheets, ordinary cotton carpets being, for our purposes, far more comfortable and sightly ; but it is nevertheless well, wherever the material is available, to lay down, beneath the floorcloth, a good layer of hay or straw, as this not only serves as a sop to the white ants, but serves the further sanitary purpose of taking up the damp that is always arising from the soil even in apparently very dry localities. As the litter is in no way damaged by its use for this purpose it is rarely necessary to buy it outright, the owners being usually satisfied with a trifle for the loan of it, sufficient to remunerate them for the trouble of bringing the straw and fetching it back. In standing camps however, litter used for this purpose should always be cleared out and dried in the sun at frequent intervals, as without this precaution it is sure to get mildewed and offensive.

There is, of course, no real difference between the rules of personal hygiene suitable to camp life, and those of dwellers in more settled habitations, and with due attention to a few special points such as those that have been touched upon in the present article, camp life, on account of the constant enjoyment of fresh air which it affords, will always be found far healthier than that passed within houses.

CHAPTER VII.

On the Prevention of Malaria.

"FEVER," *i.e.*, malaria, is responsible for so large a share of the sickness peculiar to tropical countries that the subject of its prevention requires especial and separate consideration. Up to a few years ago the causation of malaria was a complete mystery. We had known for some score of years or more that the disease was due to the presence of certain minute animalcules in the blood, but as to how they got there, or the manner in which they passed from man to man, we had not the remotest idea. There was a general opinion that the seeds of the disease were carried by the air in the form of what was pretentiously spoken of as a miasma—a formidable word which served well enough to hide from the profane vulgar the fact that no one could define, or in fact had the vaguest notion as to what a miasma might be. It was also popularly known in many parts of the world that miasmata found great difficulty in getting through a mosquito net; but by the majority of the profession these traditions were looked upon as laic fables, unworthy of scientific attention, though there were not wanting observant practitioners of tropical medicine who were willing to admit the efficacy of the protection afforded by a mosquito net, and who even attempted to account for the fact by all sorts of lame physical explanations, barring only the simple one that a mosquito net serves very fairly the purpose for which it is designed, viz., of keeping out mosquitoes. The condensed moisture of the dew on the fluff of the meshes in some way attracting the germs or dissolving some assumedly gaseous emanation, was a favourite so-called explanation, and was, I believe, that adopted by the late Prof. Maclean, of Netley, who in his lectures was always careful to impress upon us the protection afforded by mosquito nets, as a well-established, though ill-understood, fact.

This was before the date at which the French military surgeon, Laveran, discovered the fact that malaria was due to the presence in the blood of certain animal parasites *(Protozoa)*, and although this discovery was made in 1880, it was many years before its truth was accepted by the general body of the medical profession, who have somehow always exhibited a curious reluctance to admit the harmfulness of animal parasites.

Some years later Sir Patrick Manson, F.R.S., then a hard-working doctor in practice in China, made the remarkable discovery that the blood-worm disease, which is very common in those parts, was conveyed from man to man by the agency of mosquitoes; and as the parasitic origin of malarial fever became more and more firmly established, the idea suggested itself to him that this disease, too, might very well be transmitted by the intervention of the same insects.

At this time Sir Patrick had left China, to work harder than ever in London, so that he was unable to personally test the truth of his surmise, which he, however, communicated to Major Ronald Ross, I.M.S., who after prolonged work, was able to establish the truth of Manson's suggestion, which was a remarkable instance of the value of imagination in science. Almost immediately after Rossi's work was confirmed and amplified by Prof. Grassi, of Rome, and by several other naturalists, and the fact that malarial diseases are communicated by the agency of mosquitoes, and can be carried from man to man in no other manner, is now absolutely established. Medical science has commonly to accept, as a working theory, whatever hypothesis of the causation of disease may appear most tenable, but in the present case there is no room for doubt, and, like the protective power of vaccination, the carriage of malaria by mosquitoes only, may be taken as one of the few absolutely proven facts of medicine.

In saying as much, it is not implied that the reader may not on his travels meet with medical men sceptical or hostile to this theory, but this is because the training required to appreciate the cogency of the facts adduced in proof is that, not of a medical man, but of a naturalist, and though the profession of medicine numbers in its ranks many distinguished naturalists, it is quite possible to gain the highest qualifications without acquiring any knowledge of zoology sufficient to render the student capable of really forming an opinion on such a point; for, as a matter of fact, the five years of medical training are so overburdened with absolutely necessary medical subjects, that any critical knowledge of the associated subjects of chemistry, physics, and biology must needs be left to the after years of those to whom good fortune affords sufficient leisure to admit of their attacking the fringe of these great subjects when they are no longer *in statu pupilaris*. Hence, especially among the older hands, there are numbers of medical men who would regard the above statements as premature, but the reader will find it difficult to find any naturalist who entertains any doubts on the subject. Many details undoubtedly remain to be worked out, but the broad data may be taken as absolute facts, of a character that future investigations can only amplify.

These facts may be shortly stated as follows:—

(1) Malarial fevers are caused by the presence in the blood of minute animal parasites. There are several species of these, corresponding to the various types of fever; but the life-history of all is broadly the same.

(2) These animalcules multiply in the blood, and when they have become sufficiently numerous, determine an attack of fever, but while in this stage cannot pass from the blood of one human being to another, except by the somewhat difficult vivisectional experiment of injecting the living blood of an infected person into the vessels of a healthy subject, a process which cannot occur in Nature.

(3) Large numbers of the malaria animalcules are destroyed by what may be called the vital powers of the patient's blood, and the question whether an untreated case of malaria dies or recovers, depends on the outcome of the

struggle between the parasites and the vital forces of their host.

(4) The process of multiplication of the parasites within the human body is by simple division, or non-sexual breeding of the single cell of which each parasite consists; but by a well-known law of the life-history of this class of animalcules this method of multiplication cannot continue indefinitely without the intervention of a period of sexual multiplication; and this can not occur within the human subject under any circumstances, but only in the bodies of certain species of mosquitoes; so that the disease always tends to wear itself out, provided the strength of the patient holds out sufficiently long; and the parasites are unable to find their way into the blood of other human beings by natural processes, unless mosquitoes of certain special species be present.

(5) If, however, a human being infected with malaria be bitten by a mosquito of the appropriate sort, the parasites, sucked into the stomach of the mosquito along with its meal of blood, undergo further development into distinct male and female animalcules, whose union gives birth to myriads of germs which, although incapable of further multiplication within the organism of the insect, find their way into its salivary glands, which are the organs in which the irritating poison of the mosquito is elaborated, and so are necessarily inoculated into the tissues of any human being whom the mosquito may bite, with the result that a new victim becomes infected, and the chain of events commences anew.

(6) The malarial parasites can exist in the mosquito only within certain limits of temperature, and hence the disease is not found in countries where the maximum summer temperature is less than 76° F., or in places so hot that the temperature rises above 86° F. for any length of time, and the comparative healthiness of many hot continental climates is due to the fortunate circumstance that a period of excessive dry heat follows immediately on the cold season.

In considering the measures of prevention detailed below, it must be remembered that their importance is enhanced by the fact that not only malaria, but also the blood-worm disease already alluded to, or filariasis, and yellow fever, have also been shown to require the intervention of mosquitoes for their transmission from man to man, and that although not carried by mosquitoes, the germs of sleeping sickness are also probably conveyed by a winged insect, so that many of the measures detailed below will have a certain value also in the prevention of the last-mentioned disease.

Thus for the maintenance of malarial fever the co-existence of three animal organisms are essential, viz., of man, the mosquito, and the malarial protozoon; and it is obvious that even the temporary banishment of either of the three from any given locality will necessarily put an end to all possibility of the occurrence of fever; for man can be infected only by the mosquito, and the mosquito by man, and the presence of both of the others is necessary for the maintenance of the species for the parasite.

For the proper contrivance, then, of measures of prevention it is essential that we should be well acquainted with the life-history of our two partners in this curious cycle of development, and as that of the parasite has already been sufficiently described for our purposes, it remains only to describe the leading parts of the life-history of the mosquito. Mosquitoes, or, as they are called in England, gnats, are small two-winged insects whose appearance is quite familiar to most people, though midges so closely resembles them, in general appearance, that they are commonly confused with them, but mosquitoes may be easily distinguished by their possessing a long, trunk-like proboscis which is wanting in the midge, as well as by the fact that, if examined with a strong magnifier, it will be seen that their wings and the greater part of their surface are covered with minute, downy scales exactly like those of butterflies, while midges are quite devoid of any such covering. The males carry a pair of beautiful plume-like feelers, while those of the females, though quite as long, show only a few inconspicuous hairs.

Over five hundred species of mosquito have been described; and, as might be expected, their habits vary to some extent; but, speaking generally, they are mainly twilight and nocturnal insects which remain hidden in sheltered places during the day, and come forth to feed and disport themselves in the open at dusk. Owing to the peculiar structure of their mouth-parts, which consist of a long, delicate tube, supported in the midst of a group of lancets, they are incapable of taking solid food, and subsist almost entirely on the juices of living plants and animals, which are sucked up by means of the tube which is introduced into a puncture made by the lancets. With one or two doubtful exceptions, the males of all species live entirely upon the juices of plants, but the females of perhaps the majority of species are not content with so simple a diet, and attack animals of all sorts, puncturing the skin and filling themselves with blood till they are scarce able to fly. No animal is safe from their attacks, and improbable though it may appear, it is recorded, on the authority of a skilled naturalist, that young fish are killed in large numbers by the crowds of mosquitoes which pounce on them as they show their heads and backs at the surface of the water.

With the exception of the fleas and ticks, no insects are so admirably adapted for the conveyance of disease from one animal to another by inoculation; and owing to their enormous numbers, and their capability of flight, their powers of mischief must be far greater than those of either of these other pests. When biting an animal, the mosquito injects into its tissues a fluid specially secreted within its body, which being of an irritating character causes a congestion of blood round the puncture, whereby the insect is secured a full and ample feed of blood. The early life of the mosquito is passed in water, on the surface of which the eggs are laid by the female flying insects. These eggs are of various forms, but are all provided with some arrangement to secure their floating on the surface of the water. In many species they are glued together by their sides so as to form rafts consisting of some hundreds of eggs, while in others, and notably in the special sorts that carry malaria, they are laid separately and float on their sides. In a few rare cases they may be laid on dry surfaces, in situations that will be flooded during the rains. This is notably the case occasionally with the form that carries yellow fever; but for practical purposes it may be considered that the eggs can only be laid on water, and in any case, when the young insects are hatched out, it must needs be into water, as at that stage of their existence they are purely aquatic organisms, and live but a short time if removed from the

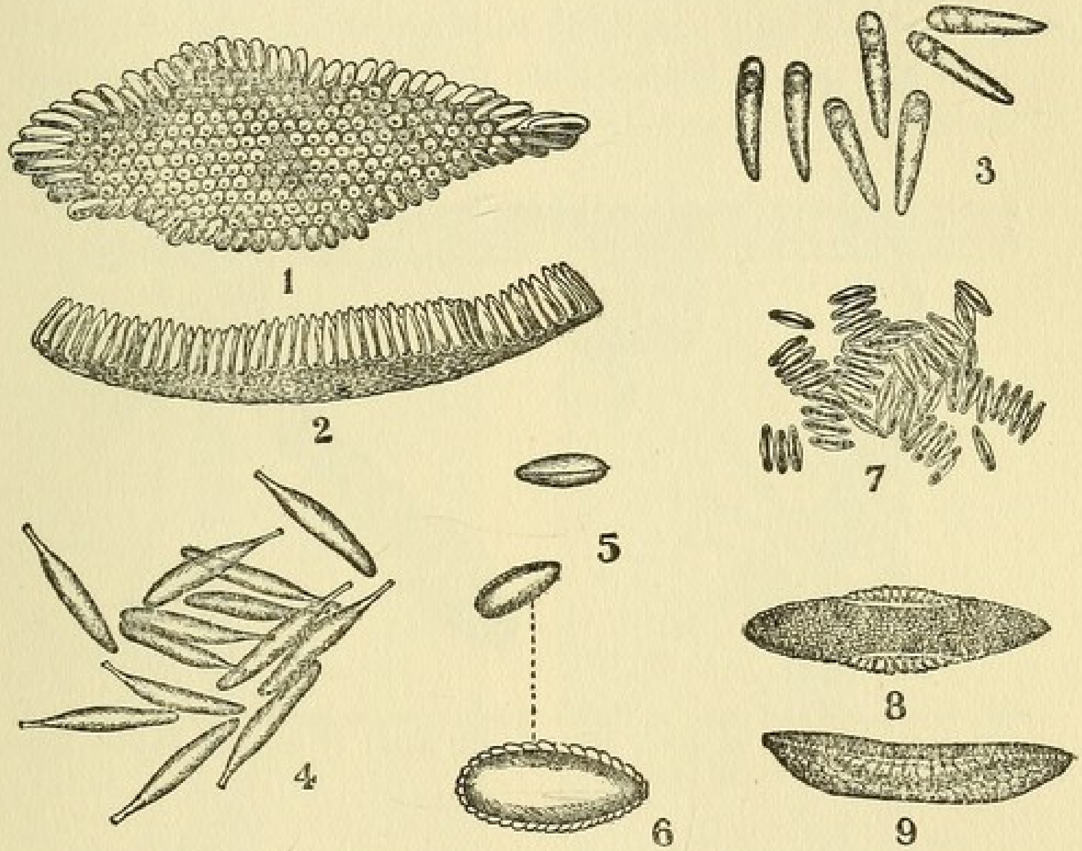


Fig. 6.—Various forms of Mosquito Eggs. (1) Egg-boat of *Culex*, seen from above; (2) the same, side view (after Sambon); (3) separate *Culex* eggs; (4) eggs of *Panoplites* (after Daniels); (5) eggs of *Stegomyia;* (6) the same more highly magnified (after Theobald); (7) groups of *Anopheles* eggs as they float on the water (after Sambon); (8) egg of *Anopheles maculipennis*, showing lateral floats, seen from above, × 20 diams.; (9) the same, viewed laterally (after Nuttall).

water. In spite of this they are air-breathers, and in the anatomy of their arrangements for obtaining air, present a curious resemblance to the type of submarine boat that gets its air by means of a small tube reaching just above the surface of the water. The young mosquitoes, or larvæ, are small, wormlike animals, which may often be seen wriggling about vigorously in water, and are especially common, in warm weather, in water standing in small stagnant pools, broken crockery, old tins, and so forth.

When full grown they are about a quarter of an inch in length, and vary in colour from bright green, through brown to black. Two principal forms may easily be distinguished by the difference between the structure of their breathing organs. The first and commonest kind, of which the common English gnat (*Culex pipiens, L.*) is a good example, has a long breathing tube projecting from the back close to the tail, so that it looks much as if the hinder part of the body were forked.

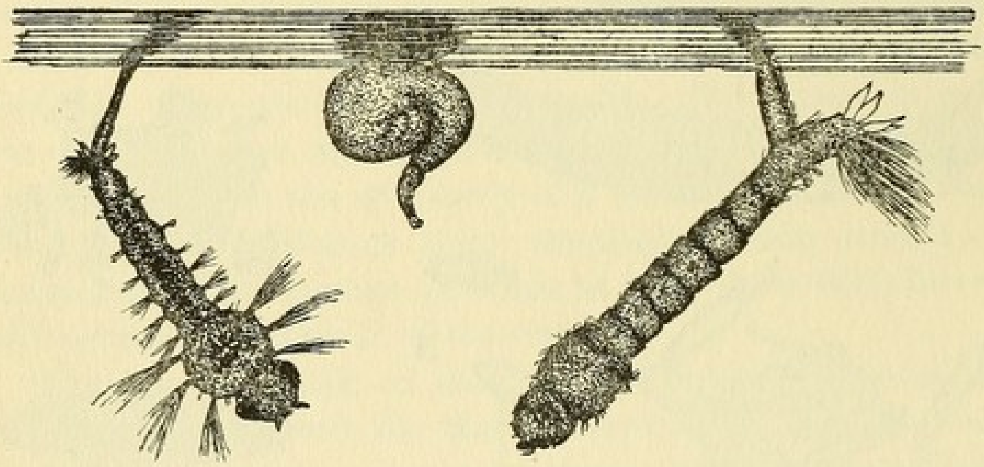
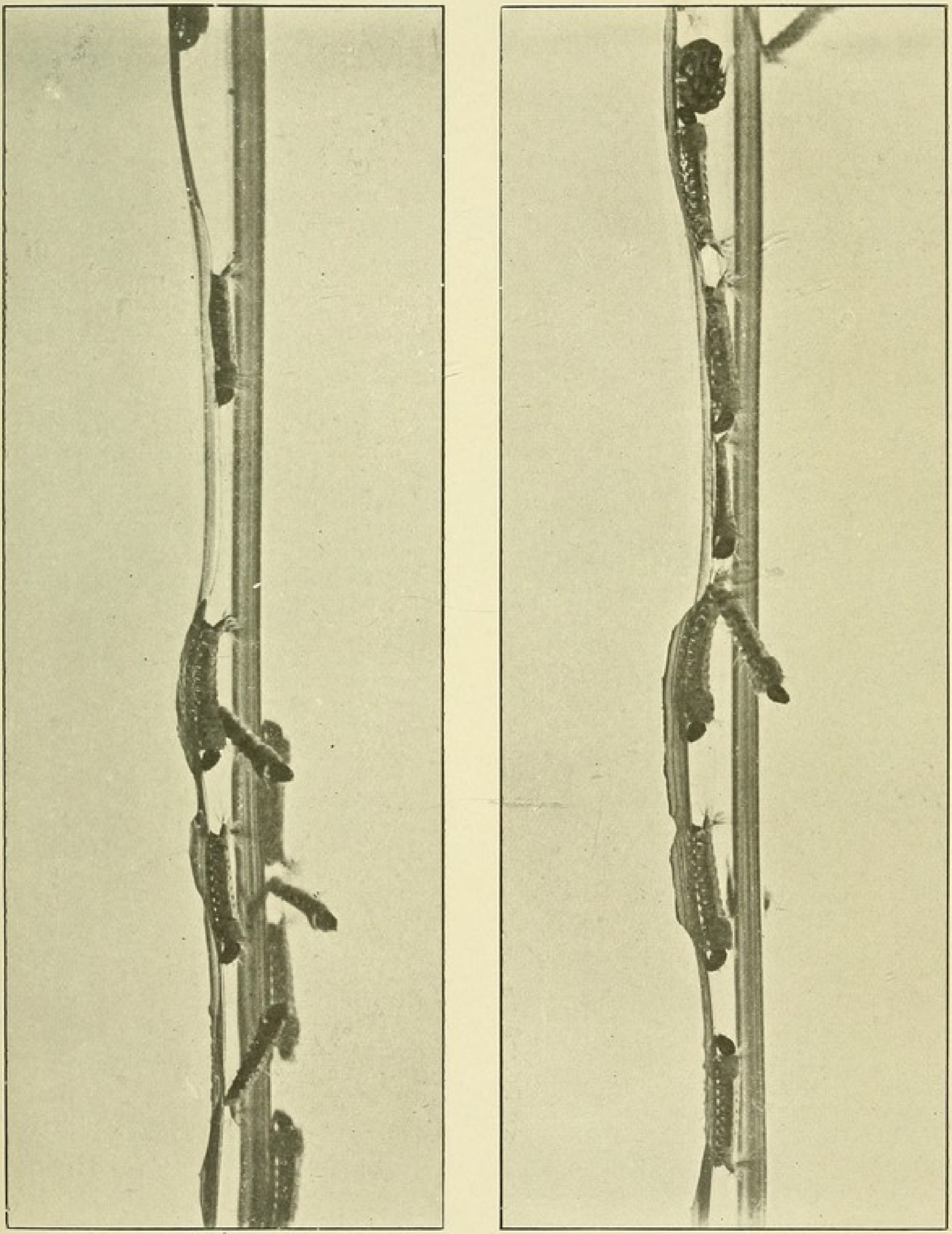


FIG. 7.—Larvæ and pupa of Culex mosquitoes, as seen when viewed from the side of a tumbler or other transparent vessel of water. Drawn from a photograph of the living insects.

As will be seen from the above illustration, only the tip of the breathing tube is kept at the surface of the water, while the body and head hang down into it in a slanting position, so that the head is the most deeply immersed portion of the insect. In the other kind there is practically no breathing tube, the air-vessels opening almost flush with the surface, though in the same part of the body; and hence, in order to keep these openings at the surface, the larvæ must needs lie horizontally at the surface, looking much like a small blackened straw, and on closer inspection are seen to have an outline not unlike the ornamental keyhole plates often seen in old-fashioned furniture. They generally lie with their tails supported against some solid object,

PLATE I.



Living *Anopheles* larvæ. Photographed by Mr. T. H. Royle, of Rosa.

such as the side of the saucer in which they have been placed for observation.

Owing to their being confused with the line of optical contact of air and water, and the latter being raised by adhesion into curves over their backs, they do not come out as clearly in the photograph as in a drawing, but they are, nevertheless, sufficiently clearly shown for easy recognition, a matter of some importance, as these are the larvæ of the sub-family *Anophelinæ*, to which belong all the mosquitoes that are concerned in carrying malaria, besides which they

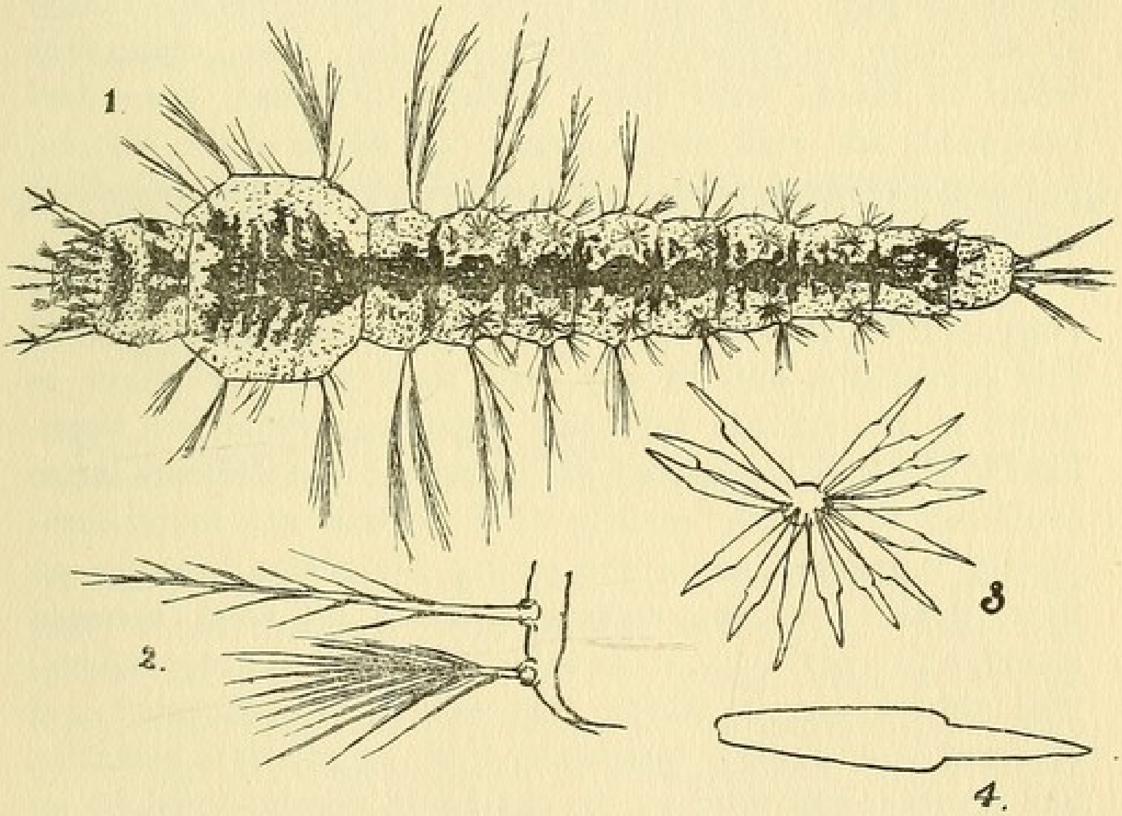


FIG. 8.—(1) Larva commonly found in jhils and tanks (probably of *Myzorrhynchus sinensis*); (2) frontal bristles of the same; (3) abdominal palmate tuft; (4) separate leaflet of palmate tuft.

are the commonest carriers of blood-worms. The mosquito, however, that conveys yellow fever (*Stegomyia*) belongs to the Culex sub-family.

For any one possessing a microscope these larvæ form most fascinating examples of "pond-life," as many species, especially when young, are transparent enough to enable one to follow the entire mechanism of their internal organs;

but a great deal of interest can be made out with a simple hand-lens.

On the back of each of the rings of the abdomen, or hindmost division of the body, of the Anopheles larvæ may be made out a pair of structures formed like minute palm leaves, the function of which appears to be that of keeping the little creature flush with the surface of the water.

One of these larvæ, magnified about twenty times, with these structures and certain peculiar hairs on the front of the head, which are of value in distinguishing one species from another, more highly magnified, is figured on the preceding page. By the aid of these illustrations the reader should have no difficulty in recognising these organisms when he meets with them. When disturbed, they dart backwards and seek refuge among the *débris* at the bottom, but cannot remain there long, and soon resume their resting position on the surface.

The larvæ of many species are said to be carnivorous, and even cannibalistic, though I cannot say I have ever observed this personally, and in any case their main provision is found in the minute vegetable organisms which are abundant in the sites where they are common; the Culicine larvæ confining themselves mainly to those that are found completely immersed, while the young Anopheles browses on those floating on the surface, keeping its head screwed round, a full half-turn, so as to bring the mouth uppermost. The abrupt way in which this action is performed and reversed is extremely quaint, so that, as a writer remarks, one is rather surprised at its not being accompanied by an audible click.

The duration of the period of larval existence depends on the temperature of the water and on the abundance or scarcity of food. When first hatched out from the egg, the larvæ are barely visible to the naked eye, whereas when full grown they contain within themselves the entire material of the adult flying insect. Once full-grown, the weather being favourable, they change into "nymphs" or pupæ, not unlike small tadpoles in form, the head and thorax being enclosed in an almost spherical envelope, to which is appended a sort of tail, formed by the abdomen, which is usually kept folded under the body, as shown in the figure below. In this stage the animal breathes through a pair of horns springing from the back of the thorax. The mouth is completely closed, so that the pupa is incapable of feeding, but is in no sense quiescent, as it is capable of lively movements and tries to elude capture almost as briskly as the larva. After a sufficient time has elapsed for the completion of the extraordinary anatomical changes that convert the larva into the adult insect, the pupa-case bursts along the back, and the perfect gnat gradually disentangles itself from its temporary home, and flies away, very shortly to reinitiate the cycle of events by laying a fresh batch of eggs.

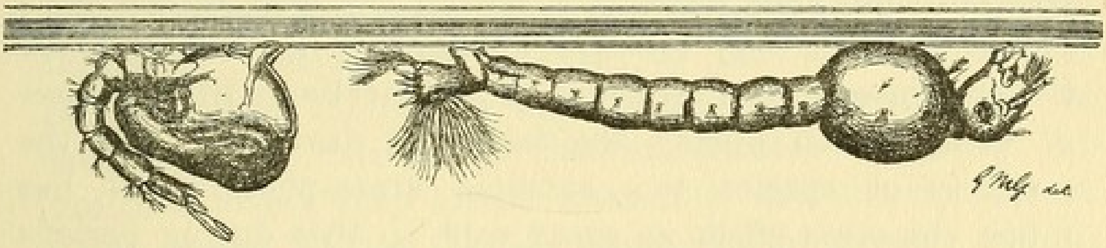


FIG. 9.—Larva and Nymph of *Anopheles*, to show habitual resting position. The head of the larva is shown looking up, as when feeding.

As has already been remarked, the time required to complete these changes varies greatly in different species and under varying environments, of which climate is the most important factor, but under moderately favourable conditions the time required is a fortnight or three weeks, the greater part of which is passed as a larva. In countries where water freezes during winter for any length of time, all larvæ that have not completed their metamorphosis by the end of autumn, must necessarily perish; and the continuity of the species is maintained entirely by the survival of pregnant females that hide themselves in warm corners and pass the winter in a truly hybernating or dormant condition. Further south, both males and females hybernate, and the dormancy is so much less pronounced that the insects are often tempted to issue from their hiding places on exceptionally warm days. In such climates, which include Italy and most of the sub-tropical zone, the species finds an additional string for its bow in the survival of larvæ, which, though they cannot be said to hybernate in the strict sense of the term, being always lively and alert in their movements, are yet incapable of growing, and appear to remain at whatever size they may have previously attained until the return of warmer weather. Quite recently Dr. Bancroft, of Queensland, has discovered that in some species these wintering larvæ can give birth to small broods of young larvæ, so that in such cases the bow has no less than three strings. Further south again, in truly tropical climates, breeding goes on all the year round.

No adult mosquito can stand the direct rays of the sun, and hence all of them have to seek the shelter of houses, trees, or some such protection, during the heat of the day; moreover, with very few exceptions, they are nocturnal or twilight insects, so that there is comparatively little danger of being bitten during the hours of daylight. For the majority of species too, extreme atmospheric heat has much the same effect as great cold, so that during periods of intensely hot, dry weather the number of species to be met with in a state of activity is very small, and fortunately those that convey malaria are not amongst the number; but on the other hand, the one or two sorts that possess this tolerance are so enormously prolific that their numbers far exceed those of all other species combined.

Another point of importance is that, for practical purposes, mosquitoes cannot fly far, and hence never wander far from the puddle on which they were born. Being tolerably long-lived insects, it is of course possible for them to slowly spread amongst trees or bushes for considerable distances, a few straying further and further away every night from the place of their birth, but the number that can travel in this way for any considerable distance, is so small as to be scarcely worth consideration; and any considerable expanse of bare, open country is practically impassable to them.

Mosquitoes are most active during the periods of twilight, and especially in the evening, at which time they quit the shelter in which they have dozed away the day, and come out into the open to seek their food, remaining outside for the most part throughout the night, though the females of those species that attack man and animals, it is needless to say, will find their way back into houses in search of their favourite food. As soon, however, as the sun has got well above the horizon they may be observed trooping back into the house, and if a window be closed it is very amusing to watch the numbers that will alight on the glass at this time of the day, and their efforts to find a way through the obstruction. The special importance of keeping all means of entry closed at this particular hour can therefore easily be understood, though in ordinary tropical practice, it is the very time at which every door and window is habitually thrown open.

Mosquitoes are found all over the world, it being a great mistake to imagine that they are confined to tropical climates. Some score of species are to be found in England, and though in high latitudes they cease to be dangerous as carriers of disease, there are perhaps no localities where they are so numerous and troublesome as certain parts of the North American Continent, and in Scandinavia, close up to the Frigid Zone.

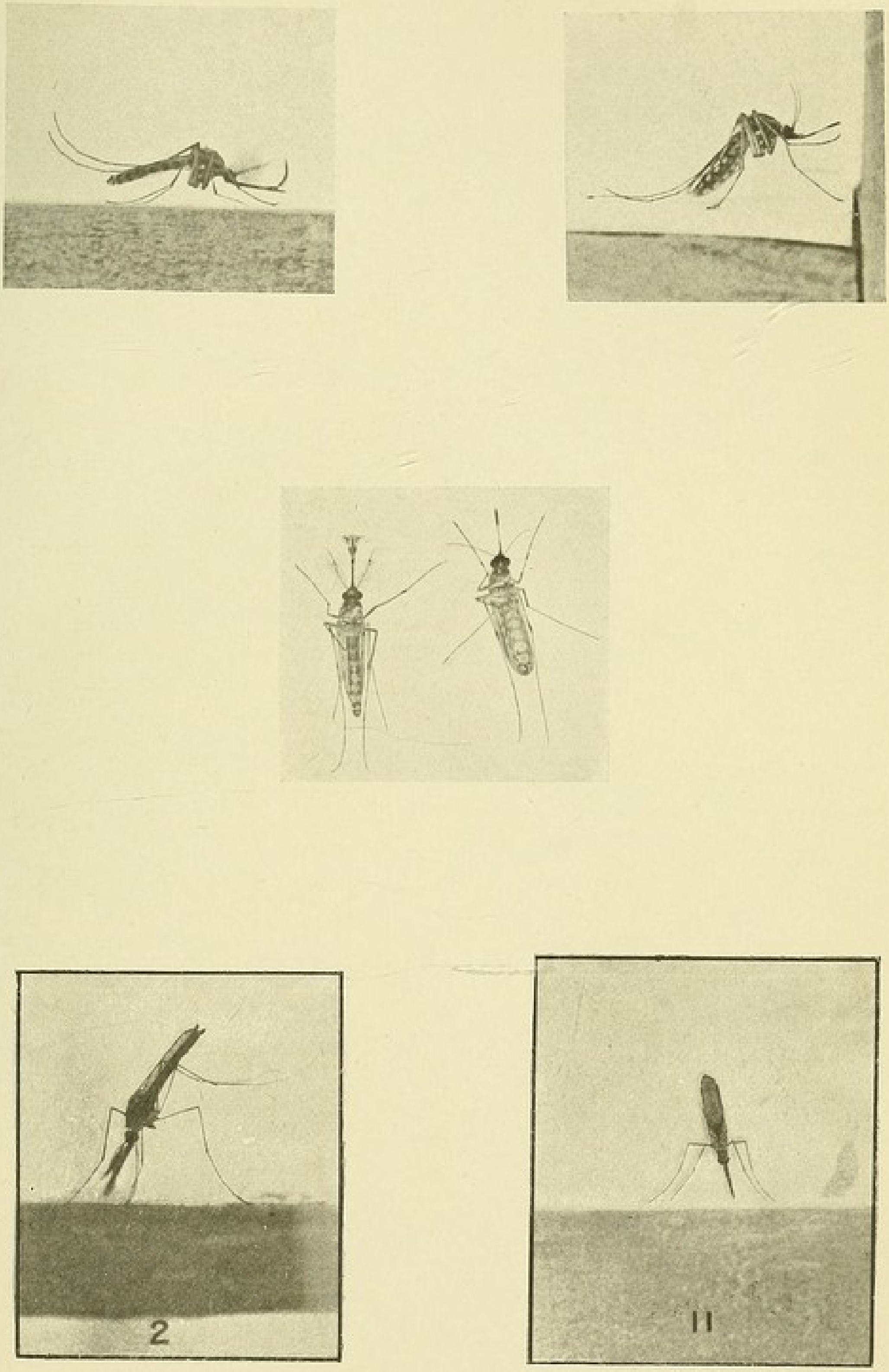
Almost any collection of water will serve as a nursery for the larvæ, unless indeed, there be a decidedly strong current; but the situations taken by preference during the breeding season are small stagnant pools and domestic collections of water, such as small tanks, broken crockery, empty tins, &c.; while wintering larvæ prefer the larger ponds and marshes which are permanent throughout the cold weather, and especially select those in which there is sufficient vegetation, reaching to the surface of the water, to afford cover and protection from their numerous enemies. Practically speaking, wintering larvæ will never be found in tanks or ponds devoid of fairly robust vegetation, and it may easily be understood from this fact that the clearing away of reeds, grasses, and weeds of all sorts during the cold weather from all such collections of water which may be found near an inhabited site is a most important sanitary measure. Some species prefer the fairly clean water of marshes and ponds, while others luxuriate in the dilute sewage of the domestic waste water, but it would occupy too much space to go into any detail on this subject, and all that the sanitary amateur need remember in this connection, is that any and every collection of water, capable of standing for ten days or a fortnight, should be regarded as dangerous to health in any country where malaria is known to exist.

For our purposes, it will suffice for the reader to understand the general characteristics of three sorts of mosquitoes. First, there are the common *Culex* mosquitoes, which are, almost everywhere, far more common than the others. They are usually of a dull grey colour, and with very few exceptions, their wings are quite plain and free from spots. As will be seen from the photographs in the accompanying plate, they sit in rather a humped-up position, and the proboscis is obviously much thinner than the body, its appendages, or palps, being held apart from it. Mosquitoes of this sort cannot convey human malaria, though they are instrumental in conveying a similar disease for certain animals. They are to be found, in greater or less numbers, throughout the year.

The second sort is the *Stegomyia*, which is the genus concerned in the conveyance of yellow fever. These mosquitoes are seldom to be seen except during the rains, and rest in much the same position as the *Culices*, which they resemble closely in form. Their wings are never spotted, and almost all are small insects clothed with jetty-black scales, picked out with an ornamentation of dazzling white lines on the body and spots on the abdomen and legs.

The third, or *Anopheles*, sub-family is that concerned in the transmission of human malaria, and, as may be seen by comparing the two lower photographs of the plate with the upper ones, can easily be recognised by their characteristic form and attitude. In these mosquitoes the feelers are long and thick in both sexes, and as they are held habitually in contact with the proboscis, these together appear to the naked eye as a prolongation of the body as thick, or thicker, than the abdomen. Moreover, except in a few species, their posi-

PLATE II.



Photographs of living mosquitoes. Above, ♂ and ♀ *Culex* mosquitoes in profile; in the middle, ventral aspects of the same; and beneath, ♀ and ♂ *Anopheles* mosquitoes. About twice natural size.

tion, when resting, forms a singular contrast to that of the *Culices*, the whole body and proboscis being held in one straight line, with the abdomen raised from, and the pro-

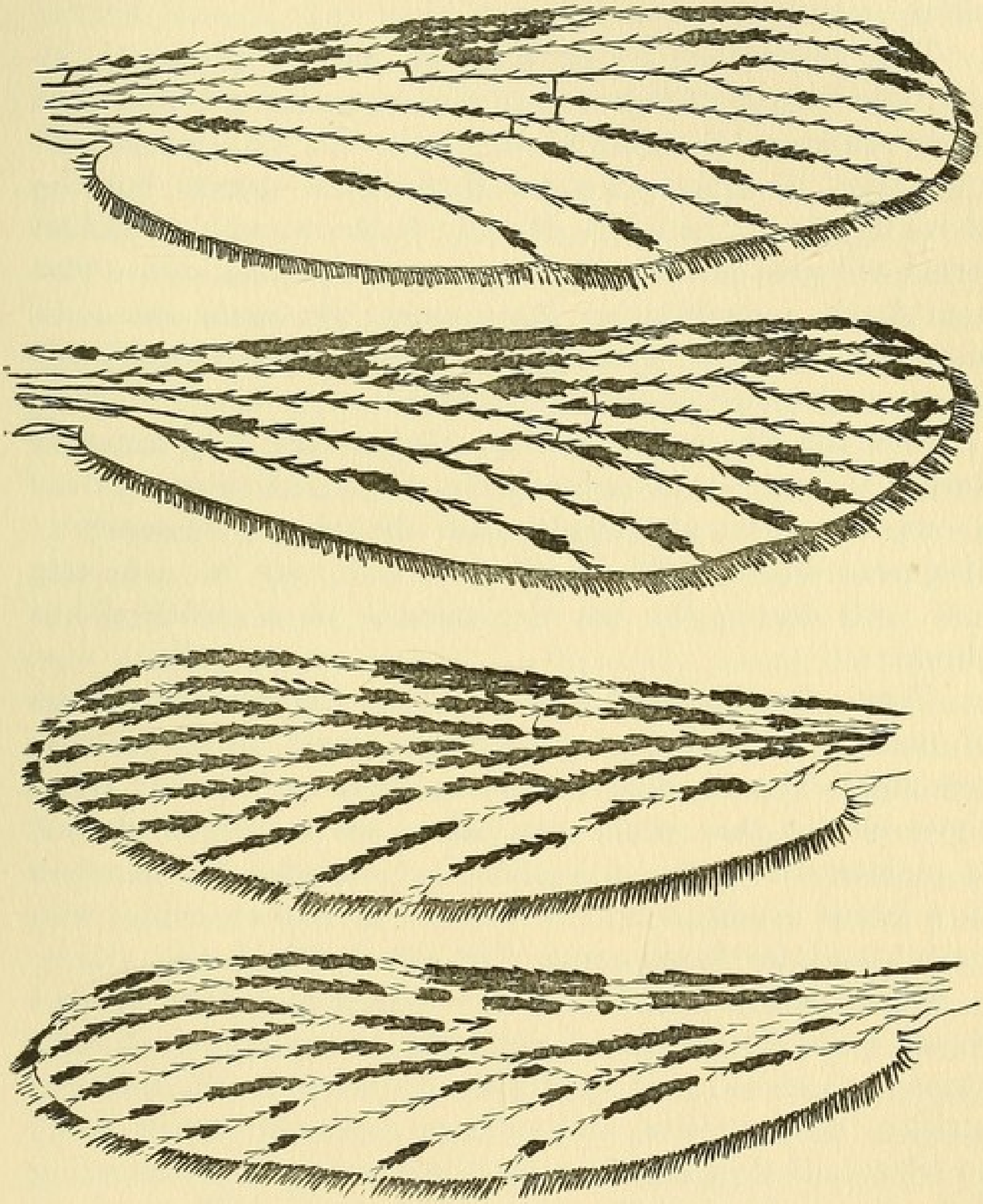


FIG. 10.—Wings of various sorts of *Anopheles* mosquitoes, much magnified, to show the arrangement of the dark and light scales which form the characteristic spots.

boscis pointed almost vertically at the surface on which they rest, and almost touching it with its point, as if they were preparing to drive the latter into it; so that, viewed with the naked eye, they look much like minute black thorns, stuck into the surface on which they are sitting. On closer examination, it will be seen that the wings are not plain, but spotted (the number of plain-winged species being unimportant).

The appearance of spotting is usually produced by alternate lengths of the veins of the wings being coloured in finely contrasted dark brown or black, and white or yellow, and varies, of course, in detail in different species, but the above figures of the wings of some of the commoner Indian forms will give an idea of the general effect, as seen under a moderate magnification, for though the spots are quite visible to the naked eye, it requires a fairly powerful hand lens to make out the details properly.

Like the *Stegomyiæ*, the *Anophelinæ* are only common during the rains, but stray specimens will be met with for a month or two afterwards; and though they practically disappear during cold weather, a few may be generally met with during the hot dry months of continental hot climates.

From what has been said, it follows that the prevalence of malaria, like that of mosquitoes, must necessarily be seasonal. The survival of the malarial parasite at those times of the year when mosquitoes are scarce or absent, is maintained by the persistence of considerable numbers in a latent condition, in the persons of human beings who have been imperfectly cured of an attack of malaria.

Cases of this sort, which have either been never treated at all, or in which the administration of quinine has been stopped too soon, are extremely common in all malaria-stricken communities, and such persons are always liable to relapses if they are brought below *par* by any depressing influence, such as chill, too great exposure to the sun, or the incidence of injuries, or of other diseases.

During such periods the latent parasites, which have been perhaps for months lying hidden in the internal organs, will reappear in the blood in large numbers, and there are always a sufficient number of such cases of relapse persisting through the naturally malaria-free season, to suffice to infect the early broods of mosquitoes that come to maturity with the advent of the rains.

This shows that the curing of all cases of malaria is matter by no means confined to the interests of the patient himself, but is of great importance to the entire community of which he is a member; for, despite the fact that the disease is only indirectly transferable through the agency of the mosquito, a case of malaria is as great a danger to his fellow-men as one of any other infectious disease, and should, as far as possible, be dealt with in the same way; only the problem of isolation is in this case easier than usual, as it suffices to prevent mosquitoes getting access to the sick person; and in a properly fitted mosquito-proof house or hospital, malaria cases may quite safely be allowed to mix freely with the healthy, as well as with persons affected with other diseases.

Relapses in persons chronically infected with malaria may occur at any time of the year, but the fresh infections, which always form the bulk of the cases met with, can only happen as the result of a tolerably recent bite by an infected mosquito; and as about a couple of weeks are required for the maturing of the parasite within the insect, and a further period of incubation is necessary within the human subject before the parasites attain sufficient numbers to produce a definite constitutional reaction, fever does not as a rule commence in earnest until some three weeks or a month after the break of the wet season. Once the process is started, infected mosquitoes and malaria-stricken men increase in numbers rapidly, and as numbers of infected mosquitoes survive for a considerable period after the cessation of the breeding season, the prevalence of malaria continues until the advent of cold weather puts a period to the possibility of the survival of the parasite within the insect organism. Hence it is generally quite possible to give a fair idea of the monthly distribution of rainfall in any warm climate from the returns of sickness and mortality, and *vice versâ*.

The natural history of the living organisms that are concerned in the propagation of malaria has been described with some detail, as suitable measures for the prevention of the disease must needs be based on a fairly competent knowledge of the subject, and is the more necessary as it is hardly possible to give any "rule of thumb" directions; because the circumstances on which the prevalence of malaria depends vary so greatly in different localities that, to ensure success, our operations must necessarily be modified in each case to meet local conditions.

In the following remarks, however, it is not proposed to deal with the question of prevention on a large and public scale, but only with such as can be adopted as measures of individual and personal hygiene, as the larger question of provincial and municipal anti-malarial sanitation cannot be adequately dealt with in a short treatise like the present.

Keeping always in view the just described data of the life history of the malarial parasite and of its temporary host, the mosquito, it is obvious that our measures of protection must be based on one or more of the following plans of action, any one of which, could it be carried to complete success, would suffice to "stamp out" the disease. These measures are :—

(1) To destroy the mosquitoes.

(2) To prevent mosquitoes biting man.

(3) To prevent mosquitoes from becoming infected, by isolating all cases of malaria in man.

In practice, however, it is extremely rare that anything like complete success can be attained on either of the three above indicated lines of action, especially as concerns the second and third methods, and though here and there localities may be met with in which the breeding places for mosquitoes are so circumscribed and easily dealt with as to render the actual extermination of mosquitoes practicable, in by far the majority of cases we must be content with a partial success all along the line, by adopting such measures as may be locally most practicable, based on any or all three of the above principles of action.

In the case, for example, of habitations placed in the midst of canal irrigation where ample and efficient subsoil drainage is impossible or too expensive, the attempt to destroy mosquitoes can be little better than a waste of time and money; for under such conditions the breeding places are so numerous, and appear so constantly in new and unexpected situations, as to defeat the utmost vigilance; and the thorough protection of all habitations against the invasion of mosquitoes, and the careful treatment of all cases with quinine, is all that can be done. On the other hand, in an exceptional case, such as that of the town of Ismailia in Egypt, where the rainfall is practically *nil*, and the breeding places all of artificial origin, the practical extermination of mosquitoes may be so easy a matter as to be effected at a small expense in a single year, with the immediate result of reducing the cases of malaria to a tithe of their previous numbers.

Measures of the first class, *i.e.*, the extermination or diminution of the numbers of mosquitoes, can often be undertaken with considerable success by private individuals, the possibilities of success varying, of course, with the extent of the area directly or indirectly under his control.

The resident of a closely inhabited town can, it is needless to say, do no more than contribute his personal mite to the general welfare in this matter, with little chance of reaping much benefit unless his neighbours follow his example; but with the exception of diplomatic officials and merchants residing in places under oriental rule, where the safety of life and property are too badly secured to admit of their living outside town limits, it is rare for any European to be so situated, as in most of our colonies and dependencies the European quarter of the town consists of widely separated villas each surrounded with a garden of some size, with generally a small hamlet of dwellings for native servants and dependents included within its boundaries. In addition to this, there are often open spaces, of considerable extent, between the various "compounds" which, though not directly under one's control, are so far "no man's land" that no one will interfere with any one employing on them any of the measures required for anti-malarial sanitation, while the most litigious municipal council is hardly likely to object to the sprinkling of a little paraffin on the roadside puddles. In this way it will generally be possible to effect a good deal within a radius of three or four hundred yards of one's dwelling, and actual experience has shown me that if all breeding places within such limits can be rendered harmless the number of stragglers that will stray across from places beyond will be too small to be seriously troublesome.

In devising measures for the destruction of mosquitoes it is obvious that while they may be attacked either in the aquatic or aerial stages of their existence, the easily localised larvæ and pupæ will be far more easily dealt with than the illusive flying insect, and it will be therefore best to devote most attention to the destruction of the former.

There are two principal methods of dealing with the insects during their aquatic stage, *i.e.* (1) by doing away with their breeding places; (2) by poisoning them. Of the two it is clear that the former method is, where practicable, the more valuable, as in nearly all cases its effects are more or less permanent. With either object in view, however, the first step is to seek out the breeding places.

As a preliminary measure, all domestic rubbish capable of holding water, such as disused flower-pots, empty tins, &c., should be carefully sought out and destroyed or disposed of by throwing into some depression of the soil which it is desired to fill in. Next, the entire surface should be carefully inspected after a brisk shower of rain, and all such puddles as are of manageable dimensions carefully filled in and levelled.

The amount of labour that can be profitably afforded in work of this sort will depend a great deal on the probable duration of one's stay in a place; as temporary residents, such as government officials, will find it much cheaper to employ temporary measures, such as the use of paraffin; while in the case of merchants and other permanent residents, the expenditure of a considerable sum on permanent measures will be more remunerative in the long run. The great difficulty often lies in finding spoil wherewith to fill in the depressions, as unless care be exercised, the only result will be to shift the site of the puddle. Sometimes, however, a bank of earth surrounds the compound by way of a hedge; and as in a level country the existence of such an obstruction to surface drainage is most objectionable such banks should always, if possible, be removed and a hedge of wire or bamboo substituted; when the spoil can be advantageously utilised for filling in hollows. Where no localised elevations are to be found, the material required should be obtained by a general very slight removal of the surface. In other cases it may be possible to drain a depression by cutting a shallow gutter to the nearest surface drain.

Another and very important class of breeding place consists of the comparatively large collections of water formed by the various reservoirs, channels, &c., constructed for obtaining and storing water for various domestic purposes, such as wells, tanks, &c., and especially the appliances for watering gardens. Of these the most harmful of all is canal irrigation, which should undoubtedly be never tolerated near a dwelling by any one valuing his health, malaria or no malaria; for the waterlogging of the soil, that is practically inseparable from the system, is either the exciting or predisposing cause of a variety of diseases, many of which, such as rheumatism, consumption and cancer, are perhaps more seriously dangerous than malaria. Sodden and waterlogged sites are notoriously unhealthy all over the world, and chronic ill-health is a high price to pay for a few flowers and vegetables; so that the settler will be well advised to leave irrigated cultivation to those who are constrained to adopt it for a livelihood, and banish it from his own premises; as much is gained by living on a comparatively dry site of however limited extent.

As a matter of fact, indeed, the possession of a garden of any sort is a more than doubtful benefit in malarious places, for trees and shrubs necessarily form lurking-places for mosquitoes; and even with the greatest care, it is difficult to carry out the necessary watering of the plants without giving rise to puddles; while the various reservoirs, &c., that are almost indispensable, are a constant source of danger unless constantly and minutely supervised.

In India, for example, gardens are commonly watered from wells by means of water lifts of various forms, which are worked either by means of bullocks or by manual labour.

In order to facilitate the distribution of the water, masonry channels are usually constructed which carry the water from the well head to all parts of the garden, and as the lift cannot conveniently be worked continuously, a number of small tanks are arranged along the line of channels wherein water is stored, so that it can be dipped out and distributed by means of an ordinary watering can without the gardener ever having to go far to replenish it. Now these small tanks are *par excellence* the main source of supply of mosquitoes of all species, and therefore of malaria, to the houses to which they are appended. If, therefore, a garden be considered indispensable, all such tanks should be carefully emptied and all deposit cleaned out at least once a week; under which circumstances, though they will probably swarm with larvæ by the end of the time, it is impossible for any of the latter to complete their metamorphoses into adult insects. By far the least objectionable plan of relieving the dust and glare of a bare situation is the cultivation of a well-kept lawn, a few large trees being left and the area of flower beds strictly limited, for as flooding the grass is sure to spoil a lawn, success can only be ensured by careful and moderate waterings at frequent intervals.

Collections of water that are too large to be done away with by filling in or by draining, should be dealt with by oiling the water with paraffin. There are some other agents which may be employed for the purpose, but none of them are so cheap, efficient, and readily obtainable. As an additional advantage, though fatal to all kinds of insects, it is in the quantities employed, not only absolutely harmless to vegetation, but water so treated is actually a most valuable application, owing to its power of destroying other injurious insects. When sprinkled on water paraffin spreads out into an extremely thin film, so that a very small quantity will cover a considerable area. A three-gallon tin, for example, contains enough to cover an area of 100 yards each way, though it may be a day or two before the oil reaches all parts of such a space. It is important to remember that the cheaper and commoner the oil, the better it is for the purpose, and the addition of a little of common bazar, *ghi*, or clarified butter, is said to make the oil spread better and render its action more lasting, though the writer has not personally experimented with the mixture.

In the quantities used there is no possible danger of fire, even though wooden structures, such as the piles of bridges, be immersed in the water, as the film is so thin that it is impossible to ignite it; a matter one would have thought sufficiently obvious, were it not that objections have been gravely raised to the use of parffin on this score.

The method of application must be varied to suit the size and situation of the piece of water to be dealt with. Small puddles, such as those left in the course of roadside ditches, may most economically be dealt with by, as it were, lightly wiping over the surface with a wisp of rags dipped in the oil; filling in being in such cases out of the question, as to do so would be equivalent to obstructing the drainage; and it is quite impossible to maintain an exact and uniform gradient in an unrevetted channel.

For larger collections of water, by far the best appliance is an ordinary gardener's watering-pot. The oil should be applied mainly along the windward side of the pool by a coolie, who should, if possible, walk out some distance into the water, and should be trained to sprinkle the oil by rapid single sweeps of the rose of the can, a few steps being taken between each sweep, as there is no need to make the loop-shaped areas of water sprinkled in this way continuous, as the oil will spread laterally and join each of them together even if separated by several yards, and no advantage whatever appears to be gained by applying the oil thickly. In exceptional cases, such as the moats of fortifications, where the water is enclosed within high vertical walls, a garden syringe may be required in place of the watering can.

In situations such as the pools in canal beds, ditches, &c., the oiling must obviously be done after each flow of water through the channel; but in most ordinary situations, the effects of a careful oiling may be trusted to last for at least three weeks, as, though larvæ may be beginning to reappear by the end of that period, none of them will have had time to complete their metamorphoses. For the destruction of wintering larvæ, two oilings, one at the commencement, and one towards the end of the cold season, amply suffice; and in Continental hot climates it is needless to repeat the process during the dry hot season, as at that time only artificial breeding places, such as garden tanks, require attention, and these are better dealt with by periodical emptying.

At that season indeed, the undried-up breeding places are so few and far between that people have only themselves to thank if mosquitoes are in evidence at all; and yet in many places there is no season of the year when they are so numerous and tormenting. There are no remaining natural breeding-places, and the pains of a weekly stroll round one's premises to ensure the emptying and cleaning out of all garden tanks, water-vessels, &c., are all that is required to secure complete immunity at that season of the year, but it is most difficult to induce people to take even this trifling trouble; and the mosquitoes are likely to flourish undisturbed until the existence of breeding places within the premises of any person is treated by the authorities in the same way as other dangerous nuisances; and yet these very people are the loudest in their condemnation of the inertia of the native in sanitary matters, and while they maintain malaria breweries on a scale in which the modest extent of his premises forbids him to compete, inveigh against him for starting a cholera factory on the most modest lines. The native who refuses to avail himself of the protection against plague of a health camp is, they admit, an impracticable fool for his pains; but the *sahibs* of the civil lines, whose gardens supply a large share of the harmful mosquitoes to the neighbouring city, are merely "common-sense" people who attach no importance to doctor's fads and "scientific rot" of all sorts. The native, however, has at least usually the excuse that he is unable to read or write; and for the rest, does not pretend to be a very highly civilised person.

Once they have emerged from the pupa case, our means of attacking mosquitoes are comparatively feeble, and for those that habitually pass most of their time in the open air practically *nil*.

In the case however of domestic species, which habitually shelter in houses, a good deal can be done in this matter; and, just as in the repression of other troublesome insects, such as fleas and bugs, scrupulous tidiness and cleanliness is by far the most important of all agencies. Useless, rarely dusted draperies and curtains, and untidy collections of clothing hung about on nails and pegs, instead of being kept in properly closed wardrobes, are the things that are mainly responsible for attracting and sheltering mosquitoes within houses, for they will not, if they can avoid it, remain in a well-lighted room, with freshly colour-washed bare walls.

In the tropics, the Italian villa with its frescoed walls and minimum of useless furniture, is the ideal that should be aimed at, and not the elaborate lumber warehouse of an English drawing-room; which, though comparatively harmless in our own climate, is about as well adapted for imitation in hot countries as the coat of the Polar bear in the Zoo is suited to our summer.

Perhaps our most effective agency in dealing with adult mosquitoes depends on the intense objection all species of these insects entertain to smoke.

That it is quite possible to effectually protect animals from mosquito bites by the agency of smoke alone, has recently been conclusively shown in the course of Mr. Power's experiments on the prevention of horse sickness in South Africa; but, though most semi-civilised people seem to live comfortably enough in a smoky atmosphere, Europeans would find such a state of things intolerable; and the plan can only be utilised to drive mosquitoes out of houses, other methods being relied on to prevent their re-entering. Smoke from almost any source will put mosquitoes to flight, and if sufficiently intense will stupefy them; but certain special materials must be burnt if it is desired to kill them outright, and our *modus operandi* must be varied according to the means at our disposal, for if we can only expect to annoy the insects sufficiently to drive them out of doors, the latter must be left open during the fumigation; whereas, if it is proposed to kill them, all openings must be closed as completely as possible, so that the fumes may reach the insects in as concentrated a form as possible.

For simply driving out mosquitoes, any fuel that produces a dense smoke, such as damp straw, will serve. Maize cobs are excellent for the purpose, but probably the least objectionable is the burning of a little incense (Hindustani, *Lobán*). To actually kill them, on the other hand, it is necessary to shut up all openings as closely as possible, and to burn certain special substances, such as sulphur, unopened chrysanthemum flowers, the leaves of the neem tree, tobacco, &c., and the degree of success attained will vary a good deal according to the character of the building in which it is attempted; it being obviously extremely difficult to secure an adequate concentration of the fumes in a very pervious structure, like a house with a thatched roof and walls of bamboo matting, such as is often met with in Burmah and the Malay Archipelago. Under such circumstances, the rapid burning of a large amount of the fumigating agent is the only way of meeting the difficulty; and under any conditions, plain sulphur, simply ignited as a powdered mass, or placed on the hot coals of a charcoal brazier, burns so slowly as to be quite useless.

A few instants' exposure to an atmosphere containing a fairly high percentage of sulphurous acid will kill any insect, whereas they will be merely stupefied or unaffected by prolonged exposure to a weaker mixture of the poison. I am quite aware that sulphur has been decried as almost useless by several observers, but this is simply because they have not used it properly; for to secure success, something must be added to the sulphur which will make it burn quickly, and what is wanted is, in fact, a weak firework. In well-constructed buildings the sulphur pastiles prescribed in the second edition of my work on the "Gnats or Mosquitoes" answer sufficiently well, but subsequent experience has shown that the proportion of nitre is not enough to secure a sufficiently rapid combustion to instantly flood the air with sulphurous acid, and that nothing short of a slow burning firework, such as a Roman candle or Bengal light, will do this in a building roofed with tiles or thatch. Possibly it might be advantageous to raise the proportion of sulphur; and it is undoubtedly better to pack the material as a powder in paper cases, than to mould it into pastiles. Proper precautions against fire must of course be taken, but in fireworks of this sort the sparks do not fly far, and it is quite safe to use them in any ordinary room if the precaution be taken of placing the cases under a low shield, formed of a sheet of corrugated iron supported on four piles of bricks.

The occasional fumigation of a dwelling in this way is a useful adjunct to the destruction of the larvæ; and where combined with proper wire-gauze protection, after the plan described below, may be relied upon to secure immunity from the attacks of insects, even where measures for the destruction of larvæ are impracticable. It has the further advantage that it is fatal not only to mosquitoes, but also to insect pests of all sorts, such as flies, hornets, bugs, or fleas, and even to such more awesome foes as scorpions and centipedes, all of which delight to share the home of the dweller in tropical climes.

Mosquitoes are always greatly attracted by draperies, especially those of dark colour, and the fact may be utilised to trap them by means of deep bags of black gauze (*chiffon*), the mouths of which are held open by an oval loop of cane, or some such material. Such bags, if hung up mouth downwards in tempting dark corners, will usually be found swarming with mosquitoes each morning, and the insects can easily be killed by crumpling the bag in the hands and then shaking out the dead insects.

By working on the above lines, especially where one has the co-operation of neighbours, it is in all cases quite possible to materially diminish the nuisance of mosquitoes, and under favourable circumstances to practically extirpate them; though, in a usual way, complete success must not be expected. In the exceptional cases where this is possible, there is, of course, no need for the adoption of any other sort of measures; but, in the majority of cases, an amelioration only in the numbers of insects is all that can be attained; and it is necessary to guard against the risk of some of the survivors becoming infected, by the adoption of measures of the second and third classes. Of these the second, *i.e.*, the protection of man from mosquito bites, is in most cases the most easily practicable.

A variety of ointments and applications of various sorts have been from time to time vaunted as protectives, and the presence of certain plants, such as the eucalyptus and the castor-oil shrub, have also been stated to be so obnoxious to mosquitoes of all sorts that they might be trusted to make themselves scarce wherever these plants might be found. For these ideas there is doubtless this much foundation in fact, that most strongly smelling bodies really are obnoxious to mosquitoes; but unfortunately, whatever objection they may have to strong scent is not very deeply rooted, and in default of more congenial shelter they will settle upon either eucalyptus or castor-oil plants, and will brave even the hated smell of paraffin to secure a good feed on the blood of a human or animal subject. All these special applications to the skin, too, have the further disadvantage that, though some of them are fairly effectual for a few minutes after they have been just applied, and so enable the user to get sleep, they leave those who are deluded into depending upon them to fall unresisting victims, as soon as the thick of the scent has evaporated. So that, though valuable for securing rest, they are worse than useless from the point of view of the prevention of malaria. With these untrustworthy exceptions, all available measures are of a mechanical character, and consist in modifications of our housing and clothing.

It must be remembered that during the working hours of the day there is little chance of being attacked, at any rate in the open air, and the same is the case in well-lighted rooms. Thus men whose work takes them into the open air for some considerable portion of the day, or are occupied in well-lighted offices, run much less risk than ladies, who, when they attempt to face the hot weather at all, are too fond of shutting themselves up in a darkened room, devoid of light or fresh air, and filled up with hangings and other superfluities, so as to form a perfect mosquito paradise in which the insects can fly about and bite during the day as comfortably as during the night. With such exceptions, there is therefore no need to modify costume to diminish the chance of mosquito bites as long as the sun is up, or even during the twilight, as long as one is in motion. It is when people are resting after the evening game of golf, racquets, or tennis, that they are most commonly attacked while awake; but the time of greatest danger is the period passed in sleep. During the waking hours it is uncommon for a mosquito to get the chance of an undisturbed meal by attacking the face and hands, but she often does so by attacking the ankles, and even thick stockings are no adequate protection. Trousers are therefore more suitable than knickerbockers for evening wear, and should be made extra long; so that when turned down after taking one's evening exercise, they thoroughly protect this very vulnerable portion of the person. A lady can generally arrange her dress so as to protect herself, but the ordinary costume of children is extremely dangerous, and certainly should be modified to meet this danger during the hours when mosquitoes are active. In the case of little boys a "sailor suit" with long voluminous trousers meets the difficulty; and—fashion or no fashion—it is a clear duty on the part of mothers to devise some cool but adequate protection for the little girls. The alternative lies between doing so and wilfully offering them as sacrifices to the god of dress by needlessly exposing them to the danger of infection.

The low-necked, sleeveless dresses worn by ladies in the evening must, we can well understand, be very temptingly cool wear in the climates with which we are dealing, but are obviously extremely dangerous, as they leave a large surface of the person exposed at the very time when mosquitoes are most active. A dress covering these parts should be therefore substituted, which, however, may safely be made of the lightest materials, provided that it be so puffed or otherwise "confectioned" as to make it difficult for a mosquito to get within reach of the skin. Mosquitoes are always fond of collecting under tables, as they are there sheltered from the glare of the lamps, and on this account it is advisable for men to wear straps to their trousers when dressing for dinner; and though the plan is a very old-fashioned one, I have some hope that the suggestion may meet the approval of our better halves, as, whatever its real object, the adoption of the plan certainly gives the wearer the air of having sacrificed comfort to appearances.

There would, however, be no need of modifying costume for indoor wear in any way were houses properly protected against the entrance of mosquitoes by means of suitably planned wire-gauze protection to all openings.

The plan in question was devised by Professor A. Celli, the Principal of the Institute of Hygiene in the University of Rome, and in Italy at least has long passed its experimental stage; though, owing probably to the small number of Englishmen who are familiar with the Italian language, it appears to be practically ignored even by our specialists on the subject.

Within a few miles of the great city of Rome there are large areas where malaria, far more virulent than the type of disease we usually meet with in India, is so rife that, during the malarious months, the country is practically deserted by all but a few necessary railway officials and caretakers. Amongst the former the mortality and invaliding used to be so heavy that the working of the lines was a matter of the greatest difficulty.

The majority of the peasantry, being only temporary inhabitants, live in grass huts not a whit in advance of those of the savages of Central Africa, and from the migratory nature of their employment, are among the most ignorant and backward of the Italian populace, and so about the last people likely to lend themselves to the adoption of any "new-fangled" custom. As a matter of fact, however, the object lesson of the advantages of the system have been so obvious that, after the first year, there has been no difficulty in securing the eager co-operation of the simple railway men and scarce civilised farm hands. As the system is necessarily being very gradually introduced, there are plenty of unprotected houses for comparison, and after personally conversing with the inhabitants, the writer found that all who had enjoyed the benefits of the plan were convinced of its efficacy.

It must be remembered, however, that it has been long a matter of popular belief in the Campagna that malaria was, in some way, caused by mosquitoes; and it is the difficulty of convincing those in high authority of this fundamental fact that is at the root of the indifference and inertia which oppose all attempts at amelioration in India and in many of our colonies.

During the first two years' experiments on the Campagna, out of 25 protected cottages, with a population of 173 persons, only 8 persons contracted malarial fever; while in 30 unprotected cottages, having a population of 220, only 17 escaped the disease; although the protected and unprotected cottages were, as far as possible, paired as regards the site, and were otherwise of a uniform plan of construction, and all inhabited by the same class of railway subordinates.

The system is the one above all others most suited for adoption by private persons, because it secures an almost complete immunity in spite of the most unfavourable surroundings, and renders the user quite independent of the sanitary lapses of his neighbours; but in spite of this, the plan is almost ignored in our English colonies and dependencies, though the writer has recently received an interesting communication from a medical man practising in China who has adopted it with signal success.

Professor Celli's plan consists in rendering habitations impervious to the entry of insects by closing all openings with wire gauze (mesh of about 12 strands to the inch). All windows, as well as such doors as only serve as such, and are not absolutely required for ingress and exit, are permanently closed by frames covered with the gauze, and all indispensable exterior doors are fitted with *double* spring doors of the same material, sufficiently separated from each other to secure the closure of the first door before the second can be opened.

In most Tropical residences, the number of doors is far in excess of actual needs, it being nothing uncommon to find rooms with four or five doors, all opening in the exterior. Though desirable and even necessary for free ventilation, no room can possibly require more than a single door opening on the outside, and in a well-planned house with suitable corridors, there is no real necessity for more than one or two exterior doors to the whole house. All outside doors, then, not absolutely necessary as such, should be treated as windows and permanently closed with single frames of wire gauze, so that the number of the more expensive double spring doors may be reduced to a minimum. In Tropical

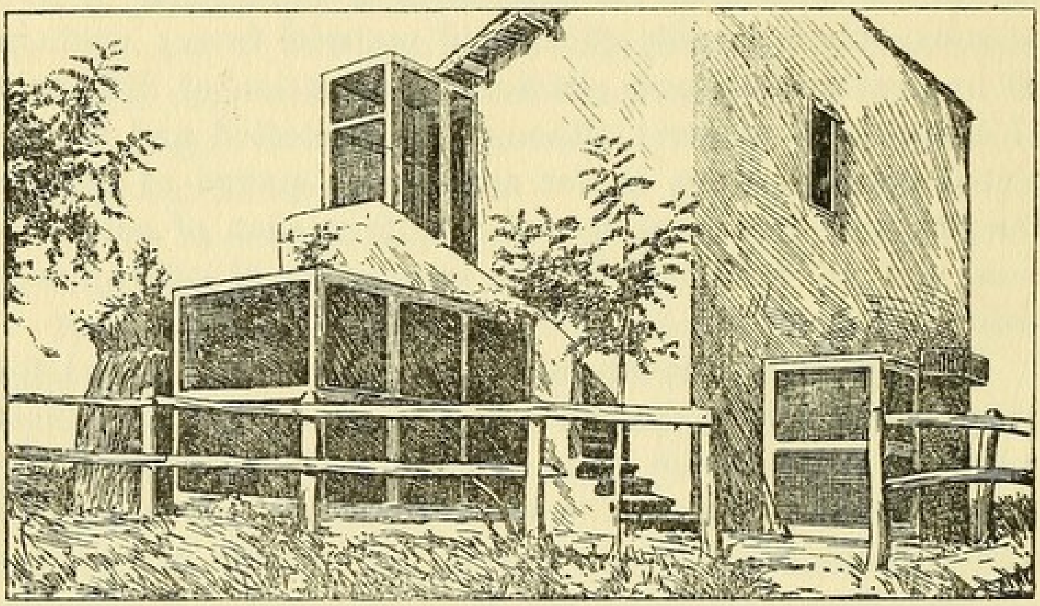


FIG. 11.—Railway servant's cottage in the Roman Campagna, protected against the entry of mosquitoes by Professor Celli's method.

climates it is, however, essential that a considerable area of verandah should be included within the protected area, as a good deal of time is necessarily most pleasantly spent in the verandah, not only in the evening, but during the rains throughout the whole day. On this account a northern verandah should be the one selected for protection in this way.

The main obstacle to the adoption of the plan is undoubtedly the expense, which would amount to £20 or £30 for an ordinary Indian bungalow, and though this may appear by no means prohibitory in the case of permanent residents, it puts the matter practically out of the reach of even well-paid officials, as they can never count on enjoying the benefits of any permanent improvement of this sort for more than a few months; the wisdom of our rulers almost

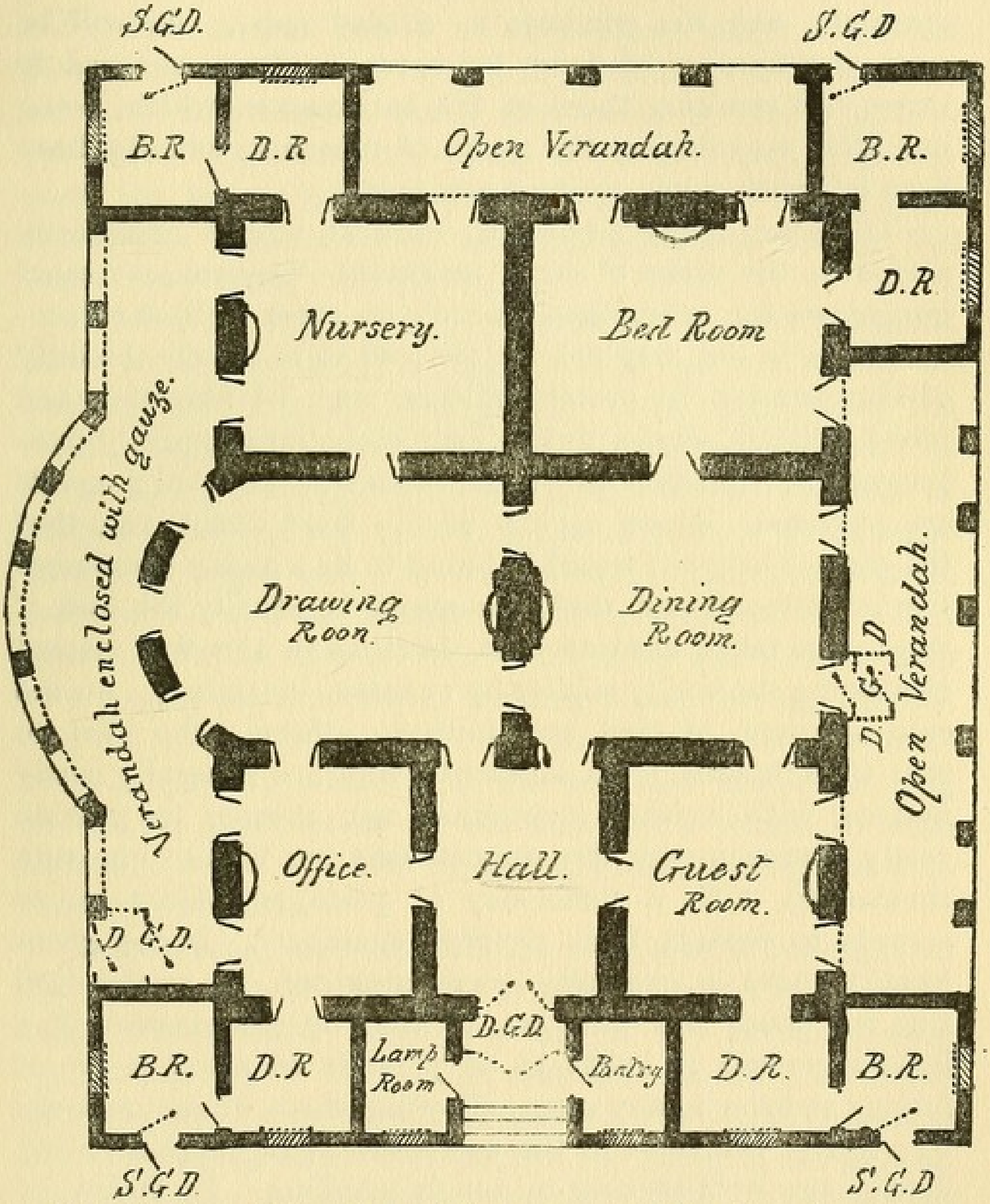


FIG. 12.—Ground-plan of an existing up-country Indian Bungalow, to show method of adapting one (Professer Celli's plan) of wire gauze protection. The dotted lines represent the wire gauze screens. *D.G.D.*, double spring doors of wire gauze; *S.G.D.*, single spring door of wire gauze combined with existing ordinary door; *B.R.*, bath-room; *D.R.*, dressing-room. Scale, 18′ = 1″.

always leading them to transfer an officer to another station long before he is likely to have thoroughly learned his way about the streets of the town he has to govern.

On the preceding page is given the ground plan of an actually existing "up-country" bungalow of a very usual type in which the spaces guarded by gauze are indicated with dotted lines. The original doors are shown as complete, and the windows as shaded gaps. As will be seen, the number of doors for actual traffic is reduced to three, not counting those of the bath-rooms, which, being but little used during the hours of mosquito activity, have been left with single spring doors only.

There are many situations, such as houses necessarily placed in the midst of canal irrigation—Government canal bungalows for example—in which no other method of protection is in any way practicable, and it is clearly the duty of Government to protect officers, such as irrigation and forest officials, whose duties lead them into specially dangerous places, in this way in all cases where official quarters are provided. There cannot be the least doubt, too, that the capital so spent would be found to be a highly remunerative investment, and that this would be equally the case if steps were taken to protect all barracks in this way instead of wasting the costly soldier by needless invaliding. In the case however, of civil and military officers, who have to rent their houses from landlords, who are generally needy natives, with neither inclination, nor means, to provide costly improvements, the utmost they can do is to provide themselves with a sufficiency of portable folding gauze screens to protect their sleeping chambers. In any given locality there is generally some approach to a standard size for doors and windows, so that by the exercise of a little ingenuity it ought to be possible to adapt a set of folding screens to any room, allowing them when too large to overlap the sides of the embrasure, and supplementing deficiencies with sacking or rough planking. In India, for example, door openings are usually about 7 ft. by 4 ft., and screens opening out to this size might be utilised in most houses. It is obvious that the set of frames provided for each room must include one filled with a small spring door. I believe that a number of screens capable of opening out to something larger than the dimensions of an average doorway would be less bulky than any possible portable mosquito-proof room—and at any rate a complete set for an ordinary family would weigh far less than an average piano, and would be far more conducive to health. It should be added that in this, and in all cases where single rooms are placed under protection, all doors, internal as well as external, must be protected, and as they would in no way prevent the use of a punkah, they would be an enormous improvement on the ordinary mosquito net, which, failing such appliances, is an absolute essential to health during the malarious season.

Where nothing more permanent is possible, recourse must be had to mosquito nets, which can with care be made to afford a fairly thorough protection during the most dangerous portion of the twenty-four hours. It is a mistake, however, to trust to tucking the net in beneath the mattress, as this is apt to become disarranged during the night, and it is further very undesirable that the net should touch any portion of the mattress at all, as if it does so, the net can be also touched by the sleeper, who thus readily exposes himself to being bitten through the net. The top of the frame of the net should, therefore, be made both longer and wider than the bed and should be long enough to reach easily to the floor, with which its edge should be kept in contact by means of a hem weighted with sand or small shot.

I have seen, especially in Calcutta, several attempts at the construction of curtains so large as to admit of a punkah being swung inside them, the top of the curtains being carried right up to the ceiling, and the strap of the punkah being pulled through a sort of sleeve; but the arrangement is necessarily an expensive one, and the swing of the punkah is always more or less crippled by the sleeve. A better plan is, I think, to make the frame supporting the netting very low, scarcely higher in fact than that of a child's cot, so that the punkah swinging outside, but almost in contact with it, still passes within a foot or two of the sleeper. Such an arrangement is rather awkward to get in and out of, but this drawback is a very trifling one, compared with the enormous advantage of combining the protection of the net with the comforts of a punkah. For this idea I am indebted to Mr. Symmonds, of Rosa, whose contrivance I presume it is, as I have certainly never seen beds fitted in this way in anyone else's house. For sleeping out of doors in the open, the net must, however, be of the usual fashion; as if the wind be at all strong, a weighted hem would not suffice to keep the net closed. It is therefore important when sleeping out to use a large bed, so that contact with the net may be less likely to happen; and the top of the

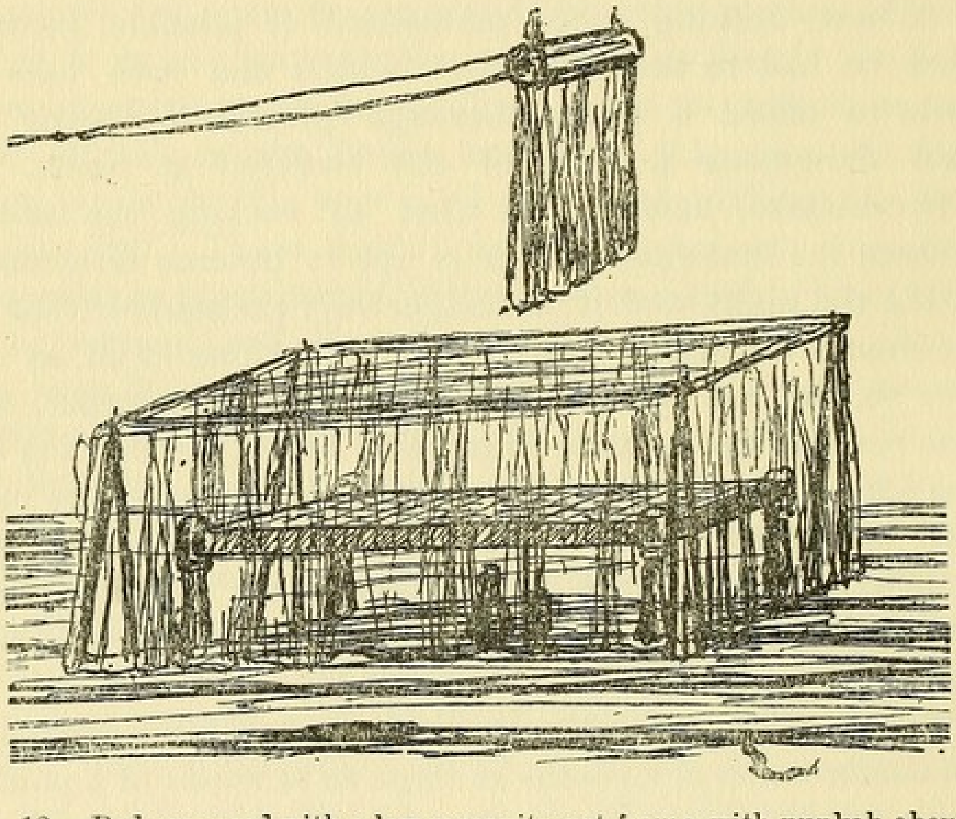


FIG. 13.—Bed arranged with a low mosquito-net frame, with punkah above it.

net should be formed of ordinary calico, so as to keep off the dew. Not unfrequently the mesh of the netting sold for making mosquito nets is too coarse, a point of some importance, as Anopheles mosquitoes in particular are adepts in creeping through small openings; and as the writer has found it impossible to confine them in enclosures formed of the coarser patterns of net, it may be concluded that such a material is equally inadequate to keep them out.

References to the protection against malaria afforded by mosquito nets by observant sportsmen and explorers are to be found in numbers of books of travel and adventure published long before any explanation of the fact was possible; and during the malarious season it is nothing better than culpable rashness to pass the night without this protection, except in a room properly guarded with wire netting. It is quite common to hear it asserted that a punkah alone is sufficient protection, but this is an entire mistake, as I have repeatedly watched a mosquito making a comfortable feed on my person within a few inches of a spot actually flicked by the towel which it is usual to pin on to the lower edge of the punkah. In non-malarious months, such as the hot dry weather preceding the rains in northern India, there is, of course, no need of a net except as a matter of protection against the harmless, but very annoying, Culices that are very common at that season of the year; and in spite of its inferior protection against being bitten, many will prefer the freer air current afforded by the punkah. After the commencement of the rains, however, the fact cannot be too strongly emphasised that to sleep without the protection of a net is to wilfully expose oneself to a real and ever-present danger.

In the matter of preventing mosquitoes from becoming infected it is obvious that comparatively little can be effected by the private individual. All he can do is to bear in mind that persons suffering from malaria are as great and real a danger to their neighbours as those affected with scarlet fever, small-pox or any other communicable malady, and accordingly to try to limit the number of such cases amongst his servants and dependents. In the great majority of cases in all probability, the mosquito that infects the European resident has been infected by a case amongst his servants; and quite apart from philanthropic considerations, it is most important to detect all such cases and have them treated with quinine.

It is a well-known fact that, even where the drug appears to fail to cure the disease, it is very difficult to find the malarial parasite in the blood of cases that have been well dosed with the drug, and as there must be parasites present in the blood itself in order to convey infection to the mosquito, it is obvious that, apart from its curative action, quinine may also be said to act as a disinfectant. On this account, where the removal of a servant "down with fever" cannot be arranged, it is highly important that he should be liberally dosed with quinine; and it must be remembered that it is not sufficient to supply him with the drug, but that it is also necessary to see it taken. In some countries, the native is so truly a child in intellect, that he has to be treated like one if a bitter drug is to be administered; while the Indian, though in no way wanting in intelligence, has often a prejudice against quinine owing to the active propaganda against the drug preached by the Baids and Haqims, or practitioners of the indigenous systems of medicine. As a matter of fact, I believe these men use quinine largely, but they take care not to let their patients know they are taking a drug which can be got for a halfpenny a full dose at any post office, and try to prevent the spoiling of their market by promulgating all sorts of fables as to its dangerous and harmful character.

According to the queer phraseology in vogue amongst these folks—and it is not so long ago since it was employed also in Europe—fever is a cold disease which by an attractive paradox should be treated by cold remedy, while quinine is made to belong to the opposite category of medicinal agents. It is as well, then, to be prepared for objections of this sort; but, as a rule, the personal influence of an European employer will suffice to secure the taking of the medicine, provided he will take the trouble to personally see it swallowed.

Liable as all residents in the Tropics are to be attacked with fever at times and places where skilled medical assistance is not obtainable, it may be well to conclude this chapter with a few words on the treatment of the malady. This really resolves itself into the adequate administration of quinine; for provided a sufficiency of the drug can be got into the circulation, it will, I believe, always cure malaria; but it is one thing to make the sick man swallow the drug and another to secure a sufficiency of it being absorbed into the blood; and unless this takes place, the remedy can have no more effect than as much oatmeal or any other inert substance. Anyone who has suffered from a severe attack of malaria, or had the nursing of a case, must have noticed that want of power to tolerate or digest even the lightest food, is one of its most prominent symptoms. In the more virulent type of the disease, nausea and vomiting is one of its most distressing features, and are nothing more than the outward manifestations of the fact that the digestive organs have ceased to perform their functions, and this may be equally the case, even where these additional evidences of the fact are not so prominent.

A little reflection will show that it is very unlikely that quinine or any other drug will be absorbed by a stomach that can no longer deal with even the lightest food, and hence it is not surprising that the severer forms of remittent fever will often resist quinine for long periods. For the same reason that quinine so often fails to do good in virulent cases, it is equally obvious that it is unlikely to do harm, and the absurd theory that "blackwater fever" is the outcome of treating malaria with quinine may now, I think, be said to be abandoned by all, save perhaps one or two of its original propounders; for though quinine appears to be of but little value in the treatment of that doubtfully malarial disease, it has now again and again been shown to occur in patients who have taken no quinine at all.

It cannot, therefore, be too strongly insisted upon that, in spite of failure to produce immediate effects, the administration of quinine should be steadily persisted in, as sooner or later in almost all cases a sufficiency will be absorbed to check the disease.

From what has been said, it is clearly important to do our best to put the digestive organs, if possible, in a position to perform their functions, and as in the majority of cases the sluggish bowels are loaded with half-digested or undigested food, it is a good general rule, as a preliminary to the administration of quinine, to administer some unirritating laxative, for which purpose nothing can be better than our old friend and bugbear of childhood, castor oil; and the dose should be repeated whenever constipation becomes a symptom in the course of the case. Once the laxative has acted, the sooner quinine is administered the better, and, unless the patient be one of those unfortunately constituted persons who are unable to take it—and there are some few to whom quinine seems as poisonous as it is to the malarial parasite—it should be given in full doses to the extent of 20 or even 30 grains (1 to 2 grammes of metric system) in the twenty-four hours. A dose of 10 grains, followed by others of 5 grains each, will usually be found a convenient plan of administration; but there are cases which do better with smaller doses more frequently administered. The best way to give it is, I think, to stir up the powder in a little milk; and it may be well here to offer a word of caution as to the employment of the drug in the form of tabuloids. For some reason, the drug appears difficult of digestion in this form, for I have repeatedly found fever yield at once to the ordinary powdered form of the drug, after days of fruitless treatment with quinine tabuloids obtained from firms of so high a reputation that the suggestion of the substitution of some less expensive material for quinine is quite untenable. The indiscriminate use, too, of antipyrin, phenacetin, &c., is also to be deprecated. They are all powerful depressants; and though they afford great relief to the aches and weariness of an attack of fever, undoubtedly have no effect whatever in curing the disease, even if they do not, as I have often been inclined to suspect, tend to prolong it. Where the suffering is very acute, an occasional dose may be of use for securing rest, but anything like continuous dosing with medicines of this sort should be carefully avoided. On the other hand, the old-fashioned "fever mixture," composed of ten or fifteen drops of nitrous ether with a drachm of Minderus' spirits (*liquor ammoniæ acetatis*), every four hours, in a wineglass of water, is often of great use in favouring perspiration, besides acting as a useful diuretic; and may be recommended as not only affording much relief to the patient's subjective symptoms, but also of being absolutely safe even in inexperienced hands.

Except in the weakness of very prolonged attacks, stimulants should be but sparingly given, but they should not be withheld when the patient is flagging, and obviously falling into what is known as a "typhoid state."

It is almost needless to remark that care is required in the matter of diet. During the febrile periods "slops" only should be given, and then in not too large quantities at a time; but in those cases where there is a distinct fever-free interval between the paroxysms of the disease, a great deal of license may be allowed, and solid food of a light digestible sort is often not only well tolerated, but even beneficial, while it is almost needless to say that these intervals of returned digestive power should always be seized upon to get a liberal supply of quinine into the system. During convalescence the administration of 10 to 15 grs. a day of quinine should be maintained for at least a week after the disappearance of all febrile symptoms, and some ordinary tonic, such as Easton's syrup, is often useful in facilitating the return to strength.

The least sign of a relapse, as evidenced by a rise of temperature, of however temporary a character, should be met with a further treatment with quinine for at least a week or ten days, as it is a clear sign that the disease is scotched, but not killed, and that some of the parasites are still lingering, in a latent condition, within the system; for the patient cannot really be considered as cured till the last of these is put an end to.

The length to which this chapter has attained may be justified by the fact that the universality and the extent of the mischief wrought by malaria in tropical climates renders the subject by far the most important of all in connection with the preservation of health in the tropics; and the writer trusts his readers may be moved to do as much as they possibly may to preserve themselves and their neighbours from the havoc wrought by this insidious disease, for without an informed and intelligent public opinion to back them, no possible efforts on the part of sanitary officials and medical men can be expected to exercise any great or lasting effects on the prevalence of the disease.

CHAPTER VIII.

On the Prevention and Treatment of Certain of the more Common Tropical Diseases.

Although the main essentials of domestic sanitation have already been dealt with at some length, and incidental mention has necessarily been made of their bearing on the avoidance of particular maladies, it appears desirable to devote a few pages to the separate consideration of the avoidance of some of the more common tropical diseases. Some apology may be necessary for the inclusion in the following remarks of some brief references to medical treatment, but it is difficult to keep absolutely distinct the subject of prevention and cure in a popular work, and while there is no desire to convert this little book into a treatise on family medicine, it is thought that a few words on the subject of remedial tréatment may not be out of place, especially as most of the writers that treat of this subject popularly, from the tropical point of view, are hopelessly out of date.

It must be clearly understood that what little is said on this subject is in no way intended to supersede the necessity of medical advice, whenever that may be available; but in these out-lands, the number of doctors to the square yard is far smaller than it is in Europe, and even in comparatively settled regions, it is quite easy to place twenty miles or more between yourself and the nearest medical man.

It must be remembered that in tendering general advice of this sort the prescriber is considerably hampered by the necessity of recommending nothing that is likely to do harm should the amateur doctor's diagnosis be faulty, and that he is thus debarred from suggesting many measures that would be perfectly appropriate were the case under competent supervision.

I do not of course refer merely to the question of poisons, as there are few drugs that are of any real use that are not capable of causing dangerous symptoms if administered in adequate doses—and many of the drugs recommended are as a matter of fact powerful poisons—but rather to the fact that even assuming reasonable care and intelligence in weighing and measuring, one must needs direct only such measures as will not be harmful in the by no means unlikely event of a mistaken diagnosis. In only too many of the scourges that devastate these latitudes, there is no time to wait for the arrival of a doctor living a day's journey away, as the chances are that the fate of the patient will be no longer in the balance when at last he arrives; so that for anything to be of any use it must be done quickly.

This method of treating the subject necessarily involves occasional repetition, but in view of the importance of the details thus emphasised, this may not be entirely disadvantageous.

CHOLERA.

When the writer first went to India some quarter of a century ago, there was still a tendency to invest this disease and its propagation with certain mysterious attributes, and a certain pompous obscurantist who was then at the head of affairs invented the awe-inspiring term of "pandemic waves" to account for, or rather cover, ignorance as to its method of spread; nor was it altogether safe for his subordinates to record facts that appeared to indicate a more common-sense explanation. But even then, the theory that the disease was usually conveyed from man to man by infected water, was held practically by all whose opinions were worth having. Still we were very much in the dark as to the methods whereby it gained access to water, and had no means of distinguishing infected from harmless water; and our measures of prevention, being thus based on guess work, were uncertain and often ineffective. At the present day, thanks in the main to the labours of Koch and Hankin, there is no disease about which our knowledge is more definite. In dealing with semicivilised communities it is still, it is true, quite impossible to prevent or foresee outbreaks of the disease, but when it occurs our knowledge now enables us to bring an epidemic to a speedy termination, always provided we are permitted to do so by the population; and personal prophylaxis may almost be said to amount to security.

We now know that the germs of cholera can exist only in the human organisation, but that they are capable of living and also *multiplying* in water. In very impure water, they cannot long survive, as they soon get crowded out of existence, in such situations, by putrefactive and other germs that are most at home under such conditions. For their *multiplication* the presence of a certain amount of otherwise harmless organic and mineral matter is of course necessary, but if introduced into water containing this, they can survive some time in the purest natural waters, though they ultimately die out in such situations. Owing to these habits of life on the part of the germ, it follows that the taste and appearance of water are absolutely valueless as regards its safety, and that the *chemical* examination of water is an equally futile test. The disease is carried about from place to place by infected human beings; but in ninety-nine cases out of a hundred is conveyed from man to man not directly, but indirectly through the agency of drinking water. In the hundredth case the germs may be carried in food, and of course milk, being often intentionally or accidentally mixed with water, is a frequent vehicle.

Direct infection from man to man does probably occasionally occur, but the contingency is too remote an one to be worthy of consideration, as it implies close personal contact, and in fact is usually traceable to those in attendance on the sick getting their hands or clothing fouled with the discharges and neglecting due measures of disinfection before eating or drinking. Save in this way, there is practically no risk whatever in the proximity of, or of attendance on, cholera cases, and no one need shrink from nursing persons stricken down with the disease, provided they observe a few very obvious precautions.

Fortunately the cholera germ is rather a delicate sort of plant, and but for its sharing with man a preference for good drinking water it would be comparatively harmless, as it soon perishes elsewhere, and is very soon destroyed by drying or too great heat. It is needless to remark that it cannot stand boiling, for the germs that can stand that sort of treatment are few and far between; but it is also very sensitive to the action of most of the ordinary disinfectants, which destroy it in dilutions far weaker than is the case with the agents of most other diseases; and it is also killed by a sufficiently long exposure to the action of carbonic acid, from which fact there outcomes the useful bit of knowledge that it is quite safe, *qua* cholera, to drink aerated waters even of doubtfully careful preparation, provided that they have been kept a few days in the house before use. Owing to the fact that the cholera germ cannot only survive, but is also capable of multiplying, in drinking water of average purity, the amount of fouling of the water which is required to infect it may be very small indeed, and usually is infinitesimally small.

A traveller draws water from an infected, but chemically practically pure well, and marches on, or it may be travels some hundred miles by train. Arrived at his next halting-place, he lowers his drinking vessel into the well he finds there. The amount of matter carried from the infected to the clean well is necessarily far too small to turn the most delicate balance ever constructed, but that same amount would suffice to infect not one, but an indefinite number of wells, so infinitely small are the individual germs concerned carrying the infection. Moreover, the drinking of infected water does not imply certain infection, as at certain stages of digestion the germs are destroyed in the stomachs of healthy people; and hence it is quite possible for the disease to be introduced by a person who has not himself suffered, though perhaps it is more common for it to be caused by mild cases; for it is a mistake to think that cholera is always a fatal or terribly serious disease, as in every epidemic large numbers of cases occur of slight upset of the digestive organs, but which we now know by microscopic examination to be really true cholera. These cases, however, are rarely recognised or recorded, and the really virulent form of the disease, which kills, roughly speaking, half of those it attacks, is alone referred to in ordinary statistics of attacks and deaths.

In India, and I suspect in most other semicivilised countries, the commonest method by which wells become infected is by the using of a vessel which has contained infected water to draw water from an uninfected well. The quantity of material required to start the fermentation in a still wholesome well is, as already remarked, infinitesimally minute, and a small drinking vessel and the string used for lowering it into the water, if carried by a traveller from an infected to a healthy place, is amply sufficient, and as the, chemically speaking, still pure water of an infected well is all that is required, it is obvious that no actual fouling of drinking water with the discharges from those stricken down by the disease is either necessary or common. The actual fouling of wells from contiguous latrines or cess-pits does no doubt occasionally occur, but owing to the extremely primitive character of Oriental plans of conservancy, is rare.

From what has been said, it will be obvious that it is perfectly easy to suggest measures for the prevention of cholera which may be trusted to be perfectly effectual. The only difficulty lies in carrying them into practice. Practically, all that is required is to protect all supplies of drinking water by covering in wells and fitting them with pumps. But the mere expense of doing so is often beyond the means of the community, and when the pumps have been fitted, there is no one available to keep them in order; so that after a very short period they become useless, and the old infection-carrying bucket and string must needs be reverted to. Nor is it by any means easy to protect one's own supply, as strangers have a free and easy way of making use of their neighbours' wells, whether rich or poor. Nor can one's native servants be trusted either to prevent this or to employ for drawing water a single vessel set apart for the purpose, for being unable to comprehend the reasons for such precautions, they naturally regard them as merely troublesome fads on the part of their employer, to be observed only when he chances to be looking on.

On this account the cardinal precaution of personal hygiene is to drink only water that has been boiled, and to see it boiled oneself. Every housewife knows that even European servants are often singularly obtuse, or neglectful, in recognising when water has actually come to the boil; and that to be certain of the perfection of the domestic cup of tea she must satisfy herself that the water is actually in a state of ebulition. Nor are such precautions onerous or troublesome. Orders should be given that the portable charcoal stove should be brought into the verandah and that the water should be boiling at the time of some meal, when the master of the house necessarily passes through on his way to table; preferably that of late dinner, so that the water may have all night to cool in, and so be ready for the next day's consumption. The boiling water should be poured directly into the vessels, porous or otherwise, in which it is to stand, and put aside in some place sheltered from dust. They should not be filled too full, as after they have cooled it is desirable to shake the water violently so as to re-aerate it, and so remove the insipid taste which the water has acquired, owing to its dissolved air having been expelled during the boiling process. The still boiling water may generally be trusted to sufficiently sterilise the containers, but it is perhaps well, as an additional precaution, to boil them occasionally in a large cauldron. Above all, do not filter; but trust to settlement. Ordinary filters are perfect germ-traps, while all varieties of the Pasteur filter are slow in action and apt to get out of order. Added to this, their rubber connections may leak without our being aware of it, and even when in their most perfect condition, they afford a protection but little superior to that given by boiling, so that personally I would far prefer to put up even with a little turbidity in boiled water than put any trust even in the best of them. Remember that you can trust no one but oneself to attend to their cleanliness and efficiency, and that to do so implies the sacrifice of a good deal of time on a very irksome job. Drinking water that chances to be impregnated with lime necessarily becomes turbid on boiling, but the turbidity is perfectly harmless. If the deposit be so fine as to be very slow in settling, the process may be hastened by stirring it round a few times with a crystal of alum. These precautions should be, of course, routine ones at all times, but should be maintained with special vigilance at times when cholera is present in one's place of residence. Aerated waters that have been kept in the house a week may also be drunk, but care should be taken to avoid any articles of food that are consumed raw, such as salads and fruits. Tomatoes may be dipped into boiling water and peeled without detracting from the pleasant, fresh acidity of their taste, but it is well to specially avoid during such periods lettuces and melons, as owing to the circumstances under which they are cultivated they are specially liable to have been wetted with infected water. Cucumbers may be dealt with in the same way as tomatoes, as from their shape it is very easy to sterilise their exterior by dipping them for a few seconds beyond the middle of their length in boiling water and changing end for end. This and the customary subsequent peeling really affords a sufficient practical security, and it must be remembered that the usual dressing of vinegar, "fortified" as this article of consumption usually is with sulphuric acid, affords an additional security, and does away with the necessity of submitting to what would be really a considerable deprivation at the time of the year when cholera is most common; for cholera and cucumbers flourish most at the same season of the year, a coincidence which has led to the not unnatural, but quite erroneous, popular idea that cholera may be caused by eating this vegetable. Of course, too liberal an indulgence in cucumber, like too much of any other rather indigestible good thing, may cause bowel disturbance, and an irritated bowel is especially liable to infection; but apart from superadded infection, no article of food is capable of causing the disease.

In dealing with drinking water on a large scale, such as the disinfection of wells and tanks, we have several available methods, for one or the other of which the materials are almost everywhere available. The most valuable of these agents is undoubtedly the permanganate of potash, and the suggestion of its use for the disinfection of drinking water from the germs of cholera is undoubtedly due to Mr. Hankin, our official bacteriologist at Agra. No doubt more than one medical officer had previously made experiments with this chemical for the purification of drinking water, but the credit of definitely proposing its use on a large scale in cholera epidemics, and of proving that it is lethal to the cholera germ, even when greatly diluted, is undoubtedly due to him alone.

The enormous practical importance of the discovery has, however, been but slowly realised, though its capabilities were put to the test of practical application by the writer immediately after Mr. Hankin published his suggestion, with the result that a severe epidemic in a town of over 10,000 inhabitants was brought to an abrupt termination within three or four days.

The method of disinfection of wells by means of this chemical has already been described on page 47, *et seq*.

The addition of a few ounces of common sulphuric acid increases, I believe, the lethal effects of the permanganate on the cholera germ, but is certainly not necessary, and I have no personal experience in its employment, as the taste imparted is somewhat persistent; and in dealing with suspicious races such as those inhabiting our Indian possessions, it is desirable that all obvious change in the taste or appearance of the water should pass off as soon as possible.

The alternative agents are alum and quicklime, either of which is very fairly effectual, though by no means as trustworthy as permanganate. Their great advantage lies in the fact that they are obtainable almost everywhere, and that being familiar articles of daily life their use is less likely to give rise to misunderstandings in dealing with ignorant and suspicious populations, who regard with mistrust the treatment to their wells with a chemical so strange and striking as permanganate must appear to them. Nearly all races are, however, familiar with the cleansing powers of lime, and in the case of Indians, the wonderful powers of alum in clearing turbid water is a bit of household knowledge familiar to everyone. A pound or two of alum, or half a hundredweight of lime, are required for each well. If alum is employed, it should be roughly powdered.

To further avert all suspicion I find it a good plan to hand the necessary money to an inhabitant of the place and ask him to fetch me from the local shop the amount of alum or lime required. I then, if alum be chosen, tell him to pound it up with a brick and himself to throw it into the well, myself standing somewhat aloof. As everyone is familiar with the use of alum in purifying water, and there is obviously no possibility of the surreptitious introduction of anything else, with ordinary tact, no objection will ever be made. Of course, the person thus impressed into the service of sanitation should always be a man of good caste, preferably a Bhraman.

Both these agents act, I believe, mechanically by coagulating certain forms of organic matter present in the water, and so carrying to the bottom, entangled with it, the germs present in the water, in which situation they perish on account of the free access of water containing their nourishment being impeded, and on this account at least two days should be allowed to elapse before the water is again taken into use, during which all disturbance of the water should be carefully avoided.

Neither of these agents is in any degree as trustworthy as permanganate, but their employment should not be neglected in cases where the latter is either unobtainable or objections are raised to its use. Of the two, lime is probably the better, but alum much the handier.

Whichever agent be adopted, it is well to treat as large a number of wells as possible. A certain number must needs, of course, be left untouched, for use during the time the treated wells must be left undisturbed, and these should be dotted about the town, so that the minimum of inconvenience may be inflicted on the townsfolk; but always leave as few as possible, as objections may be raised on your second visit, a couple of days after, to complete the process by disinfecting the remaining wells, and it may hence happen that you may have to rest content with what you have been able to effect on your first visit. Always, too, commence operations on the well you have reason to suspect is infected, or, in other words, that used by the people of the house in which the first local case has occurred.

Permanganate has now had a long trial in India. I have never known it fail, wherever it has been used in the manner above described, and the operation has been conducted *by an European officer in person.* The native medical officer, even when trained after our European methods, is seldom really convinced of its efficiency, and moreover he lacks the prestige of prophets hailing from abroad, and so may be really unable to carry out his instructions. An even commoner mistake is to go to work piecemeal, disinfecting a few suspected wells and leaving the rest till fresh cases spring up, as they necessarily must, as buckets infected from the first infected wells will inevitably be taken to other wells during the time that the former are unusable, and they can scarcely fail to infect them, and so start new foci of infection, if sufficient time be allowed for the germs to increase and multiply to a dangerous extent in their new location. Reports of failure I have received in plenty, but on investigation they have always proved to be due to some such cause as those indicated above. It is, of course, only rarely that a layman will find himself called upon to conduct such operations on a large scale; but the knowledge of how to do so may be of such great public benefit to the readers' coloured fellow-subjects, that it is most desirable that every European should know how to proceed, and, at any rate, I would strongly advise my readers, should cholera appear in their neighbourhood, never to omit the precaution of disinfecting all wells under their own control, as it is a great protection to one's servants and other native attendants. It is well, too, to repeat the process occasionally as long as the disease continues near one.

By the simple precautions as to food and drink described above, the danger of being attacked by cholera may be reduced to a very small contingency, even when it is raging around one, and there is no reason whatever for the almost superstitious fear with which the disease used to be regarded.

It remains to say a few words as to the treatment of cases should they arise in your household in places where medical aid is unobtainable.

In the first place, it should be remembered that the danger of handling and nursing patients is but small, for, as already remarked, you cannot "catch" cholera in the same way as you can small-pox or plague. To become infected by the germs you must eat or drink them. The discharges in cholera are, of course, intensley poisonous, and it is impossible to nurse a case without the hands, and perhaps one's clothing, becoming fouled; but the germs are perfectly harmless applied to the skin, and with due precautions as to cleanliness and disinfection of the hands, there should be no danger of their gaining access to the nurse's mouth. To avoid contamination of clothing, a washable overall should be worn, such as can be improvised from a sheet, with a hole for the head cut in the middle, secured round the waist with a cord, and the sleeves should be turned up well above the elbows. Care should be taken not to touch the lips or face with the hands while in attendance on the patient. On leaving him, the overall should be wrung out in sublimate lotion and spread out in the full blaze of the sun to dry, and the hands and arms should be thoroughly washed first with warm soap and water and then with sublimate lotion, care being taken not to eat or drink until these precautions have been complied with.

Medical science is absolutely at fault in the treatment of cholera, so that no treatment can be recommended beyond such measures as naturally suggest themselves to relieve the patient's sufferings.

The symptoms of the disease consist of violent purging and vomiting, the discharged matter being watery and almost colourless, with small particles and shreds of whitish matter floating in it, being, in fact, to quote the usual simile, very like rice water. Very often the patient suffers from violent muscular cramps, which cause great suffering. This active onset is followed by a stage of collapse, in which the skin becomes cold and livid and the face and hands singularly pinched and blue. If the patient survive this stage, it will be found that the urine is suppressed, the functions of the kidneys being, for the time, absolutely suspended; and the patient can never be considered out of danger till this function has resumed its natural course.

Now as to treatment. It must be in the first place remembered that it is absolutely useless to worry the patient with attempts to administer medicines by the mouth, as the digestive and absorptive functions are for the time totally stopped, and it is quite as much to the purpose to put your remedies in the patient's pocket as to force him to swallow them. To have any chance of acting, medicines must be administered by being injected beneath the skin by means of the hypodermic needle; and so powerless are all known drugs in this disease, that I should hesitate to recommend such medications to be attempted by amateur physicians. The only drug which has ever appeared to me to effect any good has been chloral hydrate dissolved in water and injected under the skin in 5-grain doses every few minutes until 30 or even 40 grains have been administered. There can be no doubt that this treatment controls the violence of the symptoms, and usually does away with the horrible suffering caused by the terrible cramps that are so common in the disease. I am even inclined to believe that a somewhat better percentage of cases recover under the treatment, though this is doubtful. Failing this, massage and frictions with the hands do much to relieve the cramps, and in the cold stage, every care should be taken to maintain the heat of the body by covering the patient with blankets and placing around him bricks heated in the fire and wrapped round with strips of wet blanket. During the reaction that follows on the cold stage, in favourable cases, attempts should be made to stimulate the kidneys by the application of mustard plasters to the loins. To attempt to give food during the acute stage is obviously worse than useless, but there is no harm in letting the patient suck small lumps of ice to assuage the terrible thirst of the disease. In the stage of collapse, stimulants naturally suggest themselves, but are seldom of any use when given internally. A few drops of ether inhaled from a handkerchief is, if available, perhaps the best method of stimulation, but the weakened kidneys have quite enough to do without having to deal with alcohol, so that it should be but sparingly resorted to, if at all. When the patient shows such signs of recovery that it appears likely that food can be tolerated, small quantities only of easily digestible food, such as milk, rendered mucilaginous by the addition of a little arrowroot, Brand's extract, &c., should be given, but it can easily be understood that after so severe a shock to the digestive system, the greatest care will have to be exercised in the feeding of the patient. Finally, it should not be forgotten that all the discharges of the patient are virulently infective, and that they and everything soiled by them should at once be disinfected. When the supply of disinfectants is limited, a good plan is to place in the bed-pan and basins used a sufficiency of sawdust, and to at once burn the contents by emptying them on to a brisk fire.

Dysentery.

We cannot claim to know much definitely as to the exact method in which this disease arises. Four or five vegetable germs and at least two small parasites belonging to the animal kingdom have been found, but none of these are present in all cases, and many of them may be quite commonly discovered in the interior economy of quite healthy persons, so that either the true germ remains to be discovered, or those we know of have only a secondary importance, becoming harmful only when they find themselves in contact with an irritated bowel. As a matter of fact, there are a good many kinds of dysentery, but to enter into their various characteristics would only confuse the lay reader.

The common characteristic is the discharge of frequent scanty motions, with much pain, and an intolerable sensation that more is to come. The material voided is always extremely offensive, of a mucous consistence, and wanting in the natural bilious colour. In severer cases, the mucus becomes streaked with blood, and sometimes little else will be seen, and the actual loss of blood itself may become a serious element of danger.

The disease does not usually occur as an epidemic, though something very like one is not unfrequently to be met with among bodies of men subjected to severe hardships and privations, as for example among soldiers during an arduous campaign in extreme climates. Some predisposing cause capable of causing irritation of the intestine seems to be essential to enable the germs, known or unknown, to take action. This irritant may be mechanical, such as coarsely ground, ill-cleaned grain; or chemical, as in the dysentery that is apt to appear among persons feeding on too newly reaped barley, or from foul or saline water; but the commonest of all causes appears to be the decomposition of the contents of the bowel which almost inevitably occurs when, from any reason, the production of the bile is arrested.

The peculiar yellowish-green secretion of the liver known as the bile appears not only to assist in the solution and digestion of the food, but to act as a natural antiseptic, which checks the too great multiplication of the various germs which are naturally always to be found in the intestine. It is comparatively rarely that the liver itself strikes work, but what does very commonly happen is that a chill, or a mechanical or chemical irritation of the bowel, may extend to the bile duct, and by causing swelling, or spasmodic action of its muscles, prevent the contents of the gall bladder, in which the bile secreted by the liver is stored up, from passing on into the intestine. The chill or irritant that thus stops the flow of the bile necessarily at the same time produces a greater or less amount of catarrh and inflammation of the lower bowel, which, lying as it does next to the wall of the abdomen, is most easily affected by cold; but stoppage of the flow of bile into the intestine seems an essential element in the production of dysentery, as a more or less complete absence of bile from the motions is a universal symptom of the condition, and to restore the action of the liver is, practically speaking, in cases taken sufficiently early, equivalent to curing the disease.

As has been already noticed, dysentery may be caused by a variety of mechanical and chemical irritants, but by far the commonest cause is undoubtedly chill to the surface of the abdomen, and the reason the disease is so common in tropical climates is their peculiarly treacherous feature of the chill that precedes the dawn. The earlier part of the night is often intolerably close and sultry, and it is only with difficulty that the jaded European manages to get off to sleep, and then naturally with next to no covering of the body. As the hours pass, the temperature falls somewhat and he sleeps more easily and deeply, and when the peculiar chill falls that usually precedes a tropical dawn, he is too far off in the land of dreams to be roused by the cold ; and the abdomen, bared probably by his restless movements during the earlier part of the night, is left exposed to the treacherous chill.

That there are other ways of getting dysentery I have no doubt, but a tolerably long experience has convinced me that the above is the history of nine cases out of every ten that one meets with, and it follows from this *that the all-important safeguard against dysentery is to protect the abdomen from chill.* From this it follows that a cardinal measure of precaution in the preservation of health in hot climates is the adequate clothing of this part of the body. It is this fact that accounts for the general consensus of opinion as to the value of the familiar article of clothing known as the "cholera belt," though I am by no means inclined to regard the said garment as the best, or even a good, method of attaining the object. At best the thickness of material is inadequate, it is generally made too narrow to include the liver above and much of the lower part of the abdomen below within its protection, and it naturally has a strong tendency to "ruck" together so as to form merely a very uncomfortable sort of belt, quite valueless for the purpose for which it is intended. For wear during the day a much more comfortable and efficient garment is the well-known Oriental "kamarband," a long, narrow scarf of woollen, cotton, or silk, according to taste, folded into a broad band and worn twisted round the waist in place of a waistcoat, over which it possesses the superiority of leaving the upper part of the body free. The elasticity of the folded scarf gives also a comfortable feeling of support, without any of the sensation of constriction inseparable from a belt, and its adaptation to climatic needs is testified by the fact of its being, in one form or another, in use by every tropical race, if we except the Negro, who seems to the manner born, and to want little artificial protection while he keeps within the limits, to meet the conditions of which he evolved. How the Negro gets on with no clothing at all, and the really much civilised Bengali contrives to survive without a hat, are problems which we poor products of centuries of artifice cannot be expected to solve; but the bald fact remains that the Northern European, when translated to the Tropics, must protect his viscera against cold in equatorial climates, even more carefully than in his native north, if he wants to get back there alive.

The cholera belt is especially fallacious at night. Unsupported as it then is by other clothing, it is at no other time so liable to slip down and leave unprotected the very parts that it is most important to keep covered. In the dark hours one wants a protection that is unlikely to be disturbed by forgetfulness, and is more likely to fall back into place than be cast off. This exigency is met by a folded blanket thrown across the trunk, within which are massed the delicate viscera essential to life; the ends of the folds lying on either side on the ground, and folded so that, without too thoroughly rousing oneself, one can spread the rug out a bit, above or below, should the chill of the morning become disagreeable to the chest or the lower limbs.

Provided that the feet, chest and arms are left free, a blanket arranged in this way gives no feeling of oppression; and after a short period of habituation, its deprivation conveys a distinct sensation of discomfort. Lying across the body, with either end on the ground, it is unlikely to be disturbed by the uneasy movements of the body. The fact of the ends resting on the ground makes it difficult to shake it off, and it affords far better protection than any closely-fitting garment, is more comfortable, and less likely to cause prickly heat. Care in this matter, especially during the hours of sleep, is second only in importance to the protection of the head against the sun during the day.

Never let the mildest dysentery, or even diarrhœa, continue unchecked. Taken early, no disease is more tractable, while if allowed to pass on to a chronic condition, no malady is more troublesome; while really severe chronic dysentery is practically incurable. Some knowledge of how to deal with such cases is therefore of special importance, as without embarking on the career of an explorer, any one may find himself a day or two's distance from competent medical assistance in the countries with which we have to deal.

Practically speaking, to restart the action of the liver is to cure dysentery in all recent cases, and hence it is of the greatest importance not to give opium, or that dangerous abomination "chlorodyne," both of which are most efficient in diminishing the flow of bile. They are doubly dangerous, because they quiet not only the action of the gall bladder, but also that of the intestines, and this, it must be remembered, without really curing the disease. The flux from the bowel is not really the disease, but merely an outward symptom of mischief going on within, and is further the useful and salutary effort of Nature to get rid of the irritating matter that is causing the mischief; and hence to stop the movements of the bowel, before the peccant matters have been got rid of, is a most dangerous step to take; so that no drug of the above description should on any account be given during the earlier stages of an attack of this sort. Next to this the matter of greatest importance is to give the irritated intestine rest by at once stopping the ordinary diet of solid food and substituting some mucilaginous preparation, such as milk thickened with a little arrowroot and taken *cold*. Where the attack is sharp, a few hours' fast is by no means unadvisable, but must not, of course, be continued too long. Wherever possible, it is best for the patient to rest in bed, and if there be much abdominal pain a hot-water bottle placed against the pit of the stomach will afford great relief. In a large proportion of cases no other treatment than rest and avoidance of opiates is required. Avoid also alcohol in all forms, at any rate unless extremely diluted. If, however, the symptoms fail to moderate under this treatment, it is well to secure the removal of any irritating or poisonous matter that may remain in the bowel by the administration of a dose of castor oil, a full ounce for a grown-up person down to a teaspoonful for small infants. The great advantage of this drug is that besides acting as a safe and certain laxative, the oil itself forms a most soothing application to the irritated bowel, just in the same way as it does to the skin when that structure is scorched or otherwise inflamed. To treat an intestinal flux by the administration of a laxative may appear strange to the lay mind, but you need never fear to employ castor oil, however violent the flux may be, and in children especially, it is a good routine commencement of treatment for any looseness of the bowels. A good plan for getting down this remedy, which, it must be admitted, is usually most obnoxious to adults, is as follows. Select a wide, shallow drinking vessel, such as a champagne glass, and moisten its interior thoroughly with a teaspoonful of some strongly-flavoured spirit, such as gin, turning the glass about until all parts are wetted, then add a couple of tablespoonsful of water, and into the middle of this pour the oil, avoiding the sides, so that it floats separately, like the yolk of an egg surrounded by the white. If now the contents of the glass be swallowed as nearly as possible at a single gulp, the oil passes through the mouth and throat so completely surrounded by the spirit and water that its presence cannot be noticed. A tabloid containing $\frac{1}{40}$ grain of perchloride of mercury should be taken shortly after, and after a lapse of three or four hours the disinfection of the contents of the intestine may be completed by taking a 10-grains tabloid of resorcin every four hours.

As a rule, under this treatment the yellow colour soon reappears in the motions and all symptoms disappear; but should the liver refuse to act, as is indicated by the continued absence of the natural yellow colour in the motions, it will be necessary to give a large dose of ipecacuanha—to get this drug down without setting up vomiting, requires a certain amount of preparation—as in smaller doses, it is one of the safest and most certain of emetics. It is best to give the dose the last thing at night, when the patient is naturally likely to be sleepy, and half an hour before it is given, a preparatory dose of a grain of opium should be administered. The patient should lie as quietly as possible, and after the dose (30 grains, or half a dozen 5-grain tabloids of ipecacuanha) all liquids should be withheld. It is also important to use as little water as possible to wash down the tabloids, as success in keeping down the drug depends mainly on the absence of any notable amount of fluid from the stomach; and this abstinence from fluids, as well as from food, should be continued until the next morning, when in all probability a copious bile-stained motion will show that the drug has taken its desired effect. As a rule, after this, two or three tabloids, containing $\frac{1}{40}$ of a grain of perchloride of mercury *per diem*, for a few days, will suffice to maintain the action of the liver and to disinfect the bowel, but occasionally the medication with ipecacuanha may have to be repeated. Remember, however, that no drugs will be of much service in this disease without the greatest care in diet.

An Indian medical officer has generally a variety of institutions under his charge, and usually amongst them a prison, of which he is not only the medical officer, but also the military governor—a sensible combination of offices which might well be imitated elsewhere. Now, although dysentery is a disease which gives much trouble in Indian prisons, the writer did not lose a single one of his jail-birds from that cause for several years; and he imputes his success to the practice he made of at once relegating each case of dysentery to a solitary cell, where it was utterly impossible for the patient to obtain any other food than that ordered for him. When left in the general wards they could not be kept from obtaining more or less of the bread and vegetable curry that formed the ordinary diet of those not seriously ill.

Soups are rarely well borne in dysentery, and hence the diet must be restricted to milk foods, the milk being always rendered mucilaginous by the addition of a little arrowroot or gelatin, cornflour, &c. When there is much dyspepsia the milk may be given semidigested by combining it with one of the numerous pancreatised proprietary articles, such as Benger's food. Afterwards a raw egg may be given beaten up with the milk or Benger's food. and subsequently rice pudding and fish ; but great caution is always required in resuming the ordinary diet, as the bowel always remains easily irritated for some time after the attack has subsided. Everything should be given cold (preferably moderately iced), and in small quantities at a time.

Diarrhœa.

Diarrhœa in tropical climates arises from much the same causes as dysentery, and like it, is very apt to be set up by chills to the abdomen ; in fact, these diseases may be regarded, for the practical purposes of prevention and treatment, as different degrees of the same condition ; the more serious disease being further complicated by concomitant affection of the liver. Heavy dosing with ipecacuanha will not, of course, be required in the milder disease, but otherwise its prevention and treatment may be regarded as the same, especially as in tropical climates, the mildest access of diarrhœa should always be respectfully dealt with, as it may easily develop into dysentery if neglected.

Hill diarrhœa is a peculiar form of chronic looseness of the bowels that is not uncommon in the Himalayas, and, I believe, in other elevated regions. Certain people appear specially liable to it, much in the same way as some are subject to hay fever, while others are never affected ; and the proclivity is so marked in some persons that it is impossible for them to reside in such localities, and they are hence debarred from taking refuge from the fierce heat of the plains. We are not very clear as to its causation, though the disease is traceable in some places to the presence of finely divided mineral matter (mica) in the drinking water, and so may be guarded against by careful filtration of all water used for drinking or cooking. The climate of the hills, again, though pleasant enough, is during the rains even more treacherous than that of the plains—damp cold, alternating with warmth; but withal, as has already been remarked, the disease is mainly one of personal proclivity, and where the tendency is very marked the only course is to avoid residing in places where it is apt to occur. Should you, when travelling in the hills, be attacked with this malady, careful filtration of water and care in diet should be attended to, and a pill or tabloid containing one grain each of euonymin, blue pill and ipecacuanha may be taken at night; but should the trouble persist, no time should be lost in returning, if possible, to within range of competent medical assistance, as if neglected, the disease is apt to develop into a most troublesome condition known as sprue.

Infantile Diarrhœa is terribly common in hot countries, and hence the least disturbance of this sort should never be neglected in young children. The rapid rise in the infantile death-rate that coincides with any approach to a tropical temperature in Europe, shows well how full of risk is a child's tenure of life in latitudes where such temperatures are not the exception, but the rule. The liquid food, which alone is suitable to the infantile digestion, is perilously liable to decomposition when the temperature of the air rises much over 70° F., and, under such conditions, food which, to the nose and eye, shows no appreciable change, may yet be virulent with a poison as lethal in its effects as arsenic, and far more deadly, weight for weight. As a matter of fact, the poisons which may be generated in food subjected to high atmospheric temperatures, differ only from the most active of mineral poisons in their greater virulence, and to commence treatment in such cases with any agent that checks the action of the bowels ensures an unfortunate result with even greater certainty than if we were dealing with antimony or vitriol.

The first *desideratum* is to get rid of the supply of poison which has already been generated within the bowels, and the second to stop the fermentation which alone can generate the poison. To meet the first indication an unirritating laxative should be at once administered. When the symptoms are severe, one or two teaspoonfuls, according to the age of the child, of castor oil is probably the safest remedy, but in less violent disturbances a drachm of our old friend, Gregory's powder, will be more appropriate. The laxative should be promptly followed by the administration of one of the intestinal antiseptics, amongst which I have a personal preference for 5-grain doses of resorcin; but β napthol grs. ii., salicylate of bismuth grs. v., or perchloride of mercury gr. $\frac{1}{64}$, if more readily to hand are equally valuable, and are, I know, preferred, one or the other, by practitioners according to their individual favourable experiences; but opiates of all sorts are always to be avoided as long as active mischief continues, though fifteen or twenty drops of paregoric or some other preparation of the poppy may possibly accelerate the cessation of obvious symptoms when the "causing cause" of the disease has been disposed of.

The germs that produce this intensely poisonous matter are quite different from those whereby milk "turns sour," and the fermentation which produces it may go on some time without giving rise to changes obvious to the nose or eye. Hence, though it is no doubt possible for the germs to reach the stomach in other ways, as a rule the changes have commenced before the food is swallowed.

Diarrhœa is naturally rare in infants fed entirely at the breast, and from what has been said it will be clear that the surest protection against this terribly fatal malady lies in the avoidance of bottle feeding; for to carry out the latter safely in a tropical climate, would tax the resources of a skilled bacteriologist. It is, however, unfortunately the fact that European women residing in such climates are very often really unable to suckle their children, in spite of all the good will to do so; and when the supply is inadequate and has to be supplemented by artificial feeding there is little real gain, as the bottle, with all its dangers, must needs be used several times in the day. On this account, whenever the mother is unable to fully nourish her infant, by far the safest course is resort to wet nursing. I have met with people who have a sentimental objection to entrusting their child to a woman of another race; and are even capable of believing that the mental and moral qualities of their offspring may be affected by such a diet; but it should be needless to say that there is no foundation whatever for any such idea. Great care is of course necessary in the selection of the foster-mother, who should be young, healthy, and vigorous. Her own baby ought not to be much older than the one she is to nurse, while it is needless to say that she should never be permitted to nourish both infants together. It is also most important that she should be examined, and, if possible, selected, by a medical man.

When, however, artificial feeding is unavoidable, the most elaborate care as to the purity and cleanliness of the milk and all utensils that come in contact with it are required. In hot climates it is not enough to merely wash the bottles and jugs which are used. They should be boiled at least once a day, and in very hot weather, even each time after using. The simpler the bottle is in its construction the better, those with long tubes and elaborate screw stoppers being so dangerous that it is far better to resort to spoon feeding than be tempted to use one, even as a temporary expedient. The form of bottle which presents least dangers, because the most easily cleaned, is that in which the nipple is in one piece, with an elastic cap that is made to fit the mouth of the bottle, thus doing away with the necessity of any stopper or cork. Moreover, if the special bottle chance to get broken, it is generally easy to find some medicine phial, or other small bottle, over which the cap can be stretched and which serves equally well. Rubber will not stand repeated boiling, hence, when not in use the nipple should be always kept immersed in a strongish solution of boracic acid (10-15 grs. to the ounce) and rinsed before and after using in ordinary drinking water. In making the boracic solution, a sufficient approach to chemical accuracy may be made by placing an eggspoonful of boracic acid in a breakfast cup and filling up with boiling water.

Asses' milk is probably the best substitute for an infant's natural food; and failing this, goats' milk is to be preferred to that from the cow. Whichever is employed, it is best to buy the animals and have them kept in one's own compound, so that one can ensure, by personal supervision, their being cleanly kept and carefully fed. Before milking, the animal's teats and the hands of the milker should be washed in boracic solution, which should be kept ready made up in a large earthen vessel (an Indian gurrah, for example).

A great drawback of cows' milk as a food for infants in India lies in the fact that, whereas human milk has a distinct alkalinity, that of the breeds of kine indigenous to that country is often (in my own experience, always) rather strongly acid, even when freshly milked from perfectly sound and well-cared for animals.

Generally speaking, indeed, the acidity is so considerable that the amount of alkali contained in even twice its bulk of lime water, is quite insufficient to neutralise it. In place, therefore, of the conventional lime water, it is better to add about as much as will stand on a sixpence, of a mixture of equal parts bicarbonate of soda and citrate of potash, to each bottle. Of course, if you wish to be exact, you can get from your chemists some books of litmus paper which change to a redder tint when dipped into an acid fluid and become bluer when moistened with an alkali; and it is a good plan to test in this way, at any rate to commence with, in order to ascertain roughly the amount required for the milk of the particular cow that yields the milk. The citrate of potash, besides being for practical dietetic purposes an alkali, has the additional valuable property of preventing the milk, after it has reached the infant's stomach, from curdling in large masses, as cows' milk is apt to do unless treated in this way. Human milk, when curdled in the process of digestion, does so in small flocculi; and the tendency of cows' milk to curdle in large masses makes it a frequent cause of dyspepsia as well as of diarrhœa. Whether or no the peculiarity of possessing a so strongly acid reaction is shared with the milk yielded by cows in other hot climates I cannot say. Whatever may be the source of the artificial food, it is needless to remark that it should be sterilised by means of one of the numerous appliances now sold everywhere for the purpose, and that care should be exercised to guard against chill to the abdomen.

The prevention of infantile diarrhœa is in fact purely a question of guarding against impure and unsuitable food, and though the same is no doubt also true for more temperate climates, precautions which may be sufficient in an English summer, break down at once in a moist heat of 90° in the shade.

Should, however, in spite of all precaution, the disease appear, steps should at once be taken to get rid of the food that is fermenting within the stomach by administering a teaspoonful of castor oil, and if any obviously large proportion of the oil be thrown up within half an hour of taking the oil, give another half teaspoonful. The milk given should be much more diluted than usual, and if it obviously continues to disagree, as evidenced by continued sickness after the bottle, it should be pancreated by means of Benger's food, which will often be kept down where the simply sterilised milk is rejected. If, however, milk in any form prove unsuitable, meat juice may be substituted for a few hours.

Meat juice is made by mincing raw lean meat, sprinkling lightly with salt, and adding just enough blood-warm water to cover it. Place the mixture aside in a covered jug in the sun for two hours and then place the pulpy mixture in a clean cloth and squeeze out the juice into a basin by wringing the cloth. Before administration, a sufficiency of sugar to make the mixture palatable should be added.

Another very useful food, as a temporary substitute for milk, when the latter disagrees, is egg albumen. To prepare this, beat up the white of a small egg with enough cold water to make a bottle, add just enough sugar to perceptibly sweeten, and let it stand till the froth produced in the beating has settled. Should these novel delicacies be refused by the infant, the addition of even a teaspoonful of milk will often lend sufficient of the desired flavour to induce the child to take it. The egg albumen should always be given cold, as even warming the bottle by placing it in hot water might easily coagulate a little of the albumen and so convert an exceptionally bland food into a very dangerous and indigestible material. After the oil has acted, about 5 grains of Gregory's powder may be given once or twice a day, and if the natural yellow of the child's napkins be not rapidly recovered a grain of grey powder should be added.

The course of infantile diarrhœa is often appallingly rapid, so that all may be over with the little sufferer in a few hours, and on this account there should be no delay in obtaining medical assistance, even on the appearance of slight symptoms of the kind, wherever such help is at hand.

Plague.

Strictly speaking, this terrible scourge cannot be said to be in any sense a disease peculiar to warm climates, for the one climatic condition that appears to check the course of epidemics of this disease is extreme heat, which always moderates their virulence as long as it lasts. In reality, it is a disease of low civilisation; and appears to be practically incapable of attaining any serious spread amongst people of European habits. During the terrible recrudescence of this disease, which, for the last decade, has been ravaging the semicivilised world, although repeatedly introduced, it has never succeeded in seriously establishing itself in any European town. Even the admittedly backward sanitation of Spanish towns appears to be too advanced to admit of the spread of plague, and, what is more remarkable, the European portion of the population of plague-stricken Eastern towns has remained practically unscathed, while the indigenous population have been dying around them in their thousands. When first the disease invaded India there was naturally a good deal of alarm amongst the European population of Bombay, but nowadays the official, commercial, and social life of the European community goes on unmoved, even at times when the disease is doing its worst—and is so assured of its own immunity that timid ladies out for their evening airing will scarcely turn their head as the bodies of the plague-stricken are carried past them on the way to the burning ghaut. Perhaps this immunity may be to some small extent a question of race, but the main determining cause is undoubtedly difference of habits of life, as natives who have adopted European habits share in it.

The most important conditions favouring the spread of plague appear to be overcrowding and inadequacy of air space and ventilation in dwellings; and especially lack of light, as well as the want of domestic cleanliness, and the treasuring up or neglect to do away with dirty rags, dust and rubbish. A further reason in India is the sacredness of animal life, which leads to the unrestricted multiplication of rats and vermin of all sorts.

The germs of the disease are easily destroyed by moderate heat, strong light, and most disinfectants, but are apparently capable of preservation for long periods when protected from such agencies; and hence the disease is capable of being transported from place to place by the agency of dirty clothing, infected rags and such like, but the characteristic which most embarrasses our efforts to deal with the malady is the fact that plague is a disease not only of man, but also of many other animals; and that rodents in particular are specially liable to be affected by it, and are in fact generally seriously involved before an epidemic has attained any serious spread amongst human beings. Not infrequently, the first warning of an impending epidemic is the discovery of dead and dying rats in large numbers; and the best considered plans of dealing with the disease are necessarily constantly defeated by the impossibility of extending to these proverbially secretive and cunning animals the measures of isolation and disinfection that are indispensable to success. It is obviously to little purpose to disinfect the room in which a human patient has died, when in hollows in its walls, roof and floors are hidden whole families of rats in every stage of the disease; and it can avail little to isolate the comparatively few human patients, while hundreds of infected rats are left to wander about at will. Luckily, the infection of plague requires close contact to secure transmission, and there is practically no danger of contracting the disease in the ordinary open-air intercourse of life.

From what has been said, it will be seen that for Europeans resident in plague-stricken towns personal prophylaxis is a comparatively simple matter, as it is instinctively carried out as a matter of national habit.

There is comparatively little danger in entering infected buildings during the day, or even in handling the sick, but unless it be a part of his duty to do so, it is better for the European to avoid passing through the infected portion of the town; to keep a keen eye on the health of his servants; and generally to restrict, as far as possible, association with the native community. The house should be kept freely open to air and light, avoiding the closing of doors and windows to exclude the heat, as in doing so we reproduce the domestic habits which cause the natives to suffer so severely. If the weather admit of it, it is better to sleep in the open; and should any mortality among rats be observed within the dwelling, there should be no waiting for any second hint, but the place should be vacated at once, and thoroughly disinfected; nor is it well to return to it for at least three weeks. Among the very small number of cases in which Europeans have fallen victims to the disease, neglect to take timely warning from the death of rodents within the house has occurred in more than one instance directly reported to the writer.

On the personal prophylaxis of plague no more need be said, but in out-of-the-way places, it not unfrequently devolves on the non-medical European to have to take measures for the protection of the indigenous community, in the absence of medical advice. To be effective, the little that can be done must be done at once, and therefore a few words on the general or public prophylaxis against the disease may not be out of place. One of the few redeeming features in the natural history of plague, is that it at first spreads very slowly. It is doubtful if, in any case, the bulk of the infections are from man to man, and it appears on the whole probable that, after the first introduction of the infection, time is usually required to admit of the thorough establishment of the disease amongst the rats before it can attain any formidable spread amongst men. During this early stage there is no great difficulty in dealing with the disease, and hence it is absolutely of the most vital importance to obtain information as to the occurrence of the first cases. In the case of these first attacks, whether imported or apparently of local origin, no measures of disinfection and isolation can be too rigorous; but the people should be made to clearly understand that except at their own express desire and by their own enforcement, compulsion in such matters will be at once relaxed should the disease unfortunately gain a firm footing in their midst. As a matter of fact it is unfortunately too true that there is really very little that can be done to any purpose, when once the disease has fairly fixed itself on the susceptible mass of an oriental urban population, and above all things it is worse than useless to attempt to enforce sanitary measures by compulsion, as it only leads to the concealment of extent and localisation of the disease, and to organised obstruction to all remedial measures attempted by those in authority.

It should be the duty of a civilised government to place at the disposal of the population every possible means of combating the disease which our superior knowledge and civilisation enables us to recommend, but it should be made absolutely clear that these benefits of civilisation are there to be simply taken or left, as they please. In the cases of measures particularly liable to be mistrusted, such as inoculation, it may even be well to charge a small fee for the operation, to be remitted of course in cases when the patient can show that he is really impecunious. The joy of getting to windward of the too credulous official by a pardonable understatement of finances, would be a temptation hard to resist by the average Oriental, and there is no harm in writing out such a receipt; for the folks who require Hibernian driving of this sort cannot read, and it was one of their countrymen who could not only read, but think very much to the purpose, who suggested the expedient to the writer.

I believe my good native friend was right, for I have actually seen ordinary vaccination eagerly sought for by Orientals over whom we had no shadow of political control, and who would have been up in arms at the idea of compulsion; through the simple stimulus of the nominal fee system.

As a matter of fact, there are few things that the Indian cannot be persuaded to do by a tactful European official who has been allowed to remain sufficiently long in a locality to become known and trusted by the people among whom he has to work; but the notion of utilising the personal factor in administration is, unfortunately, far from the Indian beaurocracy, and the theory of one man being as good as another for any purpose has been adopted to such an extent, that combatant magnates were actually selected to control the operations of the medical experts in dealing with plague. The attack on the plague bacilli with so tactless a weapon as the bayonet naturally failed, but we certainly secured a striking and no doubt valuable demonstration of "how not to do it."

The opportunities that should be placed at the disposal of the population may be epitomised as follows :—

(1) *Evacuation.*—The truth of the old proverb as to the policy of "running away," is illustrated in the case of plague, if possible, even more forcibly than in that of the late Boer war, and as the population, like the warlike Boer, should always have a new position ready to fall back on, a certain number of huts should be set up in the open for the accommodation of those who are wise enough to take Nature's hint in good time, and to leave the germs of infection behind them to "stew in their own juice" till they die for want of material.

The ruder these structures are made the better, it being essential that they should cost so little that they can be burned without regret should they become infected ; and hence nothing beyond the provision of shelter against the sun and rain should be aimed at. In the case of village communities, complete evacuation of an infected site is generally possible, but in towns of any size such a plan may be out of the question. A small camp should, however, be provided for the accommodation of such as are wise enough to avail themselves of it. Where, as is the case with tea-garden and mine managers, the European superintendent for all practical purposes constitutes the government on the spot for the time being, the policy of instant evacuation of "the lines" wherever a case of plague has appeared cannot be too strongly insisted upon. Even when left to themselves, the germs have a strong tendency to die out in the course of a few weeks; and aided as it can be by systematic disinfection of the inhabited site, there can be no doubt that this policy of flight is the sheet anchor of our armament for meeting the disease.

(2) A hospital constructed of the same temporary materials should be provided for the reception of travellers and vagrants, as well as for such cases in which, on account of panic, the friends and relatives decline to attend to the sick; a contingency which, however, is but rarely met with in India.

The patients should be left to choose their own medical attendants as far as possible, but the paid attendants should, if possible, be subjected to protective inoculation, and the people should be further encouraged to bring their sick to this hospital for treatment and nursing by themselves, but no attempt should be made to isolate the persons employed in nursing, or, indeed, to enforce isolation in any form, as experience has shown that, however desirable it might be to do so, such measures cannot practically be carried out.

(3) *Protective Inoculation.* — Although there is some doubt as to the extent and duration of the protection conferred by injection with Haffkine's protective emulsion, there can be no doubt that it confers a considerable power of resistance. The operation is one that can only safely be undertaken by professional men, but it should certainly be placed at the disposal of the community wherever practicable. As a matter of example, it is as well for Europeans to submit to the process, though in view of the rareness with which they are attacked, it can hardly be considered necessary, except in the case of those whose duty brings them into close and constant association with the native community.

(4) The destruction of rats is a measure of no small importance, and one which should be undertaken in all towns where there is even a probability of the introduction of the disease. Most communities possess professional rat-catchers, and the services of these men should be enlisted, though where a reward is offered for dead rats, only full-

grown animals should be paid for, as otherwise it may lead to breeding rats for the sake of the reward.

Quarantine, protective cordons, train inspections, and the like, have been tried, and found rather worse than useless; as like all other systems that interfere with personal liberty, they lead to concealment of cases, and concealment necessarily involves the treatment of the sick under circumstances that render the spread of the disease to relatives and attendants almost certain. At the same time, measures of this class are those that are regarded with most favour by natives, and provided they are assured that, in case of the discovery of cases, there will be no forcible interference with their habits and customs, they will generally adopt and themselves carry out the more useful and practicable of the measures of this class, such as the watching of new comers by road and rail, and even the inspection of the dead. It is a mistake to think they are not as anxious to keep the pestilence out of their towns as their European rulers can be, and, as a rule, they will make no objection to the proper disinfection of houses that have become infected, but they will prefer to run any risk rather than submit to any interference with their domestic customs.

(5) The means of thorough disinfection should be provided. The best of all disinfectants is fire, and, as far as possible, all infected bedding, clothing and rubbish should be burned, and paid for. In order to secure, to some extent, the destruction of rats and other vermin, as a preliminary measure, the house should be fumigated by means of sulphur fumes, and after this has been completed and the house opened, the floor, walls and furniture should be thoroughly washed down with strong solution of corrosive sublimate ($\frac{1}{1000}$), thoroughly acidified with hydrochloric acid. Phenyl has also proved serviceable. The men employed in this work should have been, if possible, inoculated. They should thoroughly grease all exposed parts of the skin before commencing work, and should be thoroughly clothed, being made to wear nether garments reaching to the ankles and tucked into boots of European pattern, which should be kept well greased, so that they may not get hard from

contact with the disinfecting solutions. I cannot recommend the digging up of earthern floors, as the task is undoubtedly a very dangerous one to the men employed in the work, and there can be no possible real need for it, as, of all parts of a dwelling, the floor is that which can most easily be saturated with powerful disinfectants.

Lastly, after washing down with perchloride do not limewash or attempt in any way to employ these agents in any combination, as to do so shows a pitiable ignorance, not only of the Board School rudiments of chemistry, but of the behaviour of the specific germ of plague to external surroundings. I am perfectly aware that the combination is ordered in several sets of Indian regulations, but in justice to the service to which I have had the honour to belong, I hope my readers will accept my assurance that these ludicrous recommendations are one of the natural results of the meddling of ignorant amateurs, military and civilian, who unfortunately have often been allowed to assume the command of sanitary matters within our great bureaucratic dependency.

If the inhabitants of infected houses can be induced to migrate for a time into camp, so much the better, as in such cases the enormous additional disinfecting powers of air and light can be utilised by removing, for a time, portions of the tiling or thatch, and it must be remembered also that time alone is also an excellent disinfectant. The danger they run in immediately returning should be clearly pointed out, but if return they will, they must be let do so, as compulsion means opposition, and the benefit of the disinfection to the general community is only lessened by their return in so far that should they fall victims to their own rashness they form fresh foci of infection and the process has to be gone over again. In the case of small compact communities, such as gangs of coolies working under commercial corporations, a more autocratic course of action is, of course, practicable, but should never be carried to such an extent as to bring about organised opposition, and however stupid and prejudiced they may appear to the ordinary European mind, no effort should be spared to obtain the co-operation of the people themselves, and it is in securing this that the personal element of long association and mutual trust is especially valuable.

In spite of the great advances in our knowledge of the disease that have been made during the present recrudescence of the disease, we are still a great deal in the dark on many points, and especially as to the mechanism of infection in the majority of cases. Each year of the progress of the epidemic demolishes some one or other of the few standpoints of certainty that we had imagined as firmly established, and it is evident that some great discovery remains to be made before plague will cease to be, from many points of view, an almost complete mystery.

Small-pox.

Although in no sense a malady in any way peculiar to hot countries, Europeans are necessarily much more exposed to infection among semi-civilised communities, where vaccination is at best only partial, than in Europe; and hence it is well to impress the necessity of efficient re-vaccination on all who have to live among people by whom the blessings of vaccination are, as yet, imperfectly appreciated. Even a single vaccination affords so great a protection that it is rare to meet with fatal cases amongst those who are foolish enough to live in the midst of small-pox without being re-vaccinated, but it is hardly worth while to risk suffering from so revolting a disease, with the chances of disfigurement for life, for the sake of avoiding so trifling an inconvenience as that involved in the little operation. On this account it is very desirable for the intending emigrant to tropical parts to be re-vaccinated before starting, as an inflamed arm is much more troublesome when complicated with prickly heat than it is in temperate climates. In addition to this, it is always wise to submit to re-vaccination whenever an epidemic of small-pox is raging around one. If needless, the virus will not "take," and you will suffer nothing worse than the trifling scratch involved in the operation. If, on the other hand, it "takes," it shows that a grave risk would have been run in neglecting the precaution.

Sleeping Sickness.

This peculiar malady has only come into notice of late years, since the opening up of Central Africa, and though it was at first thought to be confined to the negro race, has recently been shown to occasionally attack Europeans. In its early stages, the disease presents many points of resemblance to ordinary malarial fever, and has usually been confused with it, both by patient and doctor; but following this, after an interval of a few weeks or months, certain peculiar nervous symptoms appear, from which the disease has taken its name, and which are mainly characterised by hebetude and somnolence. It would be superfluous, in a work like the present, to enter into any details as to its peculiarities, especially as our knowledge on the subject is at present in its infancy. It may, however, be fairly said that we are almost certain that the disease is caused by certain peculiar parasites (*Trypanosomes*) that are found in the early feverish stage of the disease in the blood, and subsequently, when the peculiar sleepiness appears, in the fluid that bathes the spinal canal. From the analogy of malaria, as well as from anatomical considerations, it is tolerably certain that the disease is conveyed from one human being to another by means of inoculation through the agency of biting insects.

Further, strong suspicion, approaching moral certainty, strongly points to certain flies, of the class known as horse and cattle flies, as the species that acts as the intermediary. These flies are much more common in tropical climates than they are at home, and are characterised by the peculiar persistency with which they attack an animal, in spite of all attempts to drive them off; and so much is this the case that nothing short of pursuing the insect until it is killed is of any use. They do not, as a rule, invade houses, and it is exceptional for them to attack man, but they will do so occasionally, and the stab they give is so sharp that it is hardly likely to be overlooked.

At present the disease appears confined to Africa, but species of the same flies are to be found in India, and the writer has more than once been bitten by them, though no danger attaches to the incident, as the specific germs of the disease do not occur in that country.

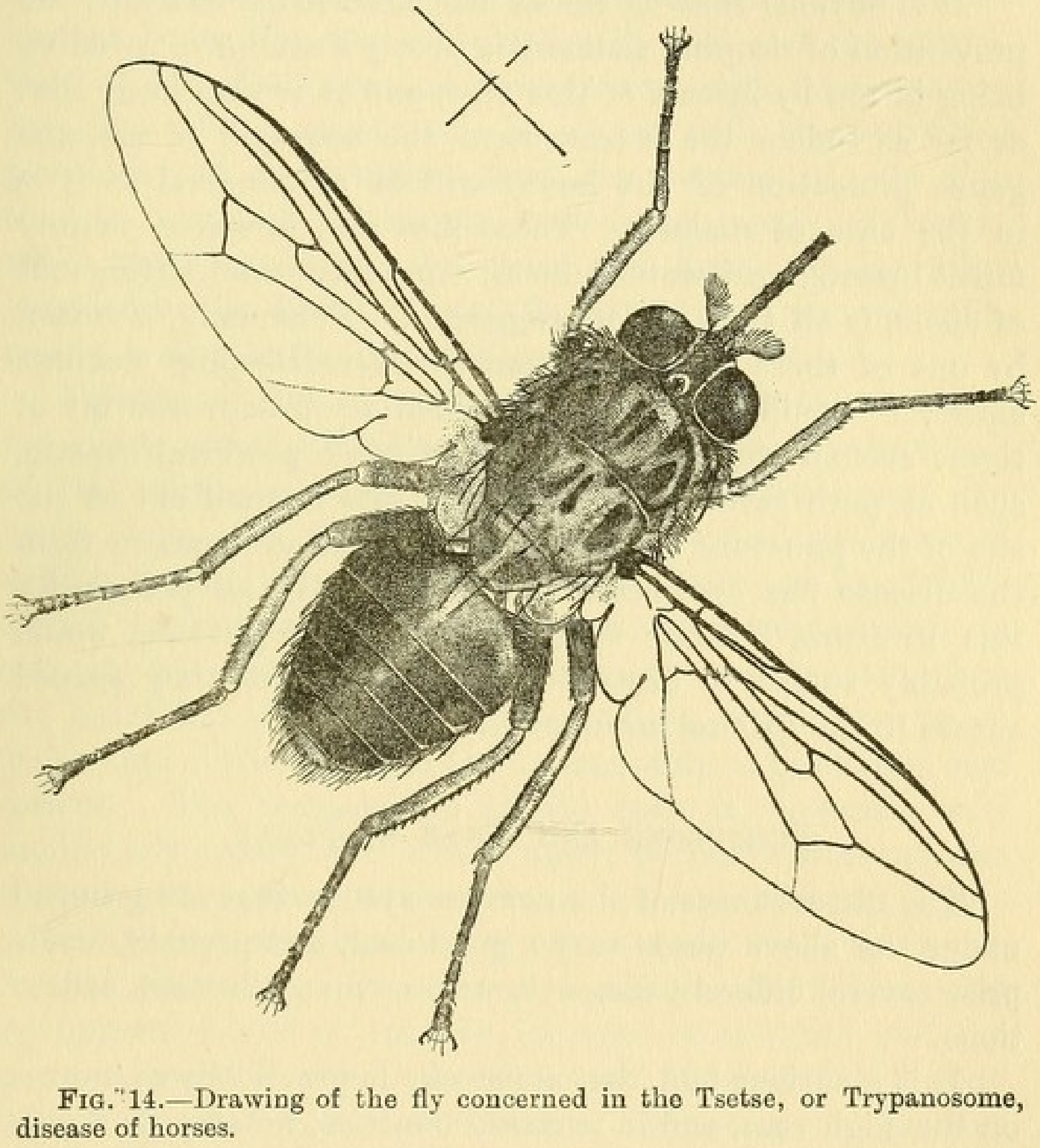


FIG. 14.—Drawing of the fly concerned in the Tsetse, or Trypanosome, disease of horses.

They are usually dark grey, flattened insects, with a peculiarly hard integument, which forms so efficient a protection against injury that, if merely squeezed between the fingers, they will commonly fly away in a perfectly unconcerned manner. The easiest way to dispose of them is to knock the insect down with the whisp of horsehair mounted on a cane, commonly carried by horsemen when flies are troublesome, and then to crush it under the boot, giving the foot a good twist, so the wound, like that of the sergeant-instructor's bayonet, may be "made incurable."

The general appearance of these insects may be best gathered from the above magnified figure.

It is obvious that as far as our knowledge extends, the prevention of sleeping sickness is purely a matter of avoiding being bitten by insects of this sort, and it is also clear that as far as indoor life is concerned, the adoption of metallic gauze protection of the house will be as effectual as it is in the case of malaria. These flies are, however, mainly forest insects, and watchfulness, especially when sitting out of doors, is all that can be suggested. Personally, if bitten by one of these flies in a country where sleeping sickness exists, I should be strongly inclined to destroy the bit of tissue around the bite by means of some powerful caustic, such as pure carbolic acid dropped into a small cut at the site of the puncture, for as yet no instance of recovery from the disease has ever been met with, and in all probability this measure, if done with tolerable promptitude, would probably suffice to destroy the germs before they gained access to the general circulation.

Sunstroke and Heat Apoplexy.

The disturbances of the nervous system that are grouped under the above heads vary a good deal, and probably comprise several different diseases, with as many distinct causations.

It is a curious fact that sunstroke is practically unknown on the high seas, and in certain countries, notably in South Africa, where the fierceness of the sun would naturally lead one to expect to commonly meet with it; and this circumstance, and the fact that something like epidemics of the disease are occasionally met with, lend a certain amount of probability to the idea held by certain authorities, that, in one form at least, the malady belongs to the category of germ-caused diseases.

The symptoms of the disease are insensibility, combined with a greater or less elevation of temperature, and a large proportion of the cases that one hears of are merely instances of fainting, due to fatigue and exhaustion from heat. Such cases are specially common where large bodies of men are massed together, and have to undergo great exertion under unsuitable atmospheric conditions, and where, besides being hot, the air is foul with dust and the emanations of the closely packed animals and men, whose sufferings are often aggravated by thirst and the restricted possibility of evaporation from the surface of the skin that is inseparable from an inadequate supply of water; while the free play of the lungs and heart are too often impeded by the unsuitable and fantastic garments and equipments so dear to the infantile genius of militarism.

Fainting is due to a sudden weakening in the action of the heart, and in a certain number of cases of "sunstroke" of this sort, the mischief goes beyond enfeeblement, the heart stops, and the man is dead. Most of the cases of sudden death from "sunstroke" that occur on hot "field-days," as well as in military operations undertaken in earnest, are probably of this character; and even when the heart has not absolutely stopped, its action may be so feeble and fluttering that the insensibility is prolonged and serious. The temperature of the body is, however, only moderately raised, and when, under proper treatment, the patient has regained consciousness, he soon recovers if permitted to rest, and in a day or two may be little the worse for his adventure. In cases of this sort all clothing and equipment should at once be loosened or removed, and the patient should be given the full benefit of what "air" there is to get. Hence, it is of the first importance to prevent sympathetic onlookers from crowding round him in a ring. The chest and face should be freely soused with water, and when the patient is able to swallow, a little stimulant may be administered.

Some kind of shade should be improvised, at any rate over the head, but no attempt should be made to move the patient till the pulse can again be plainly felt, after which he should be placed on some sort of stretcher and removed as quickly as possible to shade and comfort, where he will probably speedily recover, for though "sunstroke" of this sort is a highly dangerous condition while it lasts, it is rare for it to be followed by any serious after-effects.

Cases of this sort are comparatively rare in civil life, the conditions which lead to them being usually wanting; for it will be noticed that even the military officer takes the greatest care not to be "smart" when he goes out shooting under a tropical sun, his costume, when so engaged, being generally a model of the way he and his men ought to be equipped when engaged in the business of their profession.

What may be called true sunstroke is less common, and beyond the bare fact that the sun's rays are capable of acting in this way, we are really quite without any explanation of its causation, as the condition may be brought about by comparatively short exposure, without any coincident exhaustion or fatigue; and may occur at times when the temperature of the atmosphere is by no means excessive. It is probable that over-stimulation of the nerves of sight by glare may have something to say in the matter, as it has been found that persons at rest in the open, in the Tropics, have their temperature less raised if they wear darkly tinted spectacles than others similarly situated, but having the eyes unprotected. This cannot, however, be the complete explanation, as it appears to be exposure, not of the face, but of the skull and back-bone, to the direct rays of the sun that constitutes the real danger, and it is not the forehead but the back of the head and temples that are most sensitive to the influence of "insolation." So many unexpected discoveries have been made lately of forms of light whose very existence was, but a little time ago, unsuspected, that the matter is less inexplicable than it was before the discovery of the Röntgen rays made us familiar with light vibrations capable of passing easily through substances we have been accustomed to regard as quite opaque. The rays of the sun do not, of course, include vibrations of that particular description, or none of our ordinary wooden photographic apparatus would be of any use to us; but they may well have amongst them other vibrations, as yet not identified, which are capable of passing through the tissues and affecting the brain and spinal cord beneath; and no other suggestion appears capable of explaining the extraordinary way in which a few instants of exposure of the unprotected head to an Indian sun suffices to cause a sharp headache; as the effect is utterly inexplicable on any mere assumption of rise of temperature. It is quite a mistake, for example, to think that it is safe to cross one's garden hatless, from the house to one's stables, in the heat of an Indian day. One is not of course likely to be stretched out in a state of insensibility by so short an exposure, but you may easily earn a splitting headache which will last you the rest of the day; and from the time the sun is well over the horizon, till it again sinks beneath it, it is a purposeless imprudence to be found in the open with the head inadequately protected.

The selection of a suitable headgear for tropical wear is a matter of the utmost importance, and no material appears to be as effective in intercepting the peculiar vibrations which cause sunstroke, whatever they may be, as the pith of the solah, or Indian rush, from which the well-known tropical sun-hat is made.

Next to this in efficiency, I think, comes felt, and after this cork; but the latter material, when adequately supported to give sufficient strength, is really too heavy for comfortable wear; and if any concession to "smartness" is desired, stiffened felt is to be preferred, such as, for example, the well-known "Elgin helmet."

But those who are wise, will abjure such compromises, and stick to pith, either in the ordinary mushroom form, or in that of the admirable "Cawnpore tent club" hats. Let it be freely admitted, that either contrivance is as ugly as well may be, but it is better to keep one's brain clear for the appreciation of artistic beauty elsewhere, than to have them permanently muddled for this and other less æsthetic purposes in the effort to maintain a becoming exterior. Further, the sun is never more treacherous than just after it rises, and before it sets; because just then the nearly horizontal rays can reach the temples and other parts of the head that are well protected by any ordinary sun hat when it is higher above the horizon. In fact, as long as the sun is above it, it is a mistake to go abroad in European head gear, though in the morning and evening a soft felt hat, which can be bent and manipulated so as to shield the particular side exposed to the sun, is better than a solah hat, which of course cannot be adapted in this way. For really tropical climates, in the heat of the day, no other material but solah pith is at all adequate; but in South Africa and other sub-tropical climates a less clumsy and more comfortable covering for the head may be safely adopted, and for such purposes the broad-leafed Boer felt hat, so familiar to us of late in the drawings in the *Illustrated London News*, and *Graphic*, is hard to beat. I do not of course refer to the melodramatic brigand arrangement that, in feeble imitation of our late foes, was inflicted on the Imperial Yeomen by the would-be smart military male milliner, but to the real article, as worn by the real Boer and, it may be added, by everyone else who has work to do in the open in that climate, after he has been out there sufficiently long to have discarded the "helmet," decked out with a pugaree finished off with a pair of long tails down the back, with which his London Colonial outfitter has probably provided him. The true Boer hat is an admirable example of adaptation of costume to special climatic exigencies; but though they are, I presume, manufactured somewhere in Europe to suit the Colonial market, I doubt if such a thing can be purchased in England, for as is well known the English manufacturer insists on his customers taking his own designs, and those who would consult their own requirements must needs deal elsewhere. Hence, if you are bound to "the Cape" you will be wise to defer providing yourself with a hat till you land, for the English outfitter's muslin-bedecked helmet is a natural object of derision to those who know what is really wanted, and no extra protection is wanted under the double awning of the big liner that takes you out to your new home.

The true Boer hat has an ample crown, a very broad brim, and is not looped up at one side, as anyone but a fool can see that to do so is to make the hat suitable only for a one-sided world, in which the inhabitants never require to deviate from a course carefully laid so that the sun is always kept on the "brimmery" side of the hat. The Mexican "sombrero," worn everywhere in sub-tropical America, is practically identical, and the hat worn by the American "rough riders," though not quite so absurd as those of our Yeomen, is another good example of the mischievous effects of the childish military craving for "smartness."

In India and elsewhere in the Tropics, a broad-leafed felt of this sort is very useful and comfortable for wear in the early morning and evening, but is quite inadequate for use in the middle of the day during the hot weather, though at other seasons a less cumbrous head covering than the big felt hat may be safely adopted; but, however cool the air, it is at no season safe to go abroad in India in the ordinary small hat of Europe.

Children are strongly influenced by the sun in two ways: they are in the first place enormously benefited by getting plenty of his health-giving light; in the second their little skulls appear to be remarkably easily penetrated by the *y* or *z* rays that cause sunstroke. Hence, even in the hottest weather, it is a mistake to shut them up in the darkened rooms so dear to their mother's hearts. It is as well, of course, to keep children out of the direct rays of the sun during the day, more especially as it is difficult to ensure that they will always keep their hats on; but it is a mistake to curtail their morning and evening walks on account of the sun being above the horizon, though it must be admitted that the greatest vigilance is required to insure their keeping their hats on their heads.

Ladies resident in hot climates as a rule suffer far more from the want of the sun and light than from serious sunstroke, their greater sensitiveness to discomfort rendering them more apt to shrink too much from light and air in hot weather; but on the other hand their desire to maintain a pleasing appearance not infrequently leads to their suffering from the earlier and milder symptoms of insolation, owing to their not unnatural objection to the admittedly unbecoming forms of head-gear which alone can insure safety. The singular preference for the unfitness of things which appears everywhere to characterise the ritual of Society, and demands that a man must go a-hunting in English winter weather in a tall silk hat, ordains that in India ladies shall pay their conventional calls between the hours of noon and two p.m., when to go abroad in a hat at all in keeping with their costume is hazardous in the extreme. Unfortunately, out of the larger towns, closed carriages are possessed by comparatively few, and the result is that an umbrella, unsteadily held by the native groom behind her, is all that there is to shield her head from a tropical sun at the meridian.

That severe headache, lassitude and other less easily defined nervous symptoms should follow such expeditions is not surprising, and undoubtedly if a closed carriage be unobtainable, for a lady to attempt a "round of calls" at the conventional hours, is a proceeding involving such a real risk that it should never be attempted, and calls should be postponed to the cool of the evening. Moreover, even for occasions when not equipped in full uniform, a safe head covering for ladies living in the Tropics has yet to be popularised. Those who are wise enough to determine to be out of doors daily, and to take a sufficiency of exercise, will find it best to wear a hat of the same pattern as those worn by their husbands and children, and to entirely abjure the absurd constructions of pith, fashioned in imitation of English head gear, which have of late years appeared on the scene. Some years ago an admirable pith head gear, shaped somewhat on the lines of the "Gainsborough hat," enjoyed a well-deserved popularity, and it is a pity ladies cannot see their way to adhere to it; as it not only afforded excellent shade and protection, but when tastefully bemuslined was by no means unbecoming in its obvious adaptation to its surroundings. Recently, however, fashion has chosen as its model the "sailor hat," and frankly, inartistic as is the European original, the fantastic deformity of the Anglo-Indian pith imitation requires to be seen to be appreciated. It may be doubted if human ingenuity could shape the material to a worse form, and it is wiser for a lady to keep out of the sun altogether than to trust herself in the open wearing only such an ill-contrived head covering.

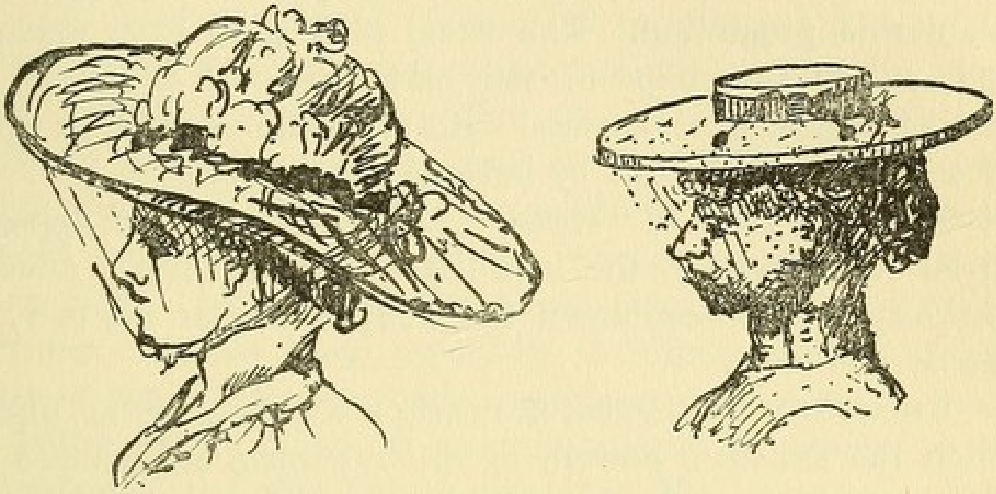


FIG. 15. FIG. 16.

USEFUL AND FUTILE FORMS OF LADIES' PITH HATS.

It is, of course, of the first importance to get a person stricken by the sun at once into the shade, and as the temperature of the body is rarely excessive in such cases, cold locally applied to the head is of more importance than a general bath, which, indeed, unless carefully watched, is apt to make matters worse, by driving the blood from the surface and so increasing the congestion of the brain and other internal organs. Hence it is better to apply ice to the head and to confine oneself to sponging the extremities as a measure for reducing the general temperature. In climates where insolation is common, there is little risk in getting wet, and hence if no proper ice bag be obtainable the ice, roughly crushed, may be applied to the head, simply tied up in a towel. Anyone who has suffered from even a mild attack of insolation remains for a long time specially sensitive to the effects of the sun, and therefore requires, for a long time, to be especially careful in avoiding exposure. When prolonged exposure to the sun at its fiercest must be braved, as in big game shooting, it is well to protect the spinal column by means of a pad worn outside the coat. Some persons are much more sensitive to the effects of the sun playing on the back than others, and though the precaution cannot be considered universally necessary, no one who feels himself inconvenienced by the effects of the sun on this part of the body should neglect the warning and fail to provide himself with a suitable protection. The usual plan is to have made a pad, cut to the shape of the back piece of the coat, of quilted cotton wool, covered with the same material as that of the coat and secured by buttons suitably placed.

The third form of "stroke" is that of heat, and appears to be due simply to the inability of the regulating powers of the system to keep down the temperature of the body to the normal level.

Unlike true sunstroke, it nearly always occurs at night, when the resisting powers of the organism are reduced to their minimum, and mostly under conditions in which the sleeper has inadequate air room, such, for example, as in crowded barracks and closely-packed railway compartments. Such cases may possibly occur, but personally I cannot recall an instance of this accident occurring to persons sleeping in the open air. Every year one reads in the Indian press of persons being taken dead out of railway carriages, and perhaps of a number of cases occurring simultaneously in a single barrack, but with adequate air space such an occurrence is, to say the least of it, exceptional.

At the same time, it is just in the hot "stuffy weather of a break in the rains," when it is always on the cards that it may rain before morning, that such cases occur, and apart from the traditional danger of sleeping outside a room during the rains, one is naturally loth to risk a ducking. Given, however, adequate shelter from rain, there is no danger whatever from sleeping in the verandah at such times of the year, always provided, of course, that protection against infected mosquitoes is assured by a carefully tucked-in mosquito net, and when the atmospheric conditions are such as to involve risk of heat stroke, I personally prefer to sleep on the roof, under the shelter of the top of a tent, or of a special thatch shelter consisting of a roof without sides, or at most with one lateral wall to windward, when there is a probability of a driving rain falling during the night. As a matter of fact, under atmospheric conditions of this sort, one is unlikely to take much harm even if one does get damp, and the admittedly enhanced danger of malaria can be entirely obviated by means of mosquito curtains.

Till lately we heard nothing of the danger of anything worse than itching being connected with mosquito bites, and naturally those who were callous enough to popular notions of safety to sleep outside the house in the rains were about the last folks in the world to trouble themselves about the tickle of a mosquito bite, and became "moral examples" by contracting fever accordingly. During periods of great heat, especially if combined with dampness of the air, under which conditions heat stroke is likely to occur, severe muscular exertion should be avoided as far as possible; a light, mainly vegetable, diet adopted, and the amount of stimulants taken should be very limited, though it is a great mistake to limit fluids of other descriptions, and tea taken very hot is often useful and refreshing. Care should also be taken not to allow oneself to become constipated, and speaking generally it should be recognised that under the extreme climatic conditions that bring on heat stroke, the European must live cautiously if he wishes to come out of the ordeal unharmed.

In this form of the disease the temperature of the body is always high, 103° to 107° F., and the stupor deep and prolonged. Should you have to do with a case in the absence of medical assistance, every effort should be made to reduce the temperature of the body, the most efficient means being to place the patient in a full length bath. As a rule, under such conditions, the temperature of the water obtainable is too near that of the body to bring down the temperature sufficiently rapidly, and pieces of ice require to be added to obtain sufficient cooling power. The patient should be kept in the bath until the temperature (taken in the mouth) is restored to the normal level of 98°-99° F., after which he may be removed; but in serious cases the temperature shows an obstinate tendency to go up again, and it is generally necessary to keep it down by continuous sponging, applied especially to the extremities. If, in spite of these measures, it still continues to rise, the bath must be again resorted to. If ice be unobtainable wherewith to cool down the bath, the want of it should, as far as possible, be met by dipping out the water warmed by contact with the patient's body, and replacing it with freshly-drawn water as cool as may be obtainable. It is well also to try to relieve the bowels by placing 5 grains of ordinary powdered calomel on the tongue, which will ensure its being gradually swallowed, even in the deepest coma, and every effort should be made to keep down the temperature of the air of the room, always provided that the freest possible ventilation be kept up.

It is never prudent for anyone who has survived a warning of this sort to remain in a climate the severity of which he has proved himself unable to resist ; and it should be the rule for those who have suffered to take refuge in a cooler climate as soon as they are sufficiently recovered to travel.

If stationed far inland, it is best to seek refuge in a mountain sanatorium, and not to attempt to reach Europe, as the long journey in the train and subsequent passage of the Red Sea would, in all probability, finish the record of a person so situated before the desired relief could be gained. On the coast the quickest relief can be generally obtained by sending the patient to sea, but if the route necessarily involves passing through the Red Sea, such a course is too hazardous at the bad time of the year, and the change to Europe should be postponed till the dreaded stretch of water can be passed in safety, or a visit to Australia substituted. It must not be imagined that in practice cases of "stroke" can be as sharply divided into classes as it is easy to do upon paper. Naturally a large number are of mixed origin, but the extent to which heat, pure and simple, is concerned, may be generally judged by the temperature of the body, and whatever may appear to be the causation of the disease, whenever this is high, no efforts should be spared to bring it down as soon as possible.

Prickly Heat and Dhobi's Itch.

Among the minor ills which European flesh inherits in the Tropics there is none that is more distressing than this troublesome malady. The symptoms and appearance are too well known to require description, and the disease is, as a rule, rather irritating and distressing than involving any danger. The process of regulating the temperature of the body depends, however, almost entirely on the action of the skin, and where prickly heat is so extensive and severe as to partially incapacitate it from its functions, it is obvious this usually trifling disease may be a predisposing cause of more serious maladies. Then, again, the loss of sleep and nervous irritation kept up by the constant itching, pricking, and soreness, are powerful helps in pulling down the already severely tried powers of resistance to the climate, and often have a great deal to say in determining an ultimate breakdown.

There is a common popular notion that prickly heat is "healthy," people saying that "it is a sign of health," and that it is a mistake to check it. This, however, except in so far that healthy, full-blooded persons usually suffer worse than those in an anæmic condition because they usually perspire more freely, is an entire fallacy; as though good health may predispose to prickly heat, it cannot but have an influence in rapidly reducing that factor in its causation. Then, too, the numerous small abrasions that result from the bursting of the minute vesicles, and from scratching, are extremely liable to become infected with the germs of suppuration, and give origin to crops of boils.

Boils are extremely common, and are most painful and debilitating when present in large numbers, as they often are in hot climates, and I believe they should be really regarded merely as *sequelæ* of neglected prickly heat and not as a distinct condition. For these reasons the writer is strongly of opinion that prickly heat should always be treated, especially as it is usually quite possible to keep it within moderate bounds, by the use of appropriate remedies. At sea the use of salt water for bathing should be avoided, but frequent bathing in fresh, and especially in rain water, is not only a great alleviation, but tends towards cure by removing the irritating accumulation of saline matter that results from the constant evaporation of the perspiration. Almost any metallic astringent, such as sulphate of copper or sulphate of zinc, 4 grains to the ounce, will be found to be extremely useful in reducing the extent of the irritation, but none of these are nearly as effectual as a lotion of perchloride of mercury of a strength of one per thousand.

This agent can be obtained ready measured out into tabloids, which are always coloured blue to prevent mistakes in handling the solution; which is a most useful one, not only for this purpose, but as a general antiseptic. Care should, of course, be taken in the custody of these tabloids, and also in the handling of the solution; but the latter is not really more poisonous than the copper solution, or than many other antiseptics which, like carbolic acid, are nowadays in constant domestic use. This mercurial solution is undoubtedly by far the best remedy we have for prickly heat, and I have never seen any harm or signs of absorption of the mercury result, even from its copious use. The tabloids should be got of such a size as to make about a quarter of a pint of the solution, and after the bath and before retiring to bed, all affected parts of the skin should be dabbed with a bit of lint dipped in the solution, which should be allowed to dry on to a certain extent before putting on one's clothes. A further great advantage over the other metallic astringents is that, owing to the weakness of the solution, it does not injure the clothes, and the slight blue aniline colouration easily washes out. It will be found, too, an almost complete preventive against boils, if resorted to from the commencement of the hot season. Powdering with violet powder is also useful in subduing the irritation, which by the adoption of the above-described plan, may almost always be kept within moderate bounds.

"Dhobi's itch" is a troublesome irritation of the skin often met with in hot climates, which is due to the growth of a minute fungus within the structure of the scarf-skin. It commonly attacks those parts of the body where the surfaces of the skin come in contact with each other, as, for example, between the legs, and in the armpits. The general appearance is very much that of a "ringworm," the patches spreading by their edges, where they are red and irritable and tending to fade in the middle. There can be little doubt that the disease is generally caught by the infection of clothing that has been washed in dirty pools along with that of previous sufferers from the disease, which is very common among the native races. If neglected, it is apt to spread so as to cover a large area, under which circumstances it is apt to be troublesome, but if taken early, there is generally no difficulty in dealing with it. All that is necessary is to destroy the fungus by means of strong antiseptics, but in doing so it must be remembered that any solution strong enough to kill the fungus must necessarily also cause more or less inflammation and, for the time, increased irritation of the skin.

On this account, if any considerable area be involved, it is a mistake to attempt to treat the whole of it at once, as such a course may easily result in producing an amount of soreness and inflammation which may involve confinement to bed. The patches should be attacked piecemeal, a couple of separate patches the size of a shilling being quite as much as is prudent to attack on any one occasion.

Equal parts of tincture of iodine, carbolic acid and glycerine painted over each patch, to the extent above described, is a safe and efficient remedy, as also is Goa powder; but the essential point is to be on the look-out for the contingency, and to at once treat any patch that may appear before it has time to spread.

The disease is, I believe, common enough in other warm climates, but I am not acquainted with its popular designation elsewhere than in India, where it is known by the above name.

On the Prevention of Diseases Caused by Internal Worms.

Internal worms are extremely common in most hot countries, and especially in those climates where moisture and heat are combined. Where they prevail to a serious extent, they often constitute one of the principal causes of mortality amongst natives, but white residents rarely suffer, as the habits of the better-class European to a very great extent protect him from being invaded by these pests.

There are three principal sorts of these parasites: the round-worms, which usually divide their time between some animal and the outer world, and the flat-worms and the flukes, both of which must pass through two or more animal hosts. The life-history of these troublesome guests, especially those belonging to the two latter classes, include some of the most wonderful and interesting pages of natural history, but unfortunately considerations of space prevent our describing these changes except by the barest allusions.

The commonest round-worms that establish themselves in mankind are the common thread-worms and round-worms (*Lumbrici*), and that much more formidable pest of tropical life, the *Ankylostoma*, or hook-worm.

Thread-worms and Lumbrici are common enough everywhere, but are far more commonly troublesome in hot climates than at home in Europe. The eggs of both are probably usually carried into the human intestine on food or in drinking water, and in the case of the Lumbricus this is the only way in which the numbers of the parasite can be maintained, as its eggs take a long time to hatch out; but those of the thread-worm, when deposited, are quite ready to burst at once, and though no individual worm as a rule resides within the intestine for any great length of time, the patient infested with them is continually reinfecting himself, so that their numbers have a tendency to increase. Thread-worms are especially common in children, on account of the strong tendency of the little folks to put their fingers in the mouth.

Thread-worms live in the lowest part of the bowel, and so cause much itching and tickling about its orifice. This prompts the child to scratch itself, with the result that some of the innumerable eggs laid by the worms adhere to the fingers, and once there soon find their way, along with the fingers, into its mouth. The intruders are usually easily expelled by an injection of salt and water, but it is difficult to get rid of all of them, and the child is nearly sure to reinfect itself unless it is made to sleep in drawers. Provided reinfection is prevented in this way, however, the remaining worms will soon be got rid of, as this species as a rule does not take up a prolonged residence.

Round-worms can be expelled by the means of a dose of santonin, but as neither these parasites nor tape-worms usually cause immediate serious symptoms, and both this drug and most other vermifuges require a certain amount of care and caution in their administration, it is better to wait any moderate time until the treatment can be supervised by a medical man.

The third common round-worm parasite — the hookworm namely—though but little known in Europe, is so widely distributed in hot, moist countries, that in such climates the greater proportion of the indigenous races are often affected to a greater or less extent. It is quite a small worm, but fastens on the lining of the bowel in exactly the same way as leeches attack the outer integuments, and exhibits the same insatiable appetite for blood. The extent of the mischief wrought by them depends entirely on the number harboured. When only a few are present, they may be considered practically harmless, and thousands of such cases are to be met with in any country where they are common ; but wherever this is so, numbers of subjects will be met with, in whom they are so numerous as to cause serious symptoms and death ; so that there are many places where they constitute one of the most serious scourges of the Tropics. The eggs of this parasite, deposited along with the dejecta of persons infested with them, hatch out in the soil, and multiply there enormously, so that owing to the insanitary habits of the populace, the soil round about a native village comes to swarm with this free stage of the parasite. Now as the population is generally a purely agricultural one, and none too nice in its habits, it can be easily understood that persons, eating as they do with unwashed hands, must constantly carry to their mouths some of the earth containing the minute embryos which convey the disease, and hence the process of infection is commonly continuous and progressive. As a matter of fact, out of some hundreds of specimens of drinking water examined by the writer in Assam, where the disease is extremely rife, in no one case was there anything found to show that the malady was commonly conveyed in water, but the contingency is clearly a possible one; and in any case, it is clear that very moderate care as to food, water, and personal cleanliness would suffice to render infection impossible. From what has been said, it is easy to understand that the disease is practically unknown among European residents whose habits have reached the most moderate degree of refinement; but though it may not affect the planter's health, it reacts most seriously on his pocket, owing to the disastrous amount of sickness and mortality it gives rise to among his native labourers. Now it is perfectly obvious that this disease can be easily prevented by the most ordinary measures of conservancy, and the question whether the evil can be obviated or not, is purely one of whether the master has the will and power to insist on the use of proper latrines. This, however, is by no means so simple a matter as it looks, where one has to deal with labourers belonging to a primitive stage of civilisation. Once seen, the disease is easily recognised by the deadly pallor of the lining membrane of the eyelids, and of the tongue, especially the latter, which looks much like a piece of a wet, pipe-clayed buff belt. By treatment with vermifuges and careful nursing there would be little difficulty in curing people of European habits; but only those who have had to attempt it know how impossible it is to get semi-civilised people to adopt, or even submit to, what to us are the most ordinary sick-room comforts, and as a matter of fact, there is very little hope for a native who is at all seriously affected with these parasites.

The best vermifuge we have is thymol; three doses of 30 grains each, given within six hours, followed up by a dose of castor oil. A certain amount of caution is required in giving this to cases in a very weak state, but after all it is the only chance for them. This medication may have to be repeated once or twice, at intervals of a week, and should be systematically carried out in all cases that have not gone too far. The worst of it is, that unless proper sanitary measures can be carried out, treatment is little better than a waste of drugs, as otherwise the patients will be sure to reinfect themselves within a few weeks, however thoroughly the vermifuge may have done its work.

The Guinea-worm is a curious parasite, which is found burrowing under the skin, and finds an exit through the opening formed by a sort of boil. It very rarely attacks Europeans, as it may be avoided by the most ordinary care in the matter of water used for drinking and bathing.

Another curious malady caused by one of the round-worms is the blood-worm disease, or filariasis. In this the parent worm is found embedded in the tissues of the host, and periodically discharges into the blood enormous numbers of its embryonic offspring. As this disease is undoubtedly communicable through the agency of mosquitoes alone, its prevention may obviously be secured by the adoption of the same measures that serve to protect us from malaria.

Tape-worms have a very curious life-history. The long, flat, jointed strip is really a chain of sexually mature individuals, but when their eggs are swallowed by an animal there is hatched out from it, not another tape-worm, but a minute embryo, which has the power of boring through the tissues of its host till it reaches some favourable resting-place, where it settles down, protected by a capsule, forming what is known as a bladder-worm. It may live for years in this condition, but cannot reach maturity until the capsule has been swallowed by some carnivorous animal, though some species can multiply non-sexually and so cause terrible damage to the animal that harbours it. Both stages of several species of these parasites infest man, but fortunately their prevention is a very simple matter, at any rate as far as the adult strings of worms are concerned, as infection is impossible provided all meat and fish eaten be thoroughly cooked. The mature stage of the bladder-worm which is found infesting man inhabits the intestine of the dog, and as it is capable, in this stage, of non-sexual multiplication, may give rise to large tumours, the effects of which may be most serious if a vital organ be invaded. Though almost a medical curiosity in Europe, it constitutes a really serious danger in certain pastoral colonies, such as Australia, where large numbers of dogs have to be kept for herding sheep, and are allowed unrestricted access to the offal of carcases, which is, of course, very abundant where meat-preserving is an important industry. The disease might be guarded against by preventing the dogs having access to anything but thoroughly cooked meat, and by avoiding undue fondling and too close association with these animals.

The third important class of parasites, the flukes, but rarely infest man, but in Egypt and, in fact, throughout Africa, a peculiar fluke, the *Bilharzia*, is found infesting the blood-vessels, especially those of the kidney, and gives rise to the appearance of blood in the urine. It is extremely common amongst the natives of Egypt, but it very rarely attacks Europeans, and though we are quite in the dark as to its life-history outside the human subject, there is little doubt that moderate care as to the water used for drinking and bathing is sufficient to afford complete protection against the disease.

PART II.

OUTLINES

OF

TROPICAL CLIMATOLOGY

ERRATA.

p. 9, line 9 from foot, *for* "Camerun" *read* "Cameroon"; and line 12 from foot, *for* "Shilling" *read* "Shillong."

p. 58, line 11 from foot, *for* "Sangor" *read* "Saugor."

p. 63, in table, line 11 from top, *for* "Ayra" *read* "Agra."

p. 84, line 1 in table, and p. 85, line 3 in table, *for* "Mazattan" *read* "Mazatlan."

OUTLINES

OF

TROPICAL CLIMATOLOGY.

SECTION I.

General Considerations.

A VERY broad belt of the earth's surface is occupied by countries that may be said to possess hot climates; as they include not only those within the Tropics, but also the sub-tropical zones. Practically speaking, the whole of Africa, much of South America, the Southern States of North America with the West Indian Islands, Asia Minor, Arabia, Persia, India and the Malay Peninsula, the greater part of China, Australia and the islands lying between it and the continents of the northern hemisphere, may be said to be included within this general term. In so wide an area, it is needless to remark that the widest range of climatic conditions may be found, the only condition common to all being that of subjection to a fiercer heat than that to which we Europeans are accustomed, for some or all the months of the year. It must be remembered, too, that climate is determined not only by the relation of a place to the parallels of latitude, or to speak more exactly, to isothermal lines, but is also affected by the elevation of a site above the sea. Even under a vertical sun, an ascent of 18,000 feet will land the climber in an absolutely arctic climate, as far as the temperature of the air is concerned; but it is only in this one item that we have any similarity to arctic conditions, as the sun's rays blaze down even more fiercely than they can at the sea-level, where they have been tempered by passage through miles of denser air and watery vapour.

On the crest of the Wakujrui Pass, at 16,500 feet, while the air temperature at noon stood at 20° below freezing point, the sun thermometer registered 165°, in May, 1886, when the writer was crossing the great divide between India and Central Asia; and yet it was sufficient to remove one's hat for a minute to realise that to do so might result in sunstroke. Moreover, apart from the effects of the rarification of the air on respiration, radiation was so rapid as to be painfully apparent; one side of the hand turned to the sun would be scorched, while the other chilled so rapidly that the sensation conveyed was that of being in contact with a cold liquid; and one was constrained to wrap up even the face as closely as possible, though the air was fortunately well-nigh still, whereas cold of similar severity at the sea-level is quite tolerable as long as there is no wind. Thus, in the consideration of a given climate, not only geographical position, but also elevation above the sea must always be taken into account.

To enter into a detailed account of the climatic conditions of the enormous area under consideration is, of course, out of the question, as it is a subject on which a special encyclopædia might well be compiled, so that only the outlines of the subject can be touched upon in the present short pamphlet. Roughly speaking, we may say that the climates under consideration have a mean annual temperature at the sea-level of not less than 64° F. (18° C.), while in the equatorial zone it reaches 80° F. (27° C.); but the difference between the maximum and minimum temperatures in tropical countries is rarely as marked as in sub-tropical localities, as the range of temperature in the latter is usually far greater than in the former, so that in spite of the lower mean, far higher temperatures are recorded for certain regions well outside the Tropics than can be anywhere found within them. At Jacobabad, in Upper Sindh, for example, a place some 500 miles outside the tropical zone, the enormous shade temperature of 127° F. (52·7° C.) has been registered, and readings of 115° F. (46·1° C.) are quite common during the hot season over large areas of sub-tropical India. With the exception of certain parts of the Soudan, such temperatures are hardly to be met with in the truly tropical zone, and even these are but barely within it.

The tropical zone may be defined as that within which the sun is at some time of the year vertical at noon; or in other words, comprises a belt extending about 23½° of latitude on either side of the Equator. To the north and south of it the sun approaches and recedes from the vertical once during the year, and there are accordingly but two distinct seasons of summer and winter; but at the Equator the sun necessarily passes overhead twice during the twelve months, and there are accordingly four seasons, none of which, however, owing to their shortness, can be very sharply differentiated from the other. The northern and southern limits of the Tropics coincide pretty closely with the isotherm, for the coldest month, of 68° F. (20° C.). On the great oceans the coincidence may be taken as practically absolute, especially along the northern isotherm, but both isotherms show a tendency to turn towards the Equator as they approach the western shores of the great continents; so that the breadth of the tropical belt is considerably contracted in these positions, and the same remark applies, though to a lesser extent, to the mean annual isotherm of 68° which bounds the sub-tropical zone. The tropical zone on the West Coast of America is contracted to little more than 30° in place of the normal 47°, while as far as mean temperature is concerned, the temperate zone extends as far north as 20° S. latitude, well within the geographical Tropics. On the West Coast of Africa the contraction is equally marked, but mainly at the expense of the northern isothermal boundary, while the sub-tropical boundaries, on the contrary, spread out, so as to leave only the extreme northern and southern points of the continent outside their limits. A third narrowing is to be found at the western side of the irregular land mass formed by Australia, the Malay Peninsula, and the intervening islands, but is much less marked, amounting to a few degrees only. The comparative coolness of the western sides of the great continental masses is due to the existence of northerly currents of cold water coming from the frozen seas of the south pole, which wash the western coasts, while along the east coast there sets a current of warm water coming from the Equator.

The principal factor in the determination of climatic characteristics is the fact that while the land heats and cools with great rapidity, the sea does so more slowly, but holds the heat better. This is due to two circumstances. In the first place, it requires more heat to warm a given weight of water than an equivalent mass of the various substances which constitute the land. In the second place, while both are alike bad conductors of heat; water, being a fluid, is mobile, and in the colder parts of the globe where the surface is colder than the intermediate depths, convection comes into play, apart from which the least movement at the surface is sufficient to distribute the heat gained from the sun to a greater depth than is possible in the case of the solid constituents of the earth's crust.

The second great determinant of climate is the fact that the temperature of the air is determined for the most part by that of the surfaces with which it is brought into contact, rather than by the passage of the sun's rays through it, as is well shown in the arctic air temperatures of great elevations in tropical latitudes. From this it follows that the atmosphere is mainly heated by the sun's rays indirectly, from below where it is in contact with the directly heated, solid and liquid surface of the globe.

In becoming heated it necessarily expands, and becoming lighter that the stratum immediately above it, ascends, drawing in, to take its place, the cooler air that has been in contact with surfaces of air or water less strongly heated. Now because, as we have seen, water heats and cools more slowly than land surfaces, along a coast there is always a tendency to the production of a sea wind from the cooler sea to the hotter land during the latter part of the day, and inversely of a land breeze from the more rapidly cooled land to the slowly cooling sea in the early morning; and in the Tropics, where the sun's rays are sufficiently near the vertical to produce a rapid and marked effect, these diurnal land and sea breezes form a characteristic feature of littoral climates, and go far to render life tolerable in them. Hence also it follows that everywhere littoral and marine climates tend to uniformity, not only as to diurnal but also as to annual variations, while continental climates tend to wide variations of temperature, and the seasons differ to a degree never experienced in places on or near the sea. As an example may be contrasted the climates of Madeira and Peshawar, in the former of which the difference between the mean temperatures of the coldest months is under 13° F. (7·2 C.), while in the latter the difference amounts to 40° F. (22·2 C.), or three times as great in the continental climate.

It is further noteworthy that while, in the continental climate, the hottest and coldest months coincide with the summer and winter solstices, in the marine climate they lag a month or two after; the coldest month being February and the hottest August in Madeira, owing to the slowness with which the water surrounding the island gains and parts with its heat.

Just as the alternating heat of day and coolness of night produce, in littoral regions, the daily land and sea breezes, so the greater heating of the world's surface over the Tropics produces, throughout the year, a steady flow of air from the north and south, to take the place of the air that has become rarified, and so floated to a higher level. These winds—"the trades"—are not, however, directly from the north and south respectively, but have also a great deal of easting in their direction, a circumstance which is explained by the fact that the air, coming as it does from latitudes where the circumference of the earth is much smaller than at the Equator, is moving from west to east, only at the comparatively slower pace of the rest of the earth's surface at that latitude; and as they do not at once acquire the quicker motion of the latitudes to which they have travelled, they lag behind the points of the earth moving beneath, and so give the effect of an easterly breeze, just as would be the case with a vehicle driving rapidly eastward through still air.

Between the two belts influenced by the trade-winds there is naturally a broad zone, known as "the doldrums," where the opposing air currents tend to neutralise each other, and which is naturally characterised by periods of prolonged calm, alternating with light and variable airs. The middle line of this zone will obviously be that in which the sun is vertical at noon, and will consequently lie north or south of the Equator according to the season of the year. For the typical development of the "trades" the absolutely uniform surface conditions of the ocean are indispensable, the variable conditions of soil and vegetation on land areas impeding their full establishment, by introducing local variations of capability of heat absorption and radiation ; but in spite of this, though less definite in force and direction, winds of the same general direction are dominant over the comparatively uniform surface of the South American continent. When, however, we find a sufficiently large land area more or less surrounded by sea, the different heat-absorbing capacity of solid and liquid surfaces may suffice not merely to neutralise, but to reverse the normal direction of the tropical and sub-tropical air-currents. Under such conditions, where the land surface is sufficiently large, the much more rapid heating of the land surface during summer brings the air in contact with it up to a much higher temperature than that of the neighbouring seas, and accordingly over India and Southern China we find that about May or June, by which month the land has had time to become sufficiently heated, a strong south-west current—the monsoon[1]—is established, which, carrying with it air saturated with moisture by its contact with the sea, determines the rainy season, and by the gradual cooling of the surface thereby produced, brings about its own termination. In the winter, on the contrary, over these regions, the prevailing wind resumes the general direction of the trades.

Another effect of rapid local heating of the air, the cause

[1] This is simply a seaman's corruption of the Arabic word for season.

of which, however, is ill understood, is the occurrence of the revolving storms which are met with during the summer months in low latitudes, and are generally spoken of as "cyclones" in the Indian Ocean, as typhoons in the China seas, and as hurricanes in the West Indies. These storms are determined by the formation of areas of low barometric pressure, to meet which the air, converging from all sides, takes on a circular motion, or vortex, round its centre. Nearly all such storms have a double motion, the vortex itself being not stationary, but travelling over the surface of the globe in a definite direction. However obscure their origin, the laws of these storms are now well understood and are as follows: In the Northern Hemisphere, the vortex revolves in the opposite direction to that of the hands of a watch, and in the southern in the same direction as they do; while in both the motion is not truly circular but spiral, in such manner that a particle carried by the wind, after circling round the centre several times, ultimately finds itself carried to the centre of low pressure. In the same way the centre of low pressure, with its accompanying vortex, always travels at first from east to west, and then curves away from the Equator, to ultimately take an easterly direction as it dies out. The dimensions of the vortex, and the area influenced by such storms, may vary from a few yards to several hundred miles, but in all cases their force, within the vortex, is very considerable.

Small atmospheric disturbances of this sort, often of no more than 50 or 100 yards in diameter, are very common on the hot, dusty plains of Rajputana and the Punjab, and are most instructive to watch, as they are exact reproductions, on a small scale, of the awful visitations that from time to time devastate huge areas of the earth's surface.

After a period of exceptional heat and stifling stillness, the still leaves of the dried-up trees are agitated by light puffs of air of irregular direction, then away in the east is seen a column of dust, and this steadily advances till one finds one's self for a few minutes buffeted by a violent, fiery wind and choked with dust. When it has passed and the air has again cleared, this is succeeded by a refreshing relief of the previously intense heat. When of very small dimensions these miniature cyclones are locally known as "devils," and their form, narrow below and spreading out like a funnel above, can be studied at leisure. The boundaries of the expanded upper part are indistinct and fade gradually into the steel-grey of the surrounding glare, but below the contour of the column is well-nigh as sharp as if it were composed of solid materials, and may sweep along close by the observer without involving him.

When of larger dimensions, so that the boundaries of the revolving column of dust and air are beyond the range of vision, they are known as "dust storms," and in spite of the temporary discomforts they cause, are gladly welcomed, on account of the relief they bring from the suffocating heat that originated them. When on the larger scale that is met with in the equatorial zone their violence is well-nigh incredible—trees are torn up, houses levelled, crops destroyed, and massive bodies, such, for example, as large anchors lying on the quays of a dockyard, trundled along as if they were straw hats in an ordinary gust of wind.

From a sanitary point of view these storms are usually beneficial by their effect in clearing and cooling the air; but this is unfortunately only small and temporary, so that they are of little interest to the hygienist. In any case the prophylaxis against their effects is purely mechanical, and consists in crawling, if possible, into the nearest cave or cellar.

Over the great Asiatic continent, especially north of the Himalayas, a strong northerly current is produced about mid-summer by the area of low pressure caused by the intense heating of the Siberian steppes, which, owing to the length of the days at these high latitutes, are exposed to the sun's rays for practically the whole twenty-four hours, and the current thus initiated makes its influence felt for hundreds of miles to the south of its point of origin, and no doubt reacts upon and modifies other periodical forces of the same character. A useful law to remember is that discovered by Professor Buys Ballot, which is to the effect that, if you stand with your back to the wind, the barometer will be lower in your left hand than in your right, in the Northern Hemisphere, and *vice versâ* south of the Equator.

The effect of ocean currents bringing with them masses of hot or cold water from other latitudes has already been alluded to, a familiar example being the mildness of our own climate under the influence of the Gulf Stream.

In the Southern Hemisphere currents of cold water sweep up from the Antarctic regions along the western shores of the great masses of land, counter-currents of warm water flowing down from the Equator along their eastern sides. In the Northern Hemisphere the reverse is the case, the cold Arctic currents clinging to the eastern, and the warm equatorial to the western shores of the continents. The more detailed distribution of these currents, however, can be better gathered by a little study of the current chart found in any good atlas, than from any description, however elaborate.

Climate may also be profoundly modified by the distribution of mountain chains, the cold summits of which determine the precipitation of the moisture brought up from the sea, so that while their seaward slopes may be inordinately rainy, the country beyond may be completely parched; and apart from such marked contrasts as are produced by the interposition of great ranges of hills, large differences of rainfall may often be found in stations a few miles apart. Cherapunji, in Assam, which is said to hold the world's record for heavy rainfall, is but 40 miles from Shilling, the rainfall of which is by no means excessive; and again, Debunja, in the Cameroons, which is said to hold the second place with a rainfall of 897 cm., is close to Camerun, where the rainfall is less than half that figure.

Another climatic factor of great importance is the amount and character of the vegetation, for it is a well-ascertained fact that not only does a heavy rainfall determine luxuriant vegetation, but the converse is also true, and it is probable that the barrenness of certain regions is due rather to improvident deforestation than to original natural dryness. Certain experiments, indeed, go far to show that it is possible to materially alter the climate of even comparatively small areas by judicious tree-planting; and it is also certain that the presence of even small patches of verdure may make a marked difference in the temperature curves of places within but a few hundred yards of each other. In the Upper Nile valley, for instance, astounding differences in the temperature and humidity of the air have been found to exist in places, respectively barren and cultivated, quite close to each other, and there is little doubt that local differences of this sort are worthy of more detailed study than they have as yet received, and would often be of value in determining the most suitable sites for habitations and stations.

From a sanitary point of view the variations of the barometer are of little interest, as at any given level they are never sufficiently great to have any physiological effect on the human organisation, and hence the elements of climate that interest us most are temperature and moisture, for the determination of which all that is required are a maximum and minimum thermometer, a pair of ordinary wet and dry bulb instruments and a rain gauge.

In forming an opinion of the characters of any given climate the temperature of the air is alone of any great importance, the data afforded by the sun thermometer and that used for determining radiation being of comparatively little interest, so that the following data are the most important:—

(1) The mean temperature of each month. This can only be given accurately by self-registering instruments, but in the absence of these is usually taken as

$$\frac{\text{max. t.} + \text{min. t.} + \text{t. at 9 hours} + \text{t. at 21 hours.}}{4}$$

(2) The mean monthly daily range of temperature, or what is practically as valuable, the mean maxima and minima.

(3) The "relative humidity" of the air, or the proportion of moisture actually present to the amount that would suffice to produce saturation, for each month of the year.

(4) The monthly rainfall.

(5) The number of rainy days in each month.

(6) The average condition of the sky, whether clear or overcast, in each month.

(7) The amount and daily distribution of wind, its direction being for us of little moment.

In speaking of air temperatures it must always be understood that temperatures *in the shade* are referred to, and in systematic scientific observations the greatest care must be taken that not only shall the instruments be thoroughly protected from the direct, but also from the reflected rays of the sun; and that means are also taken to secure a free current of air over them.

If an absolutely exact determination of the temperature of the air in any given situation be required, the observation should be taken by swinging the instrument, attached to a short cord, rapidly round the head, and by this method it is possible to secure a close approximation to the actual air temperature, even in the open and under the direct rays of the sun.

In considering the effects of climate on human beings it will be well to commence with a short consideration of the way in which they are affected by each of these elements of climate.

(1) *Temperature.*—In health the temperature of the human blood varies but little, whatever may be the climatic conditions to which we are submitted, the normal point being generally taken as 98·4° F. (37° C.), though it may range half a degree or so above or below this level without prejudice to health or comfort. The mechanism by which this uniformity of internal temperature is maintained, in spite of the widest differences in the temperature of our environment, depends upon an automatic regulation of the nutritive processes going on within the system.

The various muscular and nervous actions, going on constantly throughout life, derive the force necessary for their production from the oxidation of the various articles contained in our food, and as the oxidation of all its digestible constituents is really nearly as complete as if they had been subjected to combustion, the body gains nearly as much heat from the consumption of its food as if the latter were actually burned. In climates where the temperature of the air is less than that of the blood, a good deal of heat is conducted away from the body by its contact with the air; but where, as in hot climates, the difference is but small, or the temperature of the air may even exceed that of the blood, it is obvious that some further mechanism is required if the temperature of the body is to be kept at the normal level of health. This requirement is met by evaporation from the surface of the body, the amount of which is regulated automatically by a special set of nerves which are known as the vaso-motor system, whose function it is to regulate the calibre of the blood-vessels throughout the body, according to the varying nutritive necessities of the several organs to which they are distributed.

We are all familiar with the fact that either extreme heat or violent exertion will alike bring about free perspiration, and in both cases the object is the same, viz., to cool down the body which tends to become overheated; in the one case by the warmth of the surroundings, and in the other by the activity of the chemical changes going on within the body to provide the force required for the various muscular and nervous actions involved in the work performed. On the other hand, under the influence of cold the skin becomes bloodless and dry, very little blood being allowed to circulate at the actual surface, the bulk of it being kept to the deeper parts of the body, well beneath the protective coating of fat which lies immediately below the skin. Buried in this fat, and opening by delicate tubes on the surface, are enormous numbers of small glandular bodies—the sweat-glands—each of which, when sufficiently freely supplied with blood, pours out a fluid consisting mainly of water, but containing also a little common salt and minute quantities of other mineral constituents, as well as a trifling amount of organic or animal matter, which has served its purpose in the organism and is thrown off in this way as being of no further value.

In the conversion of water into vapour a large amount of heat is absorbed, and it is thus equally possible for the body to be kept at a temperature lower than that of the surrounding air as it is, under more ordinary conditions, to maintain it at a higher; but the endurance of intense heat throws an even greater strain on the organism than that of severe cold, as it cannot be combated in the same way by covering the body with non-conducting clothing, and under such circumstances exertion, involving as it does a further production of heat within the body, becomes well-nigh insupportable. The evil effects of intense heat become all the more marked in proportion as they are prolonged, and the effects of air temperatures approaching or exceeding that of the normal blood continuously, for many days or weeks, without any relief at night, are most debilitating, and render any considerable amount of muscular exertion not only painful but dangerous, even to natives of the country, who, indeed, thoroughly recognise the fact and abstain during such periods from any laborious tasks not absolutely necessary. The exhaustion and incapacity produced by extreme heat are naturally specially marked in persons in whom the sudorific system is ill developed, and there is no doubt that those who suffer from this defect in any marked degree should avoid subjecting themselves to such conditions and be content to remain in more temperate climes. It is obvious that under such conditions a failure in the action of the sweat glands must necessarily result in a rise of the body temperature, and there can be little doubt that this is what takes place in certain cases of simple "heat apoplexy." This failure of the sudorific system appears to be specially favoured by the overcrowding of too many persons within a limited space. It is only, however, when the temperature stands for long periods above 90° or 95° F. (33· C.) that these distressing effects of heat are at all commonly experienced; most Europeans bearing heat up to this limit even for prolonged periods, if not with comfort, at least without serious detriment to health, and much higher temperatures are well borne during the day, provided that the daily range of temperature is sufficient to secure a definite relief during the night. It will thus be seen that a wide diurnal range of temperature will go far to neutralise the bad effects of a high mean temperature, and the importance of securing information on this point in estimating the possible effects of a given climate on health is therefore obvious.

The proportion of moisture present in the air has at least as important a bearing on health as its temperature. It is obvious that when the air is actually saturated with watery vapour evaporation from the surface of the body must necessarily be stopped, and with it the natural provision for preventing an undue rise of the temperature of the body. Actual saturation combined with high temperature is, however, fortunately rare for anything but short periods, as the absolute amount of water requisite to saturation increases rapidly as temperature rises; and hence warm air, but partially saturated, and therefore still active as an absorbent of evaporation from moist surfaces, may contain a far larger absolute amount of water than saturated air at a lower temperature. In practice, saturated air is only to be found in situations where it is brought into contact with colder surfaces, such as that of the earth, cooled by radiation during the night, as is seen in the production of dew; the dew point being, in fact, the temperature at which the amount of water present in the air suffices to saturate it. Apart from its diminution by the formation of dew, the absolute amount of moisture present in the air, depending as it does on but slowly changing conditions, can naturally also change but slowly, but the relative moisture, or the percentage of the amount required to produce saturation, which is actually present always varies greatly during the twenty-four hours in all places where the diurnal range of temperature is at all considerable; so that relative moisture, when given for any day or other period, always refers to an average. As a rule it is only the stratum of air of a few yards in thickness that is cooled by contact with the soil during the night and is hence concerned in the formation of dew, a fact which is prettily illustrated by the low-lying bands of vapour which hang over the landscape after a clear night on any fine morning in the Tropics, and which clear off as if by magic as the returning sun once more warms up the soil and air.

Wherever radiation is impeded by the shelter of trees, by artificial shelter, or by sufficiently dense masses of cloud, the temperature of the soil and air falls but little, and hence, under such circumstances, dew does not fall.

For practical purposes there are no better hygrometers than those that depend on the hygroscopic properties of certain organic substances, such as hair and catgut, and it has been shown by Sresnewsky that the alteration in length of a hair caused by its absorption of moisture is directly proportional to the natural logarithm of the degree of relative humidity, so that such instruments can be graduated for use as scientific instruments. Rapidity of evaporation is, however, proportional not to the relative humidity, but to the difference of the tension of watery vapour present in the air with that of its tension when saturated—in other words, the difference of tension of watery vapour at the temperatures of the dry and wet bulb thermometers, a form of expression which admits of degrees of humidity at different temperatures to be directly compared. In practice, however, this datum is rarely to be found in climatic tables, which is of the less importance, as in its effects on our organisation a difference of 2 or 3 mm. of mercury, from the pressure of saturation at a low temperature, will give a pleasant sensation of dryness, while at a high temperature the same deficit of pressure would be felt intolerably close and sultry. Extreme conditions of either humidity or dryness are, of course, alike unhealthy, though much of the respiratory irritation ascribed to too dry air is, I believe, more truly referable to the dust which usually accompanies such atmospheric conditions; but in any case, there can be no doubt that alike in hot and cold climates it is far healthier for the air to be too dry than too moist. With the effects of damp cold we are all of us only too well acquainted in England, and those who have experienced the effects of damp heat will never need being reminded of its debilitating effects. Fortunately, however, relative humidities exceeding 80 per cent. are but rarely to be found accompanied with really high air temperatures, and are seldom met with except in localities blessed with a copious rainfall, which by cooling the air goes far to render matters tolerable.

The most trying of all climates, however, are those where high temperatures and relative humidity are combined with an absence of rain, and under such circumstances a relative humidity of far less than 80 per cent. gives rise to intolerable closeness and oppression, especially when combined with stillness of air. Typical examples are the autumnal climates of the Red Sea and Persian Gulf, the unbearable character of which is notorious. At Abusher, in the Gulf, for example, in the month of August rain never falls, there is little or no breeze, and the mean maximum temperature is 96·5° F. (35·7° C.), while the relative humidity averages 65 per cent., and though neither figure separately is remarkably high as compared with what may be met with elsewhere, the entire combination of conditions is generally admitted to constitute one of the most unendurable climates in the world. On the other hand, in the Algerian Sahara in the summer months the relative humidity may fall as low as 16 per cent., but provided that an unstinted supply of water, to supply the loss by evaporation, be obtainable, most people find crisp, dry heat of this sort rather stimulating than otherwise, and even where the temperature is so high as to become most trying to endurance, the mortality returns of such situations show that dry heat is really favourable to health. The reason of this is obviously found in the fact that a few hours' exposure to the sun's rays in such climates suffices to kill the germs of nearly all specific contagious diseases, and that the breeding of mosquitoes, which are now known to be the carriers of several of the most important and deadly of tropical diseases, is further summarily stopped. A further contributory reason is also found in the fact, that the population is driven to sleep in the open air instead of within more or less ill-ventilated houses, and hence obtains the inestimable benefit of the freest possible ventilation during a large portion of the twenty-four hours, besides reducing the chances of the direct infection of the healthy by the sick to a minimum. As a degree of relative humidity of the air so low as to be in itself irritating to the respiratory mucous membranes is almost unknown, we may practically consider that dryness of climate is everywhere synonymous with healthiness.

Effects of Amount and Distribution of Rainfall.—As already remarked, it is quite possible for a climate to be damp and yet have little or no rainfall, but such instances are rare, and on the other hand, a heavy rainfall necessarily brings about a coincident increase of relative humidity. Rain is, moreover, necessarily combined with a cloudy sky, whereby the heating of the soil during the day and its cooling by radiation during the night are alike impeded. The immediate effect of a shower of rain is to cool the air, and this for a double reason: first, coming as they do from the higher strata of the atmosphere, the temperature of the raindrops is necessarily much lower than that of the earth's surface; and secondly, from the multiplied surfaces of the descending drops and from the wetted earth there necessarily occurs a rapid evaporation, whereby a further large amount of heat is absorbed, but unless showers recur at sufficient intervals to continuously diminish air temperature, the temporary remission is apt to be dearly paid for by a period of heat combined with high relative humidity, with its attendant discomforts of reduced evaporation from the surface of the body, prickly heat, and the other discomforts inseparable from tropical damp.

The influence of rainfall on health necessarily depends to a great extent on the configuration of the land, but assuming that the latter admits of adequate drainage, more depends upon its distribution than upon its amount; for the sanitary influences of rain are, in the main, mechanical, and depend on the "laying" of the dust and the washing away of infective and otherwise deleterious material. A heavy shower of sufficient duration will carry away, *viâ* the river to the sea, the deleterious products of human occupation during a preceding drought; but to do this the rain must be heavy while it lasts, for a prolonged drizzle in a warm climate simply turns the soil into a particularly efficient cultivation ground for the germs of infective diseases, and the attendant gloom of the sky stops entirely the beneficent germ-killing power of the sun's direct rays. A prolonged drizzle, never exceeding the absorbtive and drainage capacities of a given site, marks the maximum of unhealthiness in all climates, and is possibly even more obnoxious when associated with heat than with cold: so that the most pleasant tropical climates are those that combine frequent short but heavy showers with intervals of bright sunlight, a continuously overcast sky being everywhere unfavourable to health.

To judge, then, the influence of rainfall on health, we require three data—the total rainfall, the number of rainy days, and the aspect of the sky in any given season of the year; for the beneficent influence of light on the animal organisation is at least as marked as it is on plants, though while the latter fact is a matter of common observation, the former does not meet with the recognition which it deserves. We bleach our celery by protecting it from the light, but are apt to forget that, while the consequent reduction in the amount of its characteristic essential oil makes its eatable, the plant could hardly survive but for the application of lime and other artificial antiseptics, which we are obliged to apply to make up for the lack of the natural protection. Whether the process of "earthing up" be soothing to a celery plant or otherwise is a question of which we have no means of judging, but there can be no doubt that in such matters man is far more practical in the treatment of plants than of himself, and that in tropical climates he often suffers by shrinking too much from the immediate effects of the sun's rays. In this as in all other affairs, moderation is, of course, desirable, but the commoner mistake is undoubtedly to shirk too much all exposure to the sun, whereas those whose avocations take them most into the open are generally the healthiest in the Tropics as elsewhere. Contrast the ardent sportsman who spends the broiling days of May and June in the pursuit of large game, with the lady who spends her days in a darkened bungalow, and there can be no question as to which suffers the most from "the effects of climate"; nor is the difference, as is often suggested, purely one of sex, for it will be noticed that female medical practitioners and missionaries and other ladies whose occupations involve their being much in the open are commonly at least as healthy as men similarly situated.

In all hot countries the period of the rains is the sickly season, but this is due not so much to any direct evil effects of damp on the human system as to the fact that the agents and carriers of disease, *i.e.*, low plant organisms and mosquitoes and other suctorial insects, find in heat moisture and puddles the conditions that best favour their growth and multiplication; in other words, the unhealthiness of this season can be largely obviated by suitable measures of sanitation, so designed as to impede this growth and multiplication of noxious agencies in the immediate vicinity of human habitations.

Effect of Winds on Health.—Save only in so far as it necessarily raises and transports dust, and that the latter may consist not only of mineral particles but may contain also deleterious organic matter and the germs of certain diseases, the action of wind, being equivalent to so much the freer ventilation, may always be considered desirable in hot climates. Given a free current of air, the highest air temperatures are borne with comparative comfort, whereas in stagnant air the sense of oppression is unbearable. The existence of a steady breeze from a known direction also makes it possible to artificially cool houses by placing in the doorway facing the direction of the wind wetted mats, which cool the air passing through them by the agency of evaporation. It further makes it possible to live in comfort without the use of punkahs and other artificial means of keeping up a free current of air; indeed, as a matter of fact, the habitability of places situated in the Tropics depends largely on the amount and continuity of the breeze.

As has already been remarked, the amount of dust present in the atmosphere depends mainly, in the first place, on dryness of the air, and in the second on the force of wind; but it is also a fact that under certain conditions, dependent probably on electrical manifestations, a very still atmosphere may yet carry in suspension a large amount of dust, and its presence may become inimical to health by causing irritation to the respiratory organs as well as to the eyes and lining membrane of the nostrils. This is specially liable to be the case when the suspended particles are sharp and angular, as in the case of the micaceous dust, with which, during the dry, hot weather, the air is often loaded in certain sub-Himalayan stations, producing in many persons soreness of the eyes and troublesome, dry cough.

Systematic observations on the amount of solid matter suspended in the air are as yet entirely wanting, but there can be little doubt that they would, if available, be valuable to the student of public health ; for the high mortality among tradesfolk whose occupations involve the respiration of a constantly dusty atmosphere is thoroughly well known, and it is most improbable that what is true of dusty trades is not also true of dusty places.

Although generally admitted, especially as an article of popular belief, the influence of the varying electrical states of the atmosphere is as yet so ill-understood that nothing definite can be stated on the subject.

SECTION II.

On the Special Characteristics of the Climates of Certain Hot Countries.

There is perhaps no one topic of human conversation that comes in for more discussion than that of the weather, and yet it is no exaggeration to say that there is no other as to which exact information is so scanty or so little accessible, and it is believed that even the following scanty notes are more complete than can be found in any one work in the English language.

If the intending emigrant to foreign parts desires to find out something of the conditions under which he will find himself, he may perhaps, after much trouble, unearth some undigested data on the subject from the Agents-General of Colonies, &c.; but he will find it far easier to ascertain the amount of piece goods bought by the "Borrioula Gah" tribe than the mean temperature of their capital; and, practically speaking, the only library containing anything approaching an adequate collection of the literature of the subject is that of the Royal Meteorological Society, to whom and to their courteous librarian, Mr. W. Marriott, my best thanks are due for their ready assistance in the compilation of the present chapter. Owing to the very varied sources from which the information has been drawn, any attempt at close uniformity of treatment is out of the question, but wherever possible the data given comprise the average mean, mean maximum and mean minimum temperatures, the rainfall, number of rainy days, and average relative humidity for each month of the year.

When possible, the figures given are the averages of several years, but in many cases they refer to a single year only, being derived from isolated observations or from series which have not as yet been collated by a meteorological expert. No barometric data have been included, as they have little interest for any but specialists, and a study of those given will be found quite sufficient to enable anyone to judge with what sort of an outfit he should provide himself. It will be, for example, quite obvious that it is quite useless to take a mackintosh coat to Wadi Halfa, if anyone will glance at the table given for that favoured (?) locality. In some cases the maximum and minimum temperatures tabulated are not the mean, but the absolute maxima and minima, and therefore represent only exceptional experiences and not what one may fairly expect. It must be clearly understood, too, that absolute and mean data are in no sense comparable, as the latter will always lie several degrees within the former; but in the present state of meteorological science one has to be thankful for what one can get, and this, in the case of most of the less advanced countries, is remarkably little.

The plan of the following notes is to make a sort of climatic tour round the globe, but it is obvious that it is impossible within the scope of a work like the present to describe more than a few widely distant examples, so that it is not even possible to include all our tropical colonies; but it is hoped that those given will suffice to give a general idea of what may be expected in most parts of the world. With few exceptions all data are given both in the English and in the metric systems.

The Mediterranean Basin.—None of the countries comprising the European shores of this basin can be said to come well under the heading of "hot countries," and those on the African shore are of interest rather as winter health resorts than as tropical places of residence. The first of these that requires notice is—

Algeria.—Situated in lat. 37° N., within a couple of days' steaming from Marseilles, this pleasant French colony is much the most easily accessible sub-tropical health station for the whole of western Europe, and forms an excellent resort for persons who find themselves unable to withstand the rigours of a northern winter. Thanks to the French talent in municipal organisation, the traveller finds himself at once among the novel sights and sounds of civilisation of the Oriental type, and yet surrounded with all the comforts and amenities of a fine European town. Few health-seekers venture far from the coast, though there must be many places in the interior that would be well suited for early cases of consumption, as the air of the coast is perhaps too "relaxing" for some cases of the sort. For the north coast of Africa, the rainfall is considerable, but in spite of this, on the average, the air is generally dry, as evidenced by the low average relative humidity.

The country may be divided into four zones, which present great differences of climate.

(1) A narrow littoral zone of low ground, often only a few miles wide. Most of the ports face eastward and are well sheltered by the neighbouring hills.

(2) The Tel, composed of plains and elevated mountain masses cut up by deep valleys, at the bottom of which are torrents which are dry for the greater part of the year.

(3) A high plateau of triangular form about 140 miles wide; intensely dry, but with scattered salt marshes which dry up during the summer.

(4) The Sahara, an immense sandy basin absolutely devoid of water-courses except quite to the north.

The following table of mean temperatures will give some idea of the degree of heat that is met with throughout the year in these different regions:—

Monthly Mean Temperature of Algerian Stations Situated in the Four Above-mentioned Zones.

Station	E.F.	E.M.	January		February		March		April		May		June	
			F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.
Algiers (on the coast)	68	22	53·8	**12·1**	54·6	**12·6**	57·0	**13·9**	61·4	**16·3**	66·1	**19·0**	72·2	**22·3**
Orleansville (on the low "Tel")	390	119	48·3	**9·1**	50·2	**10·1**	54·2	**12·3**	61·7	**16·5**	68·4	**20·2**	77·9	**25·5**
Térriet el Haad (on the high "Tel")	3,700	1,125	41·0	**5·0**	43·0	**6·1**	47·5	**8·6**	52·3	**11·2**	59·6	**15·4**	69·8	**21·0**
Géryville (on the high plateau)	4,300	1,310	37·5	**3·1**	40·2	**4·5**	45·5	**7·5**	52·8	**11·6**	63·8	**17·7**	74·0	**22·3**
Biskra (Sahara) ..	410	125	50·2	**10·1**	54·3	**12·4**	57·0	**13·9**	66·0	**18·9**	76·0	**24·4**	84·4	**29·1**

MEAN MONTHLY TEMPERATURES, ALGERIAN STATIONS.—*Continued.*

Station	July		August		September		October		November		December		Year	
	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.
Algiers (on the coast)	76·0	**24·4**	77·0	**25·0**	74·2	**23·4**	67·5	**19·7**	60·5	**15·8**	54·9	**12·7**	64·5	**18·1**
Orleansville (on the low "Tel")	85·0	**29·4**	85·7	**29·8**	77·2	**25·1**	66·7	**19·3**	56·7	**13·7**	49·9	**9·9**	65·2	**18·4**
Térriet el Haad (on the high "Tel")	77·4	**25·2**	78·7	**25·9**	68·0	**20·0**	58·3	**14·6**	49·9	**9·9**	43·5	**6·4**	57·3	**14·1**
Géryville (on the high plateau)	79·7	**26·5**	79·7	**26·5**	68·5	**20·3**	56·7	**13·7**	46·5	**8·1**	39·8	**4·3**	56·7	**13·7**
Biskra (Sahara) . .	90·0	**32·2**	90·0	**32·2**	80·2	**26·8**	68·0	**20·0**	57·7	**14·3**	51·5	**10·8**	68·5	**20·3**

NOTE.—In this and all following tables, F. stands for degrees Fahrenheit; C. for degrees Centigrade; E.F., elevation above the sea in feet; E.M., the same expressed in metres; Ins., inches, English; Mm., millimetres.

The character of the climate of the capital, which may be considered typical of the coast health resorts, may be gathered from the following table:—

ALGIERS. LAT. 33° 47′ N.; LONG. 0° 44′ E. E.F. 105; E.M. 33·5.

Month	Mean Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity	Rainfall		Number of Rainy Days
	F.	C.	F	C.	F.	C.		Ins.	Mm.	
January . .	56·0	**13·3**	62·7	**17·0**	50·2	**10·1**	60	3·25	**82·5**	16
February .	61·3	**16·3**	70·2	**21·2**	54·8	**12·7**	61	3·17	**80·6**	9
March . .	57·2	**14·0**	64·5	**18·1**	51·5	**10·8**	62	3·14	**79·1**	15
April . .	60·5	**15·8**	67·8	**19·9**	54·2	**12·3**	65	3·46	**88·4**	10
May . .	66·7	**19·3**	74·7	**23·7**	60·2	**15·7**	62	3·53	**89·2**	6
June . .	72·5	**22·5**	79·7	**26·5**	66·7	**19·3**	71	0·75	**19·1**	6
July . .	75·3	**24·1**	83·0	**28·3**	68·5	**20·3**	68	0·70	**17·2**	2
August . .	77·0	**25·0**	84·3	**29·1**	70·0	**21·1**	67	0·20	**4·9**	4
September	75·5	**24·2**	83·2	**28·4**	70·3	**21·3**	73	0·28	**7·1**	9
October . .	71·2	**21·8**	79·2	**26·2**	66·0	**18·9**	72	1·52	**38·6**	11
November	59·8	**15·5**	67·3	**19·6**	55·7	**13·2**	70	9·0	**228·3**	22
December	56·8	**13·8**	67·5	**19·7**	51·7	**10·9**	69	1·65	**42·0**	7
Year . .	65·8	**18·8**	73·2	**22·9**	59·8	**15·5**	66·7	30·5	**777·0**	117

From this it may be seen that Algiers possesses a very desirable climate all the year round, though a trifle too rainy in late autumn.

The figures are those of the year 1901, as the French Government does not appear to have furnished the library with mean normal results.

Malta.—Owing to the large number of our officers and men serving there, the climate of this small island, which is delightful during the winter, is of interest to many, but it perhaps barely merits the name of a hot climate. While resembling in some respects the climate of southern Italy, it approximates more closely to that of northern Africa, the rainfall being very scanty.

The following are the principal climatic data:—

VALETTA. LAT. 35° 54′ N.; LONG. 14° 30′ E.; NEAR SEA LEVEL.

Months	Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity	Rainfall		Remarks
	F.	C.	F.	C.	°/°	Ins.	Mm.	
January ..	60·2	**15·7**	50·1	**10·0**	78	5·51	**139·7**	Total Annual Rainfall, 17·1 ins., or 40·3 cm.
February ..	63·0	**17·2**	50·3	**10·2**	79	1·04	**26·2**	
March	63·4	**16·8**	49·8	**9·9**	73	1·04	**26·2**	
April	65·6	**18·5**	52·4	**11·3**	78	2·18	**55·2**	
May	72·3	**22·4**	59·1	**15·0**	78	0·55	**14·0**	
June	80·7	**27·0**	64·9	**18·3**	72	0·38	**1·0**	
July	88·0	**31·1**	70·6	**21·3**	70	0·00	**0·0**	
August	84·9	**29·4**	70·7	**21·4**	77	0·02	**0·1**	
September ..	83·3	**28·5**	68·7	**20·4**	77	0·10	**2·5**	
October	81·7	**27·5**	67·3	**19·8**	78	0·60	**15·2**	
November ..	71·1	**21·7**	59·0	**15·0**	83	3·64	**92·5**	
December ..	62·6	**16·8**	52·2	**11·2**	85	1·04	**26·2**	

During the summer, periods of hot dry winds blowing from the burning African deserts are somewhat trying, but these do not, as a rule, last for many consecutive days, and on the whole the climate is not unhealthy.

A peculiar infective fever, commonly known as "Malta fever," but also met with in other parts of the Mediterranean littoral, as well as in India, and very troublesome on account of its obstinate tendency to relapse, is the most serious drawback in the matter of disease, but under improving modern sanitation the disease is yearly becoming less common.

The climate of the Syrian coast is very similar, but somewhat warmer, with a heavier rainfall; so also is that of Algiers and the North African coast generally, there being, however, mostly a wider range between the hottest and coldest months than in the purely insular Malta. Malaria, dysentery, and other tropical diseases are not uncommon, but seldom either widely spread or particularly virulent. As we leave the coast, the range of temperature, both annual and diurnal, rapidly increases, and is especially marked in the highlands of Asia Minor, as, for example, at Erzerum, where the temperature in January falls as low as — 20° F. (— 29° C.), and in summer may exceed 90° F. (31° C.).

Cyprus.—Long. 32° 20′ to 34° 35′ E; lat. 34° 33′ to 35° 41′ N. Our administrative connection with this island, and the circumstance that it has of late been strongly recommended as a fairly stimulating winter health resort for delicate people, and especially for cases of chest diseases and others, make it desirable to include an account of it within our list.

The following are the principal climatic data:—

Nikosia, on Central Plain.

Months	Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity	Rainfall		Number of Rainy Days
	F.	C.	F.	C.	%	Ins.	Mm.	
January ..	73·4	**23·0**	32·3	**0·2**	84	4·0	**101**	11·8
February ..	70·7	**21·5**	31·8	**0·1**	84	3·70	**94**	11·8
March	76·5	**24·7**	36·4	**2·4**	81	1·23	**31**	7·4
April	84·5	**29·2**	38·8	**3·8**	78	1·14	**29**	4·5
May	90·4	**32·4**	46·2	**7·9**	74	0·63	**16**	4·3
June	100·0	**37·8**	52·4	**11·3**	67	0·39	**10**	1·4
July	100·7	**38·3**	55·5	**13·1**	68	0·13	**3**	0·3
August	103·0	**39·4**	57·2	**14·0**	66	0·8	**20**	0·5
September ..	100·5	**38·1**	54·4	**12·3**	73	0·04	**1**	0·6
October	93·5	**34·2**	47·7	**8·7**	76	0·36	**9**	2·3
November ..	84·5	**29·0**	39·3	**4·1**	82	1·97	**50**	6·5
December ..	77·5	**25·3**	34·0	**1·1**	85	2·34	**59**	7·8

The climate is somewhat cooler in summer on the coast, and the rainfall slightly higher, but with a smaller number of rainy days.

The island is mountainous; a great mass of hills occupying the greater part of the southern half, and reaching an elevation of over 6,400 feet at Mount Troödos, where a summer sanatorium has been established. A lower range of hills fringes the entire northern shore, and between the two is a central plain, on the highest part of which, at an elevation of about 500 feet, is situated the capital, Nikosia. These hills shelter the central plain from the bitter winds of the Taurus range in Asia Minor during winter, but, on the other hand, cut off the cooling sea-breezes in summer. For eight months in the year the rainfall is inappreciable, and the summer appearance of the plains arid in the extreme, but the advent of the winter rains in October changes the scene to one of the greatest fertility. The hill country, on the other hand, is generally well-clothed with pine-forests, and enjoys, during the summer, a very pleasant climate. At Nikosia the mean temperature of the year is 67·2°, the extreme maximum being 108°, and the minimum 28°, showing the large range of 80°.

At the hill station on Mount Troödos, at an elevation of 5,000 feet, the excessive heat of the plains is entirely avoided. The season there opens in June and closes in October, the temperature never exceeding 85° F. in 1901. The following table shows the great gain in coolness:—

MEAN TEMPERATURES, FAHRENHEIT.

1901	Nikosia	Troödos	Difference
June ..	77·2° ..	61·7° ..	15·5°
July ..	83·7° ..	71·7° ..	12·0°
August ..	83·3° ..	68·2° ..	15·1°
September ..	78·8° ..	61·6° ..	17·2°

During the greater part of the year the wind is usually from the north-west, but during the coldest part of the winter is usually from the east. It will be noticed that the general characters of the climate are rather those of a Continental than of an insular situation. The air is almost always highly charged with electricity, and there is comparatively little malaria or other specially tropical diseases.

Egypt.—The climate of this country is, even from the all-the-year-round point of view, one of the finest in the world, and hence its well-deserved popularity as a winter health resort. Apart from the "Khamseen," which those used to Indian hot weather might esteem a change for the better, its one drawback is what may be termed the co-efficient of rapacity of its hotel-keepers; as for the casual visitor, it is certainly an expensive country.

With endless sights of antiquarian interest, and a gay cosmopolitan society, there is little chance of boredom for either the studious or frivolous, and with the possible exception of California, no climate affords a better combination of warmth and sunlight, with a clean, stimulating atmosphere. It owes this to its peculiar geographical characters, for although it includes on the map a large area, the actually inhabited portion consists of only a narrow strip, a few miles wide, on either side of the Nile; as all the land beyond the reach of the annual overflow of the river, which is at its maximum in September, and lowest in June, is absolute desert, the intense dryness of which is necessarily fatal to all forms of vegetable life, including the organic germs of disease. On this account, even in the middle of the cultivated strip, the air has never been fouled by passing over any considerable extent of habitations and cultivation, with their inevitable emanations, but must always come, almost fresh and germ-free, from the illimitable expanse of sand and rock that immediately succeeds the narrow band of river alluvium.

Dr. Dalrymple, one of the earliest writers on the subject, remarks, " It is scarcely possible to imagine anything more invigorating and life-giving than the air of the desert; there is a dryness and elasticity about it like nothing else, and the sense of renovation when breathing it is, to the languid invalid, like a new lease of life."

Both he and Dr. Sandwith, from whose excellent " Egypt as a Winter Resort " the following tables are taken, seem agreed as to its suitability for all cases of chest disease that have not gone too far to be amendable to climatic treatment of any sort, and Dr. Sandwith finds it also suitable for such cases of heart and kidney affections as are unfavourably affected by cold; while the sulphur baths of Helouan have been found remarkably useful in the chronic forms of rheumatoid arthritis, rheumatism and gout.

The main characteristic of the climate is its intense dryness. Even on the coast at Alexandria, the rainfall is but trifling, and above Cairo it may almost be neglected; but in spite of this even during the hottest months the climate is quite bearable. " Northern rooms, if closed in good time, need never exceed 83° in the hot weather, or fall below 52° in the cold season, provided the sun-warmed air be allowed free entry." The prevailing wind is a gentle breeze from the north, but both at Cairo and Alexandria, during the fifty days about Easter-time, a peculiar dust-laden wind, highly charged with electricity, and known as "the Khamseen," blows at intervals. It is very disagreeable while it lasts, the dust sometimes obscuring the sun almost as completely as a London fog, but it rarely persists more than two days at a time, and does not usually occur more than three or four times in a season. The following tables will give a good general idea of the climate:—

ALEXANDRIA. LAT. 31° 13′ N.; LONG. 26° 53′ E. E.F., 66 ft.

Month	Temperature, F.			Relative Humidity %	Rain in Inches	Clouds, 0—10	Winds	
	Mean	Mean Maxima	Mean Minima				Direction	Force, 0—10
January ..	58·1	64·0	53·2	67	2·33	4	N.	2·5
February ..	58·6	64·2	54·0	65	1·43	4	N.W.	2·5
March ..	61·6	68·0	56·0	65	·78	3	N.W.	2·7
April	66·0	73·0	60·6	66	·12	2	N.	2·5
May	70·0	75·4	65·6	70	·03	2	N.	2·2
June	75·0	79·6	71·2	72	—	1	N.	2·3
July	77·6	81·2	74·8	75	—	1	N.N.W.	2·4
August ..	79·0	82·4	76·1	73	—	1	N.	2·0
September ..	77·4	81·2	74·3	69	·11	2	N.	2·3
October ..	74·6	79·2	70·6	68	·33	2	N.	2·1
November ..	68·2	73·4	64·0	67	1·32	3	N.	2·2
December ..	62·0	67·8	57·0	67	1·79	4	N.	2·4
Annual ..	69·0	74·1	64·8	68·6	8·24	2·4	N.	2·3

CAIRO. LAT. 30° 4′ N.; LONG. 31° 15′ E. E.F., 108.

Month	Temperature, F.			Relative Humidity %	Rain in Inches	Clouds, 0—10	Wind	
	Mean	Mean Maxima	Mean Minima				Direction	Force, 0—10
January ..	53·6	61·4	46·6	69·7	·19	4·1	S.W.	2·2
February ..	57·0	65·3	48·8	66·2	·24	4·2	N.	1·4
March ..	62·8	73·2	53·0	56·2	·03	3·4	N.	2·5
April	70·4	81·2	59·9	47·8	·12	3·4	N.	2·6
May	75·2	86·8	63·4	48·4	·22	2·3	N.	2·8
June	82·6	94·7	70·2	44·0	·02	1·0	N.	3·0
July	83·8	93·0	72·2	49·0	—	1·2	N.	4·3
August ..	82·2	92·9	71·4	55·3	—	1·6	N.	4·1
September ..	77·8	87·5	68·0	62·1	—	1·8	N.	4·3
October ..	74·3	84·0	64·8	65·8	—	2·5	N.	3·2
November ..	64·4	74·2	56·3	67·5	·21	3·0	N.	2·1
December ..	58·4	67·7	50·4	69·6	·19	3·7	N.	2·2
Year ..	70·2	80·1	60·4	58·46	1·22	2·6	N.	2·9

LUXOR. LAT. 25° 40′ N.; LONG. 32° 35′ E. E.F., 292.
Winter Climate.

Month	Temperature, F.			Relative Humidity	Rain in Inches	Clouds, 0—10	Wind	
	Mean	Mean of Maxima	Mean of Minima	%			Direction	Force
November ..	—	78·99	62·1	—	Nil.	—	S.W.	1·0
December ..	—	70·0	53·6	—		—	N.E.	1·8
January ..	56·7	65·1	41·3	53·2		2·9	N.W.	1·0
February ..	62·6	70·6	42·4	51·0		1·9	N.W.	1·1
March ..	66·9	80·1	47·6	45·0		2·1	N.W. N.E.	0·7

Assouan, 133 miles further up the Nile, has a winter climate which is said to be almost 5° F. higher than Luxor, and to be freer from dust-storms. The building of the great dam and the large artificial lake which has been thus formed can hardly fail to modify the climate, so that it is hardly worth while reproducing Dr. Sandwith's table.

For the rest, the whole of Egypt up to this latitude may be said to be very healthy for Europeans, there being much less malaria than one would be inclined to expect as a consequence of the annual overflowing of the Nile; a circumstance which may, I believe, be attributed to the generally neat character of the cultivation, and the care with which every square yard of cultivable soil is utilised. Internal worms are, however, extremely common amongst the natives, but care in the matter of drinking water will render the risk run by the European very trifling.

Another terribly common disease amongst the natives is granular ophthalmia, a disease easily acquired by contact, or indirectly through the agency of flies, but Dr. Sandwith finds that it is extremely rarely taken by Europeans, though soreness of the eyes from dust and glare is not uncommon, for which he recommends the daily use of a little boracic solution as a toilet wash. It might, however, be perhaps advisable to protect young children by means of a veil when abroad, especially when entrusted to the care of a native attendant.

THE REMAINDER OF THE AFRICAN CONTINENT.—Our knowledge of African meteorology is necessarily in its infancy, and it is only possible to furnish a few tables of widely distant parts of this immense area, which may give some idea of its climatic characters. The whole of the northern part of the continent is extremely dry, much of it being quite rainless, especially towards its eastern side. Following on this is the equatorial belt, a great portion of which is barely, if at all, explored, but which seems to usually present the general characters of such latitudes and to be usually blessed with an ample rainfall across the entire width of the continent. Southward of the equatorial zone we again meet with immense dry and desert areas, such as the Karoo, but here it is the western side that is the more arid, none of the south-eastern coast being in any sense rainless.

Malaria is extremely rife in almost all parts of the huge peninsula, and in addition to this we have in "Blackwater fever" and sleeping sickness, diseases which seem to be at present its own peculiar privilege, though, fortunately, yellow fever is not as yet included in its list of dangers. The low-lying country along the coast and of the great rivers is notoriously unhealthy, such as the Bight of Benin, where, according to the sailor's proverb,

> "There's two comes out
> Where three goes in."

But inland there are considerable tracts of elevated country which present climates by no means to be despised, and which will no doubt in time, with the advance of civilisation, become eligible and healthy sites for European occupation, and more than one example of climatic conditions that appear decidedly inviting will be found amongst the tables furnished below.

An example of the climate of the Sahara has already been furnished in the notice of Algeria, and in the northern part of the continent the only other at all well-known climate (apart from Egypt) is the *Soudan.*

Practically rainless in parts, the climate is intensely hot and dry, the relative humidity showing one of the lowest records in our collection; but as the equatorial zone is approached a moderate rainfall develops, and throughout the region the large daily range of temperature results in the nights being comparatively cool, and therefore less trying than many parts of India. The northern portion is too dry to be very unhealthy, apart from the danger of abdominal chills, but as we ascend the Nile it expands into the immense marshes described by Baker and others, which are necessarily intensely malarious, while round the great lakes the sleeping sickness, previously rare or unknown there, is spreading rapidly.

Commencing with the dry Soudanese region, climatic tables of three stations will be found below, the first and most northern of which, it will be seen, is practically rainless. The figures of the first table are averages of ten years' observations.

WADI HALFA. LAT. 21° 55′; LONG. 31° 19′ E. E.F., 530; E.M., 128.

Month	Mean Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity		Rainfall
	F.	C.	F.	C.	F.	C.	At 9 h.	At 21 h.	
January ..	59·4	15·2	73·7	23·2	47·5	8·6	42	44	Practically *nil*. Drops recorded 15 times in 10 years
February ..	62·6	17·0	77·2	25·1	48·4	9·1	39	36	
March ..	71·5	21·9	87·5	30·8	56·5	13·6	30	30	
April	80·5	26·9	95·8	35·5	63·7	17·6	23	24	
May	87·8	31·0	104·3	40·2	70·5	21·4	17	19	
June	90·7	32·6	106·7	41·6	74·4	23·5	20	22	
July	90·5	32·5	105·7	40·9	74·5	23·6	23	30	
August ..	90·0	32·2	103·5	39·7	75·0	23·9	31	34	
September ..	88·7	31·4	99·6	37·6	73·5	23·1	35	38	
October ..	82·5	28·1	97·2	36·2	69·0	20·6	37	40	
November ..	70·7	21·6	85·0	29·4	58·7	14·8	41	43	
December ..	63·0	17·2	76·5	24·7	51·0	10·6	45	45	
Year ..	78·0	25·6	92·9	33·8	63·5	17·5	—	—	

The two remaining tables are for the year 1901, and are not even complete in places. Kassala is, of course, much nearer the sea than Omdurman, and hence its better rainfall.

OMDURMAN. LAT. 15° 38′; LONG. 32° 29′. E.F., 1,250; E.M., 376.

Month	Mean Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity	Rainfall	
	F.	C.	F.	C.	F.	C.		Ins.	Mm.
January ..	72·9	22·7	88·5	31·4	62·6	17·0	24	—	—
February ..	79·9	26·3	94·5	34·7	70·2	21·2	28	—	—
March ..	82·7	28·2	99·7	37·6	—	—	19	—	—
April	87·5	30·8	103·7	39·8	72·5	22·5	14	—	—
May	93·0	33·9	112·0	42·4	79·0	26·1	20	—	—
June	89·9	32·1	106·2	41·2	77·4	25·2	46	0·63	16·1
July	90·4	32·4	103·9	39·9	79·3	26·3	48	0·50	12·8
August ..	87·0	30·6	99·0	37·2	77·7	25·5	58	0·13	3·3
September ..	90·4	32·4	104·5	40·3	81·0	27·2	40	—	—
October ..	89·9	32·1	103·2	39·5	79·5	26·4	30	0·32	8·0
November ..	82·4	28·0	96·7	35·9	72·4	22·4	24	—	—
December ..	76·2	24·5	91·2	32·9	65·5	18·6	28	—	—
Year ..	85·2	29·5	99·9	37·7	74·4	23·5	32	1·58	40·2

KASSALA. LAT. 15° 28′ N.; LONG. 36° 24′ E.

Month	Mean Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity	Rainfall	
	F.	C.	F.	C.	F.	C.		Ins.	Mm.
January ..	72·6	22·6	86·4	30·2	58·9	14·9	—	Dro	ps
February ..	—	—	95·6	35·4	—	—	—	—	—
March ..	82·0	27·8	100·5	38·1	68·1	20·1	51	—	—
April	86·4	30·2	103·3	39·6	73·0	22·8	32	0·08	2·0
May	89·6	32·0	106·2	41·2	76·9	24·9	25	0·25	6·4
June	86·0	30·0	101·2	38·4	75·5	24·2	40	2·85	72·4
July	83·7	28·7	96·9	36·0	74·2	23·4	59	1·48	37·4
August ..	79·8	26·6	92·5	33·6	81·8	27·7	64	3·96	100·6
September ..	—	—	99·8	37·7	75·4	24·1	—	1·24	31·3
October ..	—	—	101·4	38·5	76·5	24·7	—	—	—
November ..	—	—	99·2	37·3	73·5	23·1	—	—	—
December ..	—	—	—	—	—	—	—	—	—
Year ..	83·0	28·3	98·5	36·9	—	—	40	9·84	250·1

Abyssinia.—The greater part of the Ethiopian empire is high ground, and in many parts of the country the climate may almost be described as temperate, as may be judged from the following statement (derived from a French official source) of the climatic factors of the capital during the year 1901.

ADIS-ABABA. LAT. 9° 1′ N.; LONG. 38° 43′ E. E.F., ABOUT 7,000.

Month	Mean Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity	Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January	—	—	—	—	—	—	—	—	—	—
February	55·4	**13·0**	73·4	**23·0**	47·9	**8·8**	81	2·15	**54·6**	8
March ..	58·0	**14·4**	75·7	**24·3**	50·4	**10·2**	83	5·23	**132·7**	10
April ..	58·4	**14·6**	74·2	**23·3**	51·4	**10·7**	86	4·39	**111·1**	11
May ..	60·9	**16·0**	78·5	**25·8**	52·7	**11·5**	74	1·36	**34·7**	4
June ..	57·5	**14·2**	72·3	**22·4**	49·7	**9·8**	72	8·36	**212·3**	30
July ..	56·0	**13·3**	69·0	**20·6**	49·7	**9·8**	80	10·10	**256·5**	30
August ..	60·2	**15·7**	69·0	**20·6**	50·0	**10·0**	79	9·46	**240·1**	28
September	63·0	**17·2**	73·5	**23·1**	49·8	**9·9**	66	5·48	**139·2**	14
October ..	61·5	**16·4**	77·2	**25·1**	46·5	**8·1**	37	0·60	**15·2**	3
November	60·0	**15·6**	77·0	**25·0**	44·5	**6·9**	28	—	—	—
December	57·2	**14·0**	74·4	**23·5**	44·3	**6·7**	39	0·54	**13·5**	3
Year ..	58·4	**14·6**	72·2	**23·6**	48·7	**9·3**	66	49·11	**1247·5**	141

The Region of the Great Lakes.—Turning now to the great lakes of Central Africa, the following data from Hann's "Klimatologie" may give some notion of the conditions prevailing.

In the Victoria Nyanza region (at E.F., 3,900; E.M., 1,200), according to E. G. Rauenstein, the mean annual temperature is 71·2° F. (21·8° C.), March 73·7° F. (23·2° C.), July 67·7° F. (19·8° C.), October 75·2° F. (24·0° C.), December 71·7° F. (22·0° C.). The extreme mean monthly maxima and minima (of January and February), 94° to 54° F. (34·4° to 12·2° C.), and the absolute maximum and minimum, 99·7° and 50·2° F. (37·7° and 10·1° C.).

The average rainfall for nine years was as follows:—

	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Ins...	2·5	3·3	3·7	4·8	4·2	3·4	2·5	3·3	4·8	4·8	5·3	3·2	40·6
Mm..	63	84	94	122	106	87	63	83	122	122	136	80	1,160

In the north (Uganda) the climate is warm and moist, though without excessive rainfall, but the air is a good deal drier along the southern coast.

In Tanganyika, in lat. 4° S., long. 29° E. (E.F., 2,670, E.M., 813), the mean annual temperature is 76·7° F. (24·8° C.), the mean of the hottest month (of October) being 81·7° F. (27·6° C.), and of the coolest, in December, 74·2° F. (23·4° C.), the extremes being 90·7° and 64·4° F. (32·6° and 18° C.). The rains occur in April and May and November and December, while from June to September is dry, the annual rainfall being 50 ins. (1,270 mm.).

Further south, Zoruba, in Nyassaland, has a total rainfall of 62·23 ins. (1,581 mm.), falling on 144 days in the year, but should otherwise be a pleasant climate, as the relative humidity is usually low.

Zoruba. Lat. 16° S. E.F., 1800. E.M., 548.

Month	Temperature at 7 a.m.		Mean Monthly Maxima		Mean Monthly Minima		Relative Humidity at 2 p.m.	Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January ..	69·8	**21**	81·2	**27·3**	65·9	**18·9**	78	11·62	**295**	27
February	66·7	**19·3**	77·6	**25·3**	63·7	**17·6**	74	15·42	**391**	20
March ..	66·7	**19·3**	78·9	**26·1**	64·7	**18·2**	90	7·60	**193**	23
April ..	64·4	**18·1**	75·4	**24·2**	61·7	**16·5**	76	11·74	**298·5**	14
May ..	61·1	**16·1**	76·9	**25·0**	58·0	**14·4**	65	0·37	**9·0**	7
June ..	57·1	**13·9**	68·4	**20·3**	54·4	**12·5**	66	2·55	**64·8**	12
July ..	55·0	**12·8**	68·8	**20·5**	52·9	**11·7**	65	0·87	**21·8**	6
August ..	55·4	**13·1**	71·4	**21·9**	52·3	**11·3**	51	0·15	**3·8**	4
September	62·7	**17·0**	79·0	**26·1**	58·1	**14·4**	48	1·80	**45·7**	4
October ..	68·5	**20·3**	85·4	**29·7**	62·6	**16·9**	53	·95	**24·1**	4
November	72·0	**22·2**	88·3	**31·3**	67·1	**19·4**	53	·35	**8·9**	4
December	73·2	**23·0**	83·6	**28·6**	65·6	**18·6**	66	8·81	**223·8**	19

The capital, Blantyre, at E.F., 3,280, E.M., 1,000, is naturally even cooler, but has a heavier rainfall, distributed as below :—

	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Ins. ..	19·51	17·60	14·48	13·77	4·05	3·28	3·34	1·56	1·83	4·13	5·54	15·35
Mm. ..	484·6	447	368	349·5	102·9	83·7	85·1	39·5	46·8	105·3	140	390

The Congo Basin.—The climate of the basin of the Congo is notoriously unhealthy, especially as the portion as yet opened up seldom extends far beyond the low malarious banks of the great river and its tributaries. The warmest month is February or March, and the coldest July or August.

Hann gives the following table of the temperatures of the following stations:—

Station	Latitude	Mean Annual Temperature		Mean Temperature of Warmest Month		Mean Temperature of Coldest Month	
		F.	C.	F.	C.	F.	C.
Luluaberg	5·9° S.	81·3	**27·4**	81·7	**27·6**	80·8	**27·1**
Congo, mouth of ..	6·0° S.	76·8	**24·9**	80·5	**26·9**	70·9	**21·6**
Vivi	5·7° S.	77·2	**25·1**	80·5	**26·9**	71·7	**22·0**
San Salvador	6·3° S.	77·9	**25·5**	81·0	**27·2**	72·8	**22·7**
Brazzaville	4·3° S.	81·2	**27·3**	84·7	**29·3**	75·2	**24·0**
Bolobo	2·2° S.	80·5	**26·9**	81·5	**27·5**	79·4	**26·3**
Equatorville	0·0	79·1	**26·2**	80·6	**27·0**	78·2	**25·7**
Bangala..	1·5° N.	78·9	**26·0**	80·8	**27·1**	77·7	**25·4**

These are typical equatorial climates, the greatest range between the means of the coldest and hottest months being at most 9·5° F. (5·3° C.), while in one case the range is less than one degree of the Fahrenheit scale, and though the temperatures are in no case excessive, the dampness of the atmosphere makes the heat of a very trying character, especially in certain localities, as at Stanley's Pool, where during August and September there are certain peculiar night-winds which, not unfrequently, are the cause of cases of heat apoplexy, and this although the highest temperature recorded is but 97°, at Brazzaville.

There are two rainy seasons, in April and November. The dry period falls in June and July, but is not very marked in the interior.

The table on next page will give an idea of the amount and distribution of the rainfall.

On the West Coast, at Bathurst, the highest temperature occurs in October, during the period of the greater rains, the annual extremes being 98·8° F. (37·1° C.) and 57·4° F. (14·1° C.); the greatest daily variation of temperature being met with during the dry season, January to April, when it amounts to about 20° F. (11·5° C.). The rainfall varied during eleven years from about 32 ins. (813 mm.) to 78 ins. (1,980 mm.). In December, a cool morning breeze known as the Harmattan sets in, and continues till

February or March. The rains begin in June and end in September.

MONTHLY RAINFALL IN THE CONGO BASIN.

Month	Station.					
	Congo, Mouth of		Lower Congo		Bolobo	
	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.
January	3·70	**94**	2·93	**74**	5·0	**127**
February	3·12	**79**	3·87	**98**	6.97	**177**
March	4·09	**104**	4·73	**120**	4·61	**117**
April	3·86	**98**	8·87	**225**	7·17	**182**
May	2·98	**76**	2·84	**72**	5·64	**143**
June	0·23	**6**	0·19	**5**	0·39	**10**
July	0	**0**	0	**0**	0·04	**1**
August	0·08	**2**	0	**0**	2·60	**66**
September	0·16	**4**	0	**0**	3·98	**101**
October	0·48	**12**	2·17	**55**	6·54	**166**
November	3·95	**100**	8·31	**211**	9·58	**243**
December	2·28	**58**	4·64	**118**	10·80	**260**
Year	24·95	**633**	39·85	**1,008**	62·7	**1,593**

At Sierra Leone, in spite of its lying north of the equator, the distribution of the monthly temperature resembles that of the Southern Hemisphere, the minimum falling in August, while the hot season lasts from February to May. The mean annual temperature is 77·6° F. (25·4° C.), and the average annual extreme temperatures 97·5° F. (36·4° C.) and 64·8° F. (18·2° C.). No month is absolutely rainless, and the annual rainfall is very heavy, ranging from 100 ins. (2,540 mm.) to 204·5 ins. (5,230 mm.).

Curiously enough, the Cape Verd Islands are very dry, although they agree generally as to temperature with the coast, tempered by their insular position and the influence of the trade wind, having a rainfall of only about 10 ins. (260 mm.), the most rainy month being September.

Gulf of Guinea.—Along this coast there is a double rainy season; the greater from March to the end of July, and the lesser in October and November; with the dry season in August and September, and the cool Harmattan blowing between November and March. In speaking of the Harmattan as a cool breeze, it must be remembered that one refers only to the sensations produced by it; for as a matter of fact, it has no appreciable effect on the mean temperature, and feels cool only by virtue of the accelerated evaporation from the skin caused by its intense dryness. On the coast it really raises the mid-day temperatures, although it renders the mornings and evenings cooler. In the interior the Harmattan may figure indeed as a hot wind, and may be additionally disagreeable on account of the red dust it carries.

The rainfall is everywhere very heavy, that of the Cameroon district reaching the enormous figure of 350 ins. (8,970 mm.), the second greatest in the world.

The mean annual temperature is about 77° F. (25° C.), with annual extremes of 89·6° F. (32° C.) and 68° F. (20° C.).

The following table of the climatic data for the coast of British Nigeria will give a fair idea of the conditions that will be met with in the coast towns of the group of colonies in this region:—

Old Calabar. Lat. 4° 58′ N.; Long. 8° 17′ E.

Month	Mean Monthly Temperature		Mean Monthly Maxima		Mean Monthly Minima		Relative Humidity Per cent.	Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January..	83·4	**28·6**	90	**32·2**	68	**20·0**	78·8	2·68	**68·1**	1
February	86·5	**30·3**	94	**34·4**	72	**22·2**	78·1	6·69	**170·0**	5
March ..	84·8	**29·2**	94	**34·4**	71	**21·7**	81·6	7·70	**195·6**	8
April ..	85·5	**29·7**	93	**33·9**	71	**21·7**	75·8	11·01	**279·5**	10
May ..	81·9	**27·8**	94	**34·4**	75	**23·9**	77·6	10·95	**279·0**	19
June ..	80·8	**27·0**	92	**33·3**	71	**21·7**	84·4	32·59	**827·0**	22
July ..	77·9	**25·5**	90	**32·2**	70	**21·1**	85·8	13·61	**345·4**	25
August ..	77·1	**25·0**	86	**30·0**	70	**21·1**	88·2	6·39	**162·4**	15
September	80·8	**27·0**	92	**33·3**	70	**21·1**	85·7	11·84	**300·0**	25
October ..	82·3	**28·0**	91	**32·8**	70	**21·1**	83·6	9·38	**238·0**	17
November	82·3	**28·0**	91	**32·8**	71	**21·7**	83·9	11·34	**288·3**	12
December	81·9	**27·8**	89	**31·7**	70	**21·1**	83·6	1·32	**33·6**	1
Year ..	82·2	**28·0**	94	**34·4**	68	**20·0**	82·1	119·50	**303·6**	150

The remarkable uniformity of the temperature data is very striking. In the interior of Nigeria, however, much higher temperatures are experienced, especially at the times when the hot Harmattan is blowing off the northern deserts, the noon temperature at such times being rarely under 100° F. (37·8° C.).

As we get farther south the temperature moderates and the rainfall rapidly diminishes; the mean temperature in Angola being no more than 68° F. (20° C.), while in the elevated interior the climate is neither disagreeable nor unhealthy.

Dr. Yale Massey sends me the following information from his Mission station in the Benguela district, at 4,700 feet, lat. *circa* 12° S.; and long. 17° E. "The distinctly wet months are from October to April inclusive, and this is also the hot season. There are usually a few showers in September, and rarely some in May, and during the dry season there is usually a strong breeze. In the wet season the mid-day temperature ranges from 80° to 100° F., at night from 45° to 60° F.; while during the dry weather the mid-day temperature is from 70° to 90° F., and at night even slight frost may occur. As might be expected from the elevation and climate, this is a generally healthy locality, but there is a certain amount of fever, most of the cases occurring in April and May."

East Coast.—The reputation borne by the east coast is scarcely more enviable than that of the western, the accounts of travellers voyaging on the Zambesi being generally alternate wails on attacks of mosquitoes and upsets from hippopotami. The rainfall is, however, much lighter, and at corresponding latitudes the temperatures generally seem somewhat lower.

Owing to the presence of a considerable Arab element, the population have attained, in some places, a larger grade of civilisation than is the case on the west coast, so that the introduction of hygienic measures might be somewhat more practicable, albeit that Arab civilisation, *per se*, has hardly reached the stage of promoting sanitation.

The two following tables of a tropical and subtropical station, each on this coast, will give some general conception of the conditions prevailing.

ZANZIBAR ISLAND. LAT. *circa* 7° 30′ S.

Month	Mean Maximum Temperature		Mean Minimum Temperature		Rainfall	
	F.	C.	F.	C.	Ins.	Mm.
January	86·1	**30·0**	79·6	**26·5**	3·26	**82·6**
February	87·0	**30·6**	80·3	**26·8**	1·51	**38·2**
March	86·3	**30·2**	79·3	**26·3**	6·27	**159·1**
April	84·7	**29·3**	77·6	**25·4**	11·94	**303·3**
May	82·4	**28·0**	75·6	**24·3**	10·23	**260·2**
June	81·5	**27·5**	74·2	**23·5**	1·36	**34·7**
July	80·2	**26·8**	72·7	**22·6**	2·75	**69·8**
August	81·8	**27·0**	72·7	**22·6**	1·68	**43·0**
September	82·0	**27·8**	73·4	**23·0**	2·10	**53·3**
October	83·2	**28·1**	75·3	**24·0**	3·74	**95·1**
November	83·7	**28·7**	77·1	**25·1**	8·23	**209·1**
December	85·8	**29·8**	79·5	**26·4**	4·18	**106·3**
Year	83·6	**28·7**	76·4	**24·6**	57·25	**1,454·2**

NATAL, DURBAN. LAT. 29° 50′ S.; NEAR SEA-LEVEL. (1902.)

Month	Temperature at 9 a.m.		Monthly Maxima		Monthly Minima		Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.	Ins.	Mm.	
January ..	74·0	**23·3**	92·1	**33·4**	56·4	**13·6**	6·53	**166·2**	23
February ..	78·2	**25·7**	95·2	**35·1**	60·5	**15·8**	2·09	**53·2**	12
March	74·5	**23·6**	93·8	**34·3**	59·2	**15·1**	10·23	**256·5**	20
April	70·1	**21·1**	86·2	**30·1**	56·9	**13·8**	2·52	**64·0**	9
May	66·5	**19·2**	83·5	**28·6**	52·0	**11·1**	1·21	**30·6**	10
June	61·6	**16·5**	78·3	**25·7**	47·4	**8·6**	0·73	**18·0**	3
July	62·0	**16·7**	88·0	**31·1**	49·5	**9·7**	0·27	**7·0**	4
August.. ..	63·5	**17·5**	79·0	**26·1**	48·4	**9·2**	3·90	**99·1**	12
September ..	67·1	**19·5**	105·6	**40·9**	51·5	**10·8**	2·54	**64·7**	13
October ..	69·6	**20·8**	91·2	**32·9**	51·3	**10·7**	2·23	**56·6**	17
November ..	70·9	**21·6**	92·3	**33·5**	57·1	**13·9**	5·15	**130·8**	19
December ..	75·2	**24·0**	91·4	**33·1**	58·2	**14·5**	3·96	**100·4**	18
Year.. ..	69·4	**20·8**	105·6	**40·9**	47·4	**8·6**	41·18	**104·7**	160

Madagascar.—With the exception of the littoral, which is rather warm and extremely malarious, the greater part of this island is too elevated to present a really hot climate, but the rainfall in the interior is rather heavier than on the mainland, that of the capital, Antananarivo, being 52·4 ins. (1,331 mm.), which is distributed as follows:—

MONTHLY RAINFALL OF ANTANANARIVO. E.F., 4,850; E.M., 1,478.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Ins.	11·54	9·28	7·36	2·00	0·71	0·33	0·20	0·28	3·18	3·51	5·25	11·0
Mm.	294	236	187	51	18	8	5	7	17	89	133	280

The Island of Mauritius.—Latitude *circa* 20° 20′ S. The mean annual temperature of Port Louis is 77·2° F. (25·1° C.), the absolute extremes of temperature in nineteen years being 89° and 53·5° F. (31·6° and 11·9° C.), and the mean relative humidity 74 per cent., so that in the matter of heat there is nothing to be feared; but unfortunately malaria, which was quite unknown in the earlier days of its colonisation, is now very rife and of a very obstinate type. The rainfall amounts to 74·5 ins. (1,892 mm.), which is rather heavier than that of Madagascar, and is distributed as below:—

MONTHLY RAINFALL OF PORT LOUIS, MAURITIUS; NEAR SEA-LEVEL.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Ins.	11·55	8·18	11·35	9·14	5·73	4·65	4·25	3·86	2·71	2·64	3·24	6·98
Mm.	293	208	288	232	145	118	108	98	69	67	82	177

The southernmost portions of Africa, Cape Colony, &c., do not belong to the category of hot climates, either in climate or in their diseases, and so need not be considered here.

Red Sea and its Coasts, including Somaliland.—The horrors of the climate of the Red Sea are too well known to need comment. The whole region is almost rainless, subject to suffocating calms, and the presence of the large, but completely land-locked, sheet of water renders the relative humidity constantly high. Moreover, the whole basin is comparatively shallow, so that it becomes highly warmed even in its depths. At its southern end the temperature of the water at the surface may reach 95° F. (35° C.), and 90° F. (32·2° C.) has been registered at a depth of 5 fathoms. In the Gulf of Suez, pleasantly fresh days may be met with during winter, but in the south the mean temperature of a day seldom falls below 80° F. (26·7° C.), and in July the mean maximum temperature exceeds 108° F. (42° C.) July is the hottest month, but there is little to choose between the discomforts of any of the four months, June to September. The least hot month is January, but the climate is a singularly uniform one, the night bringing comparatively little relief, and when followed by a breeze of about the same speed as the ship, cases have occurred in which steamers have actually been obliged to put about and steam against the wind, in order to prevent the crew from falling victims to heat apoplexy.

North of lat. 19°, the prevailing winds are from the north or north-west, while in the south the predominating winds are from the south and south-east, between the two lying a belt of variable winds. From June to August north-west winds prevail over the whole Red Sea. This is known as the "Kamsin," or fifty days' wind, the word being derived from the Arabic root of that numeral, which, originally, intensely hot and dry, rapidly takes up moisture from the water, and is hence particularly insupportable on the Arabian side of the sea ; though the fine sand with which it is loaded makes it equally objectionable from another point of view on the African side. Its velocity is often considerable, and under such circumstances may be even dangerous to the lives of those who are so unfortunate as to be exposed to its fury in the open desert. The extremely fine dust penetrates everywhere in spite of closed doors and windows, reaching even ships far out at sea. Fortunately, on the coast it is generally a good deal modified by sea-breezes springing up in the afternoon, but there is also a tendency to fall dead calm at night, under which circumstances the dark hours are even more intolerable than those of the day.

The following table of the principal climatic data of Massawa in the Italian colony of Erythrea, compiled from data contained in a pamphlet by Dr. Giovani Petella, of the Royal Italian Navy, gives a good idea of the character of the climate of the Red Sea littoral.

MASSAWA. LAT. 16° N.; NEAR SEA-LEVEL.

Month	Mean Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity. %	Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January ..	78·0	**25·6**	90·4	**32·4**	68·0	**20·0**	75	2·05	**52·1**	5·2
February .	78·9	**26·0**	92·2	**33·4**	68·4	**20·2**	76	0·63	**16·2**	1·6
March ..	81·0	**27·2**	94·8	**34·9**	70·1	**21·2**	74	0·68	**17·5**	1·7
April ..	84·3	**29·0**	98·2	**36·8**	72·8	**22·6**	69	0·11	**2·5**	·2
May ..	88·5	**31·3**	101·7	**38·7**	76·6	**24·7**	66	0·56	**14·1**	1·4
June ..	92·4	**33·5**	105·9	**41·0**	80·7	**27·0**	51	—	—	—
July ..	94·7	**34·8**	108·5	**42·5**	84·5	**29·2**	56	0·13	**3·3**	1·3
August ..	94·6	**34·7**	106·7	**41·5**	83·4	**28·5**	57	0·26	**5·7**	1·7
September	92·0	**33·3**	103·0	**39·4**	78·2	**25·7**	60	0·17	**4·0**	1·0
October ..	89·0	**31·7**	98·7	**37·0**	77·2	**25·1**	60	0·35	**9·0**	1·0
November	84·3	**29·0**	95·2	**35·1**	75·0	**23·8**	65	0·78	**20·0**	2·1
December	80·7	**27·0**	92·0	**33·3**	69·5	**20·8**	70	2·27	**57·6**	3·7

The total rainfall amounts only to 7·86 ins. (198 mm)., falling on 29·2 days in the year, but the amount and distribution is very capricious, varying greatly in different years. In so far, however, as Massawa can be said to possess a rainy season at all, the wet weather comes in the winter, instead of about August, as is normally the case in the Tropics of the Northern Hemisphere.

Sometimes a whole year may be practically rainless, as for example 1885, in which only 41·2 mm. (about 1½ ins.) was collected, whereas 1891 had the respectable rainfall of 500 mm. (or 19½ ins.). Apparently, however, it never rains in June.

Owing to the antiseptic powers of the intense light and heat, the place is singularly free from zymotic diseases, the cases of fever being usually not malarial, but truly climatic.

For the greater part of the year the skin is kept in a continuous bath of perspiration, and accordingly prickly heat in its most acute form, with the usual sequel of boils, is very common; as also, of course, are heatstroke and less acute forms of nervous prostration. During the continuance of the Kamsin Dr. Petella finds that the temperature of even strong and healthy individuals is raised distinctly above the normal.

The extreme character of the climate of Suakim, the frequent scene of British military activity, may be gathered from the following nearly complete table for portions of the years 1902-1903.

SUAKIM. LAT. 19° 5′ N. NEAR SEA-LEVEL.

Month	Absolute Maximum Temperature		Absolute Minimum Temperature		Rainfall		Clouds	Relative Humidity	Wind
	F.	C.	F.	C.	Ins.	Mm.			
Jan.	78·5	**25·8**	68·4	**20·2**	1·17	**29·7**	4·5	71	N.N.W., occasionally N. and E. in afternoon
Feb.	79·0	**26·7**	70·4	**21·3**	0·68	**0·17**	4·8	78	N.W., shifting to N.E. or N.
Mar.	82·5	**28·1**	71·9	**22·1**	0	**0**	2·1	90	Ditto, ditto
April	Wanting								
May	95·0	**35·0**	76·1	**24·5**	0	**0**	0·5	78	Ditto, ditto
June	100·2	**37·9**	78·0	**25·6**	0·13	**3·0**	1·2	69	Variable, but generally N.E. in afternoon
July	107·8	**42·1**	82·0	**27·8**	0·36	**9·3**	1·5	48	S.W. to S., shifting to E. or N.E. in afternoon
Aug.	112·0	**44·4**	84·4	**29·1**	0	**0**	1·3	68	Ditto, ditto
Sept.	Wanting								
Oct.	92·0	**33·3**	78·0	**25·6**	4·80	**122·0**	3·5	75	N.W. to W., shifting to N.E. in afternoon
Nov.	86·5	**30·3**	75·9	**24·3**	6·10	**154·9**	5·6	78	Ditto, ditto
Dec.	81·0	**27·2**	69·5	**20·8**	2·02	**51·5**	4·5	78	Ditto, ditto

No European constitution could, however, endure such climates for any considerable time with impunity without periods of relief in a more moderate climate, and it is therefore fortunate that, owing to configuration of the Colony of Erythrea, the inland portion of which for the most part consists of elevated plateaux and mountains; these extreme conditions of heat and moisture are limited to a comparatively narrow belt of country, consisting of plains formed of slightly elevated coral formation, and the foothills which gradually rise to elevations at which the climate is necessarily temperate, some of the peaks reaching over 7,000 feet above the sea.

The progressive improvement of climate as one gains increasing elevations, even where that at the sea-level is of the most extreme character, is instructively shown in the table on next page, taken from Dr. Petella's pamphlet.

Table showing the Mean Monthly Temperature of Four Stations in Erythrea at Various Elevations, the diminution of temperature being equivalent to about 1° F. for every 300 Feet of Elevation, or 1° C. to each 150 Metres.

Month	Massawa, 6 m. elevation = 18 ft.		Ghenda, 962 m. elevation = 3,165 ft.		Cheren, 1,460 m. elevation = 4,790 ft.		Asmara, 2,327 m. elevation = 7,533 ft.	
	F.	C.	F.	C.	F.	C.	F.	C.
January	78·0	**25·6**	65·2	**18·4**	63·3	**17·3**	58·8	**14·9**
February	78·9	**26·0**	69·4	**20·8**	67·0	**19·4**	61·4	**16·3**
March	79·4	**26·3**	73·3	**22·9**	72·0	**22·2**	61·5	**16·4**
April	84·3	**29·0**	78·6	**25·8**	77·0	**24·9**	62·8	**17·1**
May	88·5	**31·3**	79·6	**26·3**	75·8	**24·3**	63·5	**17·5**
June	92·4	**33·5**	84·1	**28·9**	76·5	**24·7**	63·5	**17·5**
July	94·7	**34·8**	87·2	**30·7**	72·7	**22·6**	61·5	**16·4**
August	94·5	**34·7**	83·4	**28·5**	68·0	**20·0**	61·4	**16·3**
September ..	92·9	**33·8**	84·5	**29·2**	68·4	**20·2**	62·5	**16·9**
October	89·2	**31·8**	76·8	**24·9**	67·4	**19·6**	56·5	**13·6**
November ..	84·3	**29·0**	72·3	**22·4**	65·2	**18·4**	58·4	**14·6**
December ..	80·7	**27·0**	65·8	**18·7**	63·3	**17·3**	58·8	**14·9**
Annual Means..	86·5	**30·3**	76·7	**24·8**	69·7	**20·9**	60·0	**15·8**

In these elevated regions, a little away from the coast, there is a definite, though not very abundant, rainy season, and the direction of the prevailing winds is normal for these latitudes, *i.e.*, north-east during the winter and south-west during the monsoon, which, however, breaks a good deal later here than at corresponding latitudes on the eastern side of the Arabian sea. More complete data of Addi Ugri, an Italian sanatorium on one of these Erythrean hill-stations, are extracted below from a pamphlet by Captain Tancredi, an Engineer officer.

The hottest time of the year is, it will be noticed, in the spring, and the rainy season takes place at the normal time in July and August, after the setting in of the south-west monsoon. There is also a secondary period of rainfall about February and March, corresponding to our "chota bursat" in India.

From the inspection of the table on next page it will be seen that the climate must be an exceptionally pleasant one, the mean temperature of the year corresponding to that of Southern Italy, though the range of temperature is less than a third of that of Palermo and other Mediterranean ports. The climate is also said to be very healthy, though there is generally a certain amount of malaria to be met with about the drying up of the rains. Its uniformity and mildness, coupled as it is with great dryness, suggests that the site might well be utilised for certain forms of chest disease.

Climate of Addi-Ugri, Erythrea (Serahè). Lat. 14° 53′ N.; Long. 38° 48′ 40″ E. Elevation 6,633 Feet.

Month	Mean Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity %	Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January ..	64·9	**18·2**	79·0	**26·0**	51·6	**10·9**	39·6	0·02	**0·3**	2
February .	66·3	**19·0**	81·2	**27·4**	51·9	**11·0**	28·6	0·11	**2·7**	1·6
March ..	70·6	**21·4**	87·0	**30·6**	55·5	**13·1**	30·0	0·62	**15·4**	6·6
April ..	70·4	**21·3**	85·5	**29·7**	56·5	**13·6**	35·3	0·91	**22·8**	9·3
May ..	70·6	**21·4**	84·5	**29·1**	58·2	**14·5**	36·6	1·85	**46·2**	10·3
June ..	69·5	**20·8**	82·3	**27·9**	60·4	**15·7**	39·1	2·41	**60·6**	15·3
July ..	64·3	**17·9**	73·6	**23·2**	54·6	**12·6**	71·9	5·30	**134·9**	25·0
August ..	63·8	**17·6**	73·4	**22·9**	54·6	**12·5**	74·1	7·05	**179·1**	24·3
September	67·5	**19·7**	78·6	**25·9**	56·2	**13·3**	53·4	1·45	**36·8**	6·6
October ..	67·6	**19·7**	80·3	**26·8**	54·4	**12·4**	53·0	0·65	**1·6**	3
November	65·4	**18·5**	78·6	**25·8**	52·5	**11·3**	43·6	0·19	**4·2**	1·6
December	63·5	**17·4**	78·0	**25·5**	50·0	**9·9**	42·3	0·32	**8·3**	1·6
Year ..	66·9	**19·4**	80·2	**26·8**	54·7	**12·6**	45·6	20·2	**513·0**	107·2

Travelling, however, in Somaliland is necessarily arduous, as the country is nearly impassable during the short rainy season, and intense heat and great suffering have to be encountered in the low-lying valleys, owing to the waterless character of the country and the intensely desiccating effects of the air, which, elsewhere than on the coast, is intensely dry. The frequent dust storms are also a source of much discomfort and even of danger.

Once issued from the Red Sea and arrived in the Gulf of Aden, things begin to improve, as although the thermometer may show but little difference from the conditions left behind in the Red Sea, it is at once felt that the heat is of quite a different kind, and that it is not, as Gilbert's heroine would describe it, "such a stuffy class of death." There is nearly always a fresh sea breeze, and for several months of the year the climate is much less oppressive than that of Bombay, especially in the spring.

Strange as it may appear to those who have only seen the grim fortress from the sea, Aden seems to have a queer fascination about it, and is generally rather liked than otherwise, many preferring to serve there to remaining in Bombay.

The Asiatic Continent.—Owing to the fact that the distinction between Europe and Asia is a purely geographical convention, and that the area of the eastern extremity of the Mediterranean is of too small an area to exercise any marked influence, we find that once the Syrian shore is left behind we are at once under typical intra-continental weather conditions, with a wide range of temperature, and a rainfall either small or almost non-existent. Speaking generally, these arid conditions prevail over the whole of south-western Asia, from the coast of Palestine till we have crossed the five waters of the Punjab, and within these limits there are many places that can put the maximum thermometers of even Omdurman and Suakim to shame.

The scanty rainfall is almost confined to the hills, so that cultivation in the lower lands depends more or less completely on irrigation from the rivers that have their origin in the mountain masses, which attract to their peaks the lion's share of the little moisture obtainable. On this account the greater part of western tropical Asia is desert, but in spite of this under-irrigation, Mesopotamia was once the granary of the world, and might still, under a more enlightened government, soon regain her position.

Palestine.—On account of its petty area, the whole of Palestine must be considered as a part of the Mediterranean littoral, and hence enjoys a moderate rainfall, which, combined with almost continuous sunshine, without really excessive heat at any period of the year, renders the enthusiasm with which this little land is described by the sacred writers easily understood.

The following table will give some idea of the amount and distribution of the rainfall :—

Place ..	Jerusalem		Smyrna		Jaffa		Beirut		Mosul	
Latitude	31° 47′ N.		26° 38′ N.		32° 4′ N.		33° 54′ N.		37·20′ N.	
Scale ..	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.
January..	6·30	**160**	4·14	**105**	5·71	**145**	7·40	**188**	3·47	**88**
February	5·75	**146**	2·95	**75**	3·63	**92**	6·03	**153**	3·08	**78**
March ..	3·58	**91**	3·35	**85**	1·46	**37**	3·89	**98**	0·93	**24**
April ..	1·73	**44**	1·78	**45**	1·08	**27**	2·32	**59**	0·78	**20**
May ..	0·29	**7**	1·26	**32**	0·28	**7**	0·55	**14**	0	**0**
June ..	0	**0**	0·49	**12**	0·18	**2**	0·28	**7**	0	**0**
July ..	0	**0**	0·19	**5**	0	**0**	0·03	**1**	0	**0**
August ..	0	**0**	0·12	**3**	0·04	**1**	0·03	**1**	0	**0**
September	0·04	**1**	0·90	**23**	0·04	**1**	0·28	**7**	0	**0**
October ..	0·39	**10**	1·79	**45**	0·68	**17**	1·93	**49**	0	**0**
November	2·04	**52**	4·25	**108**	3·32	**84**	5·39	**137**	1·03	**26**
December	5·35	**136**	4·41	**112**	5·39	**137**	7·40	**188**	3·70	**94**
Year ..	25·48	**647**	25·59	**650**	21·66	**550**	35·59	**904**	11·2	**283**

At Jerusalem the annual extremes of temperature are from 101·7° F. (38·7° C.) to just above freezing point, while on the sea-coast the range of climate is rather less marked.

The following table, adapted, like the preceding, from Hann, epitomises most of the necessary temperature data :—

Place	Elevation above Sea		January Mean		April Mean		June Mean		October Mean		Annual Mean		Annual Range of Temperature	
	Ft.	M.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.
Jerusalem	2,510	**765**	47·3	**8·4**	59·9	**15·5**	75·7	**24·3**	68·7	**20·5**	62·9	**17·1**	67·3	**38.5**
Smyrna..	—	—	45·5	**7·5**	56·8	**13·8**	79·5	**26·4**	65·4	**18·5**	61·7	**16·5**	79·2	**44·0**
Jaffa ..	50	**15**	54·0	**12·2**	68·4	**20·2**	83·5	**28·6**	78·8	**26·0**	70·2	**21·2**	—	—
Beirut ..	115	**35**	55·5	**13·0**	65·2	**18·4**	81·5	**27·5**	75·2	**24·0**	68·7	**20·4**	56·1	**31·2**
Damascus	2,380	**725**	45·0	**7·2**	58·7	**14·8**	80.0	**26·7**	67·0	**19·4**	63·4	**17·4**	—	—
Mosul ..	400	**120**	44·7	**7·0**	59·7	**15·4**	93.5	**34·2**	72·3	**22·4**	68·2	**20·1**	—	—

Between the cultivations of Syria and Mesopotamia there stretches a wide extent of desert country of which, as yet, but little is known, as it is even now, not altogether too safe a land to travel in.

In the upper part of the Euphrates valley, at Mosul, which, to save space, is included in the two above tables, the climate, though hotter in summer, does not differ to any great extent from that of Palestine. The rainfall is, however, very much smaller and absolutely confined to the winter.

Of the lower and better known part of the valley; once the granary of the world, and even now a rich country; the climate of Bagdad, lat. *circa* 33° 30′ N., in Turkish Arabia, may serve as a specimen.

Months	Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity %	Rainfall	
	F.	C.	F.	C.		Ins.	Mm.
January ..	63·3	**17·3**	39·9	**4·4**	84	1·59	**40·5**
February ..	65·6	**18·6**	40·3	**4·6**	76	2·49	**63·0**
March ..	74·7	**23·8**	47·1	**8·4**	62	1·93	**49·3**
April ..	80·9	**27·0**	54·4	**12·4**	52	1·19	**30·3**
May ..	90·6	**32·5**	67·3	**19·6**	42	0·21	**5·2**
June ..	103·2	**39·5**	76·3	**24·6**	35	0	**0**
July ..	106·8	**41·6**	78·8	**25·9**	33	0	**0**
August ..	107·8	**42·1**	78·2	**25·7**	32	0·13	**3·2**
September..	100·8	**38·2**	71·1	**21·8**	37	0	**0**
October ..	91·3	**33·0**	62·2	**16·8**	52	0·10	**2·5**
November..	76·6	**24·7**	50·0	**10·0**	74	1·03	**26·6**
December ..	64·3	**17·9**	43·0	**6·1**	81	1·16	**29·5**

The intense heat and dryness of the summer months are very noticeable, but the locality does not suffer from hot nights to the same extent as parts of Northern India.

Persian Gulf.—The delights of service in this inland sea are only too well known to most of H.M.'s Indian Marine, and to many naval officers, but it must be remembered that although the climate presents much resemblance to that of the Red Sea, the Gulf corresponds to the northern end of those unpleasant waters, and that in winter the climate is further tempered by breezes from the high Persian plateau, so that in the cold weather it would be difficult to choose a more pleasant scene for a yachting cruise, coral reefs and Arabs permitting, and it is only from the middle of June to that of October that anything like the stew-pan of the southern Red Sea is met with. This, combined with the circumstance that the passage of the Gulf should only last half as long as that of the Red Sea, is one of the strongest arguments in favour of the adoption of the Euphrates valley as a rapid route of communication with the East. The climate may best be realised by an inspection of the climatic table for Bushire, which is included in the following brief note on the climate of Persia.

Persia is continental and sub-tropical in geographical position, but does not, as a matter of fact, for the most part, properly come under the category of hot climates, as, with the exception of "the Dashtistan," or narrow belt of recently upheaved coral forming the northern shore of the Gulf, the whole country is a mountainous mass, the lowest portions of which are sufficiently elevated to bring them, from the point of view of climate, within the temperate zone. For practical purposes the country is absolutely without roads, the tracks that connect the various towns being merely made by the constant passage of travellers without any assistance whatever from art, and was probably a good deal more "advanced" two thousand years ago than it is now. On this account travelling is a very slow business, and any one proposing to visit the country must necessarily be prepared for a somewhat extended stay. As all routes cross over a succession of passes which often closely approach the snow-line, intending visitors should bring not merely clothes suitable for an English winter, but some fur-lined garment, such as is used by an automobilist, only slit behind so as to be wearable when mounted, as any one unprovided with a semi-arctic outfit may have to endure a good deal of suffering in surmounting the passes even during the summer.

Properly provided, however, travel in Persia offers many attractions, as the people are a pleasant, intelligent race, who make excellent camp servants in any capacity but as cooks, for which an Indian servant is better suited if obtainable. They are often spoken of as "the French of the East," and there is no doubt a good deal of justification for the parallel, but, however this may be, they are not at present likely to produce an Oriental Soyer.

The Dashtistan is simply an emerged portion of the coral bed of the Persian Gulf, and the abominable character of its climate goes far to counterpoise the bright, temperate weather of the rest of the country. It is often no more than 20 miles or less wide, and is badly off for fresh water, most of the wells being brackish. Even here, the cold weather is extremely pleasant, so that one is glad to sit over a big coal fire in February in rooms not directly warmed by the sun, and there is nothing much to complain of till early June—the earlier hot months being rendered quite endurable by strong breezes which make punkahs quite needless. This, however, is succeeded by a period of intense, damp, breathless heat, entirely unassuaged by a drop of rain, which requires to be endured to be thoroughly appreciated.

The climax of discomfort is attained somewhere about the middle of August, but it is well on in October before any very decided improvement sets in, the hot weather being thus prolonged far on into the autumn. Under these circumstances, it is not surprising that cases of heat apoplexy are far from uncommon, but fortunately there is comparatively little malaria, though digestive disturbances arising from the brackishness of drinking water are naturally rather common. There is nothing like the proportion of cases of eye diseases that is to be met with in Egypt, but the intense glare and the sparseness of the vegetation make the use of neutral-tinted spectacles very advisable.

The following table of the temperature and rainfall of Bushire (Abusher) will serve as a sufficient example of the climate of the Dashtistan generally:—

Month	Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity	Rainfall	
	F.	**C.**	F.	**C.**		Ins.	**Mm.**
January ..	65·2	**18·4**	52·0	**11·1**	79	3·39	**86·2**
February ..	66·0	**18·9**	52·5	**11·4**	80	2·51	**63·7**
March ..	72·6	**22·5**	58·2	**14·5**	72	0·87	**21·7**
April ..	84·6	**29·3**	66·1	**18·9**	61	0·58	**15·1**
May ..	89·8	**32·0**	75·3	**24·1**	60	0·02	**0·5**
June ..	92·2	**33·4**	80·3	**26·8**	61	0	**0**
July ..	95·5	**35·3**	84·0	**28·9**	65	0	**0**
August ..	96·5	**35·8**	83·6	**28·7**	64	0	**0**
September	94·2	**34·5**	78·8	**26·0**	65	0	**0**
October ..	87·9	**31·0**	70·7	**21·5**	65	0	**0**
November..	78·0	**25·6**	62·1	**16·8**	74	2·16	**54·7**
December ..	69·7	**20·9**	55·5	**13·1**	73	3·98	**101·3**

The Dashtistan forms, however, a very small percentage of the area of Persia, as its level plain is abruptly succeeded by the mountains, which rise, terrace over terrace, to a height of 5,000 to 6,000 feet, and once the plateau of Fars is reached the traveller finds himself in surroundings which, although suffering a good deal from the scarcity of water, have much to recommend them in the purity and dryness of the air, and which would no doubt be thoroughly healthy under a decently sanitary *régime.* At present the country is out of the question for purposes of health, as one requires to be pretty "hard bitten" to get about it at all; but assuming the introduction of the amenities of civilisation there can be little doubt as to its suitability for the treatment of pulmonary disorders; and even as matters stand, I cannot recall meeting with cases of tuberculous disease amongst the natives of the country.

Owing to the very different levels, it is difficult to give any general idea of the climate, but the climate of two of the principal towns given below must suffice as a sufficient example.

Month	Teheran. Lat. 35° 41′ N.; Long. 57° 25′ E. E.F., 3,700; E.M., 1,130.						Ispahan. Lat. 32° 38′ N.; Long. 57° 40′ E. E.F., 5,000; E.M., 1,530.					
	Mean Maximum Temperature		Mean Minimum Temperature		Rainfall		Mean Maximum Temperature		Mean Minimum Temperature		Rainfall	
	F.	C.	F.	C.	Ins.	Mm.	F.	C.	F.	C.	Ins.	Mm.
January ..	42·3	**5·7**	26·2	**−3·2**	1·17	**29·6**	46·5	**8·1**	23·1	**−5**	0·21	**5·2**
February	52·1	**11·2**	32·9	**−0·5**	0·85	**21·6**	54·3	**12·3**	29·2	**−1·6**	0·21	**5·2**
March ..	57·2	**14·0**	38·4	**3·5**	2·44	**62·1**	61·0	**16·1**	36·2	**2·3**	0·83	**20·8**
April ..	71·4	**21·8**	49·9	**9·9**	0·87	**21·7**	73·1	**22·9**	45·7	**7·6**	0·60	**15·2**
May ..	82·9	**28·2**	59·4	**15·2**	0·41	**10·3**	84·1	**29·0**	54·1	**12·3**	0·10	**2·5**
June ..	94·4	**34·6**	67·1	**19·5**	0·04	**1·2**	94·4	**34·6**	61·9	**16·6**	0	**0**
July ..	98·4	**36·8**	72·1	**22·3**	0·35	**8·9**	98·4	**36·8**	66·3	**19·1**	0·05	**1·3**
August ..	96·7	**35·9**	70·7	**21·5**	0·04	**1·2**	95·5	**35·3**	61·5	**16·4**	0	**0**
September	90·7	**32·6**	64·9	**18·2**	0·11	**2·6**	90·4	**32·4**	55·1	**12·9**	0	**0**
October ..	77·5	**25·3**	54·0	**12·2**	0·14	**3·7**	77·4	**25·2**	44·4	**6·9**	0·27	**6·5**
November	61·4	**16·3**	42·2	**5·7**	1·17	**29·6**	61·9	**16·6**	35·9	**2·1**	0·84	**21·5**
December	57·3	**14·1**	33·9	**0·5**	1·33	**34·0**	52·3	**11·3**	29·2	**−1·7**	0·47	**12·0**
Year ..	73·0	**22·8**	57·0	**10·6**	8·92	227·0	74·1	**23·4**	45·2	**7·3**	3·58	**90·3**

The better rainfall of Teheran is no doubt due to its proximity to the Caspian, but in both places the climate is typically continental, both the daily and annual ranges of temperature being very considerable.

The climate of Beluchistan resembles closely that of Persia in its general characters, but owing to the generally lower level of the country the temperature is necessarily higher, approaching that of the Dashstistan.

Arabian Peninsula.—With the exception of Muskat, which does not differ very markedly from the other Gulf ports, we have no reliable information as to the climate of Arabia proper, beyond the fact that it is a hot and arid land. The climate of the southern coast is, however, much more tolerable than that of the Persian Gulf, owing to the influence of the south-western monsoon, during the worst months.

India and Ceylon.—If we draw a line from Karachi, at the mouth of the Indus, to those of the Hughli, a little south of Calcutta, it will be found that we have divided the irregular diamond-formed outline of the country into two triangles, the upper or northern of which may be called the continental, and the lower the peninsular triangle. We also find that the dividing line coincides pretty accurately with the Tropic of Cancer, and that, therefore, all to the north of it is sub-tropical, while in the southern triangle there is, as one travels south, an increasingly marked tendency to a duplication of the rainy season and of weather conditions generally, with a resulting general uniformity of climate throughout the year, while the proximity of the sea ensures that the daily range of temperature will be also small. North of this, therefore, there is a distinct "cold weather," while to the south this pleasant climatic interlude can scarcely be said to exist. One of my predecessors, writing at the end of the eighteenth century, in the course of some 300 very sober pages devoted to life and habits in India, perpetrated "with deeficulty" a single joke. He devotes a table of some six lines to the elucidation of the subject of climate, the columns being headed, Hot—Cold—Rainy Seasons. Opposite Madras the first column stated, "Begins January 1, ends December 31." From his ill-concealed contempt of Madras and Bombay "presidencies" I am sure this old "Qui hai" hailed from "the Bengal side," but, prejudice apart, there is a good deal of truth in the impeachment.

Taking first the northern or sub-tropical triangle, we find that it presents a much greater variety of climate than can be found to the south, for while its north-western side is intensely dry and arid, the eastern angle of the triangle contains the wettest spot in the world. This triangle includes, too, within its boundaries another "record," viz., that for extreme heat. The man who "sent back for his blankets" resided, I believe during life, somewhere in the United States; but I fear he must have been a person of comparatively small endurance, as in the entire American continent there is no spot that in the matter of heat is in the same field with Jachobabad, where 127° F. (52·8° C.) in the shade has actually been registered, and, in fact, the whole of Scind easily "licks creation" in this unenviable detail.

The northern triangle may be divided into three distinct climatic regions, viz.:—

(1) The Persian frontier zone, including the Punjab, Scind and Rajputana.

(2) The *Old* North-west zone, containing Oudh, Rohilkhand, Benares, &c., Behar, and a good deal of Central India.

(3) Lower Bengal, including Assam.

It must not, of course, be imagined that there is any distinct line of demarcation between these "zones," as each climate, of course, shades off gradually into the next, but this division greatly facilitates description.

The Persian frontier zone, especially in its western portion, closely resembles Persia in climate, and gives one a very good notion of what that country would be, were it not an elevated plateau. Excluding, of course, from consideration the Himalayas and Suleiman Range, its highest part, near Rawal Pindi, is only about 1,700 feet above the sea (E.M., 530), which is too little to sensibly modify the temperature.

Along the actual north-west frontier, the rainfall is very small and the summer heat intense. The daily range is very small at the worst time of the year, as the arid soil gets so baked during the day that it is able to give out an ample supply of heat to make the short night intolerable, without having time to cool down to any appreciable extent. The few scanty showers that occur relieve matters for a few hours only, after which the only trace of their passage is an increased dampness of the air, with the concomitant exacerbation of "prickly heat." In certain places situated in some of the confined valleys that are to be found at the foot of the Suleiman Range, the heat, day and night, is perfectly appalling. Unfortunately, some of these choice localities are of administrative importance, as affording the best alignment for our railways, and their continuous occupation by a number of unfortunate European officials and by a native staff little better able to bear it, is an unfortunate necessity.

In one of these pleasant spots the Anglo-Indian community are said to save themselves from the sun during the day by sitting beneath the Club billiard table, still wearing their solar hats, to cut off certain of the rays that have found their way through the slate bed of the table, and there is a good deal of foundation in fact for the "yarn," as one requires to have lived there to have any adequate conception of what it is like. For seven months in the year indeed the climate is extremely trying, but as some compensation the cold weather, which lasts a full five months, at Peshawar in the north is most enjoyable and goes far to brace up residents to bear the horrors of the hot season.

At Peshawar I have been glad to sit over a blazing fire all day at the end of February, and even in Scind there are some three months of very pleasant weather. In the Eastern Punjab there is, however, a much more respectable rainfall, and the climate closely approaches that of the next zone. During the cold weather the daily range of temperature is considerable, so that if chills are to be avoided it is necessary to put on additional clothing after sunset.

The Old North-west, so called because up to "the forties" it formed our actual frontier, has in many ways the best climate to be found in the plains of India, the best part of the area being undoubtedly the Rohilkhand division.

No.	Station		January		February		March		April		May		June		July	
			Rainfall	Mean temperature	Rainfall	Mean temperature	Rainfall	Mean temperature	Rainfall	Mean temperature	Rainfall	Mean temperature	Rainfall	Mean temperature	Rainfall	Mean temperature
1	Simla	SUB-TROPICAL INDIA.	2.35	41.5°	2.68	41.5°	2.24	50.7°	1.90	59.7°	3.64	64.5°	6.79	68.0°	17.55	65.0°
2	Peshawar (N.)		1.77	51.7	0.98	53.6	1.70	64.2	1.84	73.7	0.75	83.6	0.35	91.0	1.79	99.0
	Lahore (Mid.)		1.06	54.4	1.10	57.1	0.73	69.2	0.46	80.7	1.03	87.4	1.84	92.7	6.67	89.5
	Multan (S.) ..		0.48	56.3	0.38	59.5	0.38	72.1	0.07	82.7	0.42	90.3	0.59	94.5	2.94	93.1
3	Meerut ..		1.27	57.4	0.79	61.0	0.77	72.4	0.24	83.2	0.69	88.5	2.44	91.1	9.54	86.3
	Agra		0.53	61.0	0.21	65.0	0.31	77.2	0.14	88.2	0.60	93.7	2.54	94.8	11.50	86.6
	Allahabad ..		0.85	60.8	0.28	65.3	0.32	77.8	0.11	88.1	0.39	22.4	5.69	92.6	12.33	85.4
	Benares ..		0.79	61.2	0.37	65.9	0.28	77.8	0.08	87.9	0.72	91.6	5.13	91.6	10.74	85.5
	Jhansi		0.59	63.3	0.33	67.3	0.35	79.3	0.13	89.9	0.49	94.9	4.89	93.5	12.60	84.5
4	Patna		0.65	61.3	0.53	65.3	0.38	77.4	0.26	87.0	1.97	88.6	7.34	88.4	11.75	85.1
	Hazaribagh ..		0.56	61.7	0.82	65.8	0.75	76.3	0.41	85.2	2.26	86.3	7.63	84.2	14.16	79.0
5	Calcutta ..		0.60	66.2	1.38	70.7	1.57	80.0	1.74	85.5	7.62	85.2	10.74	85.0	12.46	83.2
	Dhubri ..		0.40	62.5	0.53	66.0	1.93	75.6	4.83	79.4	13.97	79.4	24.53	81.0	16.17	83.1
	Sibsagar ..		1.47	59.9	1.96	62.9	5.07	69.7	9.37	74.6	12.63	78.9	13.69	83.2	17.10	84.5
6	Jaipur		0.69	61.1	0.19	63.0	0.39	75.4	0.09	84.9	0.45	90.9	2.49	91.4	9.37	84.4
7	Kurrachi ..		0.72	66.8	0.31	69.4	0.23	76.8	0.33	82.2	0.00	86.3	0.52	88.5	3.47	86.1
8	Deesa		0.17	67.1	0.10	70.2	0.05	79.9	0.01	86.9	0.25	91.8	2.62	91.1	10.99	84.4
9	Khandwa ..	TROPICAL INDIA.	0.31	67.6	0.06	71.7	0.13	81.3	0.17	89.3	0.45	93.1	6.05	87.7	8.82	81.0
	Jubulpur ..		0.76	62.8	0.47	66.8	0.51	77.2	0.18	86.2	0.71	91.6	9.10	87.4	20.80	80.1
	Nagpur .		0.55	69.2	0.27	74.2	0.61	83.1	0.34	90.8	0.80	94.9	8.74	87.9	14.73	80.9
10	Bombay		0.13	75.1	0.01	75.5	0.03	79.6	0.01	82.7	0.94	85.2	19.37	83.3	27.17	80.7
11	Hyderabad ..		0.09	71.0	0.04	76.8	0.75	83.6	0.67	88.7	1.15	90.4	4.85	83.7	6.90	78.6
	Poona		0.06	70.0	0.04	74.2	0.05	80.7	0.54	85.5	1.65	85.3	4.73	80.6	6.87	76.3
	Belgaum ..		0.06	70.3	0.02	74.0	0.35	78.9	1.72	81.8	2.62	80.5	6.59	74.3	15.37	71.2
	Bellary ..		0.13	76.0	0.04	79.5	0.22	86.1	0.58	90.4	1.70	89.8	1.85	85.1	1.93	82.6
	Bangalore ..		0.19	67.9	0.11	72.0	0.54	77.3	1.15	81.2	4.02	80.1	3.45	75.6	4.59	73.7
	Trichinopoly ..		0.26	77.0	0.90	80.0	0.55	85.1	1.53	89.2	3.04	89.7	1.62	88.3	1.50	87.1
12	Cochin (West Coast)		0.59	80.0	0.62	81.2	2.44	83.7	4.37	84.7	13.30	83.2	28.41	79.5	21.51	78.6
	Madras (East Coast)		0.89	76.0	0.28	77.2	0.39	80.6	0.62	85.1	2.12	89.3	2.11	89.3	3.87	87.0
13	Rangoon ..		0.17	76.3	0.34	78.9	0.28	83.6	1.83	87.0	9.42	84.9	17.51	81.3	21.68	80.3
14	Mandalay ..		0.08	69.7	0.07	74.8	0.21	82.4	1.37	89.4	5.56	89.0	6.21	86.5	3.17	86.1

Mean Temperature of Thirty-One Indian Stations.

No.	August Rainfall	August Mean temperature	September Rainfall	September Mean temperature	October Rainfall	October Mean temperature	November Rainfall	November Mean temperature	December Rainfall	December Mean temperature	Remarks
1	17·98	63·5°	6·56	62·4°	1·22	56·8°	0·54	49·7°	0·74	45·8°	Hill station, with practically temperate climate. Not malarious.
2	2·70 5·83 1·58	88·4 87·4 91·1	0·64 2·49 0·42	82·8 84·9 88·5	0·11 0·26 0·00	72·9 76·6 79·9	0·57 0·10 0·10	60·6 63·7 67·8	0·34 0·38 0·20	53·0 56·1 58·6	Punjab Stations.—Intensely hot in summer, quite cold in winter; rainfall scanty. Malaria rife from August to November; sometimes of a very virulent type.
3	10·59 7·67 11·10 11·83 12·50	84·5 84·5 84·1 84·3 82·6	5·74 4·91 6·05 6·59 6·80	83·2 84·3 83·8 84·2 83·1	0·42 0·47 1·83 2·30 0·70	76·4 80·4 78·8 79·3 80·5	0·08 0·05 0·17 0·36 0·12	65·3 69·5 68·2 68·7 70·4	0·32 0·19 0·32 0·24 0·13	58·6 62·1 61·2 61·4 64·3	North-West Provinces.—Hot and dry from April to mid-June; then to September moderate rain; cool with bright sun, November to March. Malarious from August to November. but seldom of a severe type.
4	11·30 13·11	84·4 78·3	7·40 8·76	84·7 78·3	3·25 3·41	80·5 75·0	0·17 0·29	70·7 67·2	0·13 0·22	62·6 66·9	Upper Bengal.—Intermediate in climate and salubrity between N.W.P. and Lower Bengal.
5	12·95 13·76 16·19	82·6 82·3 83·8	9·33 13·35 12·22	82·6 81·4 82·6	4·39 3·50 4·84	80·5 79·0 78·0	0·66 0·26 0·98	72·9 71·8 69·1	0·24 0·10 0·57	66·1 65·3 61·1	Lower Bengal and Assam.—Moist, except for a few weeks in March and April; heavy and prolonged rains, but seldom with intense heat. Malaria prolonged, and often of a severe type.
6	10·07	85·0	4·40	82·7	0·30	78·9	0·24	68·8	0·08	62·8	Rajputana. – Closely resembles the Southern Punjab.
7	1·55	83·8	0·54	83·6	0·00	82·2	0·09	75·0	0·16	69·0	Seaport of Sind.—Waterless and desert; but climate modified by proximity to sea. Exceptionally little malaria previously to the introduction of a regular water supply.
8	7·60	81·8	4·83	83·1	0·35	81·5	0·16	75·6	0·06	68·6	Gujarat. — Scanty rainfall, July, August; heat of prolonged drought modified by proximity to sea. Malaria moderate, more or less throughout the year, with two maxima—in February and October respectively.
9	7·14 16·12 10·25	79·8 79·3 81·0	7·56 8·77 10·13	80·2 79·9 81·2	1·73 2·07 2·95	78·0 75·6 78·9	0·31 0·50 0·90	70·4 66·6 71·8	0·56 0·38 0·64	65·3 60·6 66·8	Central India.—Prolonged dry season, intensely hot in May and June; rainfall moderate. Malaria autumnal, prolonged far into cold weather, but seldom particularly virulent.
10	11·43	80·3	11·81	80·2	2·47	81·8	0·66	79·7	0·09	76·8	Considerable rainfall, almost confined to three months. Not very malarious.
11	8·17 3·22 8·74 2·58 5·80 4·67	78·4 75·7 71·2 82·1 73·6 86·2	5·99 5·21 4·64 4·09 4·72 3·21	78·4 76·3 71·9 81·7 73·5 85·4	3·08 4·80 6·39 4·29 7·15 7·49	77·3 77·5 73·7 80·1 72·9 82·4	1·76 1·31 2·11 2·13 3·59 5·37	72·5 72·4 71·6 76·0 70·3 79·1	0·27 0·26 0·13 0·14 0·55 2·55	69·1 68·6 69·6 73·0 68·1 76·7	Southern plateau.—Scanty rainfall, but no great annual variation of temperature; intense heat of central region modified by sea breeze as ghauts are approached. Malaria worst in August, prolonged far into cool season, but rarely of virulent type.
12	13·31 4·56	78·7 85·5	9·38 4·69	79·2 85·2	14·01 11·00	80·1 82·1	6·77 13·21	80 6 78·7	1·81 5·28	80·3 76·7	Southern littoral.—Climate uniform and moist. No marked malaria-free season, but disease seldom specially severe.
13	18·19	80·3	16·04	80·7	6·74	81·4	2·98	80·1	0·09	77·5	Lower Burmah.—Resembles Indian Southern littoral in climate, but disease often of severe type.
14	3·88	85·3	6·54	84·8	5·08	83·1	1·28	76·9	0·28	70·5	Climate resembles that of Southern Indian plateau. Malaria from June to December, worst in August; disease often of virulent type.

During the hot weather, it is true, the heat rivals that of the Punjab, and one may at times have a long succession of hot nights, but the worst is over by the middle of June, as with the "bursting of the monsoon" comes a great and welcome relief, which in good years is kept up through the rest of the warm weather. When, however, a "break in the rains" of any duration occurs, the climate for the time becomes, if anything, more trying than the contemporaneous conditions in the Punjab. The cold weather, however, goes on for four months, and affords one of the finest climates in the world for those who are not enthusiasts for the miseries of ice and snow.

In the third zone, that of Bengal, the cold weather is short, but even in Calcutta there are two months during which ordinary European clothing becomes desirable. There is a short hot weather, relieved by a rainy period, the "chota barsât," about Easter, but the heat never approaches that of the western part of the continental triangle. The rainfall is extremely heavy towards the east, as in Assam, so that extensive floods are common, and malaria necessarily very common and often serious.

In the northern part of the peninsular triangle we find the same tendency to dryness in the west and moisture in the east, Khathiawar and Surat having but moderate rainfalls, while that of Orissa is very heavy; but in neither is either the fierce heat or bracing cold weather of the northern triangle to be met with.

Between the two lie the "Central" Provinces, which, apart from some favoured spots, such as Sangor and Chindwara, which have an elevation of over 2,000 feet, undoubtedly possess one of the vilest climates in India, or in the world. The hot, dry weather is severe and prolonged, and towards the burst of the monsoon is combined with a moist atmosphere without any alleviation of the heat. The writer has personally verified in the Nerbudah valley a temperature of 105° F. (40·6° C.) at 4.30 a.m. in the open, the observation being taken carefully with a swung Kew thermometer.

The so-called cold weather lasts barely two months, and the only time of the year that by any stretch of politeness can be said to be pleasant, is that of the rains, which probably rather by force of contrast than by virtue of any real superiority to the same season elsewhere, includes days when the air seems really refreshing.

The entire coast and the greater part of the surface of the southern portion of the peninsula have a warm, equable climate with a considerable rainfall. Portions of Haidrababad and Mysore, in the plateau of the Deccan, approach continental conditions, being somewhat dry and arid, and occasionally visited by droughts, but the climate of the greater part of the country is profoundly influenced by its proximity to the great oceans that wash its coasts. In this inland plateau the distribution of the rainfall has the further peculiarity of being much later than elsewhere, the rainiest month in Mysore being not July, as in most other localities throughout India, but November: this corresponds to the second rainy season, the first rainy season being represented by a somewhat smaller maximum in August. There is no very marked difference between the climates of the eastern and western coasts, though as will be seen on comparing the figures for Chochin and Madras in the subjoined table, the monthly rainfall is somewhat differently distributed.

COLOMBO. LAT. 6° 56′ N.; LONG. 80° 0′ E. OBSERVATORY A FEW FEET ABOVE SEA-LEVEL.

Months	Mean Monthly Maxima.		Mean Monthly Minima.		Relative Humidity	Mean Monthly Rainfall	
	F.	C.	F.	C.		Ins.	Mm.
January ..	89·8	**32·1**	72·6	**22·6**	80	3·72	**94·6**
February ..	91·9	**33·2**	74·4	**23·5**	75	0·63	**16·0**
March ..	94·0	**34·4**	75·7	**24·3**	73	3·71	**94·1**
April ..	90·0	**33·2**	76·2	**24·5**	83	9·73	**247·5**
May ..	89·8	**32·1**	78·7	**25·9**	86	16·0	**406·4**
June ..	87·4	**30·7**	78·5	**25·8**	84	7·83	**199·3**
July ..	86·3	**30·2**	76·5	**24·7**	84	6·77	**171·5**
August ..	87·2	**30·7**	77·3	**25·2**	83	7·35	**186·7**
September	86·9	**30·5**	76·5	**24·7**	83	4·00	**101·6**
October ..	89·1	**31·8**	75·4	**24·1**	82	9·47	**241·0**
November ..	88·4	**31·3**	74·3	**23·4**	80	9·25	**234·9**
December ..	85·5	**29·7**	73·1	**22·9**	82	5·20	**132·1**

These climatic conditions are naturally found in their most typical form on the island of Ceylon, the climatic data of which are epitomised in the above table for the capital of the island, Colombo, which is situated on the western coast.

The total rainfall is about 88 ins. (2,237 mm.), and the mean annual temperature 80° F. (26·7 C.).

The bursting of the south-west monsoon, which is one of the main factors in determining the sequence of seasons in India, takes place in Ceylon in the latter half of May, and gradually creeps northward, reaching Bombay early in June, and finding its way inland in the latter half of that month. Traditionally, the 15th June is the date for the advent of the rains in Northern India, but it is rarely that the hopes of the anxious denizens of the broiling plains are fulfilled by its appearance at so early a date, and the end of the month probably more nearly approaches the average. On rare occasions the rain may not come till the 15th July, and the last month of waiting in such years is always a time of much tedium and suffering, as the absence of precipitation does not prevent the air from becoming saturated with moisture, which, combined with unabated high temperature, renders the lives of all subjected to it barely tolerable.

India is fortunately well provided with hill-stations, Bombay being the only presidency which is badly off in this respect. There the two or three health resorts reach an elevation of no more than from 4,000 to 5,000 ft., and are practically utilised only during the hot, dry season preceding the burst of the monsoon. Once the rains are established the health-seeker has to leave these stations for Poona, a large station on the summit of the western ghauts, where, thanks to the pleasant sea-breeze, the climate during the rains, if rather too warm for choice, is on the whole very pleasant.

Madras possesses excellent sanatoria in the Nihilgerris, the principal hill-station of Ootacamand, at an elevation of over 6,000 ft., being in many respects the best of the Indian hill-stations. Owing to its southerly position it enjoys an admirable climate all the year round, and unlike the Himalayan stations, which are perched on steep spurs and peaks, is situated on a wide, rolling table-land, so that it is possible to drive about in ordinary carriages, and even to follow the hounds, though, it must be confessed, the hunting is much more like that to be got with the Dartmoor hounds than in "the Shires."

Temperature Table of Indian Stations Expressed in Metric System.

Region	Place	Elevation, Metres	Mean Annual Temperature	Coldest Month		Warmest Month	
				Name	Temperature	Name	Temperature
Bengal	Darjeeling ..	2,107	12·2	Jan.	5·0	July	17·2
	Calcutta ..	6	25·4	Dec.--Jan.	18·4	May	29·5
	Saugor Dl ..	7	25·7	Dec.	19·2	May	29·5
	Dacca ..	6	25·4	Jan.	18·9	July	28·4
	Chittagong ..	26	24·9	Jan.	19·1	May	27·8
Assam	Sibsagar ..	101	19·1	Jan.	14·3	July	28·3
	Goalpara ..	118	23·6	Jan.	17·2	July	27·2
	Silchar ..	31	22·4	Jan.	14·3	July	28·4
Orissa and Central Provinces	False Point ..	4	25·4	Dec.	19·2	June	28·9
	Kutták ..	24	26·7	Dec.	20·4	May	30·9
	Jubbulpur ..	404	24·1	Dec.	15·7	May	32·7
	Pachmari ..	1,070	20·9	Dec.	13·7	May	29·3
	Nagpur ..	312	26·2	Dec.	19·3	May	34·4
	Sironcha ..	122	27·6	Dec.	20·6	May	35·0
Punjab	Peshawar ..	420	21·7	Jan.	10·8	June	32·8
	Lahore ..	150	22·8	Jan.	12·2	June	33·3
	Multán ..	130	23·9	Jan.	13·3	June	34·7
United Provinces	Meerut ..	100	22·8	Jan.	57·4	June	32·8
	Jhánsi ..	200	23·3	Jan.	63·3	June	34·2
Western Presidency	Bombay ..	11	26·4	Jan.	22·8	May	29·3
	Poona ..	561	24·3	Jan.	20·2	April	29·2
	Sholapur ..	485	26·1	Jan.	21·4	May	31·8
	Secunderabád	544	25·7	Jan.	20·8	May	31·8
Eastern Presidency	Vizagapatám	9	28·2	Jan.	24·0	May	31·1
	Belgaum ..	769	22·4	Jan.	20·6	April	35·9
	Bellary ..	450	26·9	Jan.	22·5	April	31·8
	Madras ..	7	27·7	Jan.	24·2	May—June	30·7
	Trichinopoli ..	78	28·1	Jan.	24·6	April	31·2
	Mercára ..	1,152	19·8	Jan.	18·4	April	22·7
	Wellington ..	1,890	16·2	Jan.	12·8	May	18·8
	Dodabetta Peak	2,633	11·2	Jan.	9·7	May	13·8
	Agustia Peak	1,890	14·3	Jan.	12·2	April	16·3
	Tevandrum ..	4	25·5	Jan.	24·5	April	27·0

The Northern, or sub-tropical, triangle possesses a large number of elevated health stations, varying from 5,000 to 9,000 ft., from Darjeeling, north of Calcutta, to Thandiani, near Peshawar. All of these afford an excellent refuge from the extreme heat of the plains, but the eastern stations have so heavy a rainfall as to make them barely tenable during the rains, although Assam possesses, in Shillong, a delightful health resort, not unlike Ootacamand in miniature, where the rainfall is comparatively moderate and it is possible to drive about the station, if one is not too particular as to the size and magnificence of one's equipage. With this exception, however, it is better, provided the choice be an open one, to resort to one of the western Himalayan stations, as in the others the period of the rains is somewhat trying even to adults, and is especially badly borne by children.

The principal data of the climates of the regions described above may be gathered in detail from an inspection of the table on pages 56, 57, as the places therein mentioned include one or more towns in each of the regions into which we have, for purposes of description, divided the Indian peninsula. Owing to the size of page it is impossible to adhere to our general plan of tabulating the facts in both the English and Continental scales, and in place of duplicating the table according to the metric nomenclature, it has been thought better to reproduce a table of the same character from Hann's "Klimatologie," as by this course the facts are expressed from a different point of view, and it enables us to some extent to supplement the original list with the data of a number of additional places.

Lastly, the table on next page, from Blanford, is reproduced, as it illustrates well the remarkable differences of climate in the matter of annual ranges of temperature that are to be found within the confines of the Indian peninsula.

The Bay of Bengal naturally has a climate which generally resembles that of the surrounding coasts. During the south-west monsoon the winds are strong, and there is generally a heavy sea running, but throughout the period of north-easterly winds, from October to May, a calm sea with moderate breezes will as a rule be met with, the pleasant weather being interrupted only by occasional cyclonic storms during the first half of the period. Short spells of rather bad weather due to disturbances of this sort will be met with in every year, and it is rare for a season to pass without rather heavy weather, but the really serious storms, which meet the popular notions of what a "cyclone" should be, are fortunately rather rare. Of these dangerous disturbances, the greatest number occur in October, but they

TABLE OF MEAN AND ABSOLUTE EXTREME TEMPERATURES IN CERTAIN INDIAN STATIONS.

Place	Annual Range of Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Absolute Maximum Temperature		Absolute Minimum Temperature	
	F.	C.	F.	C.	F.	C.	F.	C.	F.	C.
Leh	94	52·2	90	32·2	− 4	− 20·0	93	33·9	−17	− 27·2
Quetta	84	46·6	99	37·2	15	− 9·4	103	39·4	11	− 11·8
Simla	63	35·0	88	31·1	25	− 3·9	94·5	34·7	20	− 6·8
Peshawar ..	86	47·8	115	46·1	29	− 1·7	119	48·3	24·5	− 4·1
Multan	80	44·5	114	45·6	30	1·1	118	47·8	29·1	− 1·7
Lahore	83	46·1	117	47·2	30	1·1	120	49·0	30	− 1·2
Jachobabad ..	86	47·8	118	47·8	32	0·0	121	49·4	29	− 1·6
Kurrachi.. ..	62	34·5	107	41·7	45	7·2	117·5	47·5	41	5·0
Mount Abu ..	57	31·7	96	35·6	39	3·9	101	38·3	32·6	0·4
Deesa	72	40·0	112	44·4	40	4·4	118·5	48·1	34·2	1·2
Avra	76	42·3	116	46·7	40	4·4	120·5	49·2	36·4	2·4
Calcutta	54	30·0	102	38·9	48	8·9	105·5	40·8	45	7·2
Sibsagar	57	31·6	99	37·2	42	5·6	102	38·9	40	4·4
Nagpur	69	38·3	115	46·1	46	7·8	117·5	47·5	43·2	6·2
Bombay	34	18·9	95	35·0	61	16·1	100	37·9	53·2	11·8
Sholapur.. ..	63	35·0	110	43·3	47	8·3	112	44·4	42·9	6·0
Darjeeling ..	48	26·7	78	25·6	30	− 1·1	84	29·0	26·0	− 3·3
Madras	48	26·6	108	42·2	60	15·6	113	45·0	57·5	14·2
Wellington ..	43	23·9	80	26·7	37	2·8	81	27·2	34·2	1·2
Colombo.. ..	25	13·9	93	33·9	68	20·0	95·5	35·4	65·8	18·8
Newera Eliya ..	42	23·3	77	25·0	35	1·7	79	26·1	0·0	0·0
Akyab	45	25·0	96	35·6	51	10·6	99	37·3	47·4	8·5
Rangoon ..	46	25·6	104	40·0	58	14·4	106·5	41·5	55·8	13·2
Port Blair ..	26	14·4	95	35·0	69	20·6	96·5	35·8	65·8	18·8

are not unknown even in the period of the south-west monsoon. Out of 111 noticeable revolving storms "in the Bay" that have occurred in 139 years, Blanford states that the monthly distribution has been as follows:—

Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2	0	2	9	21	10	3	4	6	31	18	9

It will be noted that there is a second maximum in May, so that one of the most important factors in determining these storms is obviously the change of the monsoon. Their influence rarely reaches far inland, so that one rarely hears of serious damage being inflicted much further inland than Calcutta, and even there, the havoc seldom goes beyond the uprooting of a few trees and the unroofing of crazy native huts. At sea these storms are no light danger, but it is to be doubted if they ever approach the terrific visitations that are to be met with in the West Indies.

The Indo-Malay Peninsula.—The climate of the coast of Arakan and Lower Burmah generally resembles that of the other side of the Bay of Bengal, but has a much heavier rainfall, as may be seen from an inspection of the following table of four ports situated on the west coast of the peninsula with that of Madras.

TABLE SHOWING COMPARISON OF RAINFALL ON WEST AND EAST COASTS, BAY OF BENGAL.

	MADRAS (West Coast of Bay)		PORT BLAIR ISLAND (nearer Burmah)		AKYAB (East Coast of Bay to North)		MOULMEIN (East Coast of Bay, middle)		SELANGOR (East Coast of Bay to South)	
	Ins.	**Mm.**	Ins.	**Mm.**	Ins.	**Mm.**	Ins.	**Mm.**	Ins.	**Mm.**
January ..	0·98	**25**	0·91	**23**	0·13	**3**	0	**0**	7·37	**187**
February	0·33	**8**	1·30	**33**	0·19	**5**	0·08	**2**	6·03	**153**
March ..	0·39	**10**	0·39	**10**	0·54	**13**	0·13	**3**	7·84	**199**
April ..	0·59	**15**	2·40	**61**	1·63	**41**	2·76	**70**	10·04	**255**
May ..	2·20	**56**	15·08	**404**	12·21	**310**	19·68	**500**	10·72	**272**
June ..	2·09	**53**	17·08	**455**	51·63	**1,311**	38·38	**975**	3·04	**77**
July ..	3·78	**96**	16·54	**419**	50·98	**1,295**	43·98	**1,115**	3·98	**101**
August ..	4·42	**112**	15·20	**386**	38·57	**980**	43·0	**1,092**	7·68	**195**
September	4·68	**119**	19·65	**498**	22·98	**584**	30·32	**770**	7·18	**182**
October ..	10·08	**274**	11·80	**300**	12·40	**315**	8·39	**213**	11·17	**283**
November	13·70	**348**	9·49	**241**	3·89	**99**	1·49	**38**	11·01	**280**
December	5·13	**130**	5·33	**135**	6·59	**15**	0·13	**3**	9·77	**248**
Year ..	49·12	**1,246**	116·73	**2,965**	195·72	**4,971**	188·32	**4,781**	101·30	**2,573**

The more even distribution and the appearance of two maxima as the Equator is approached are also well shown in this table, which further shows that the north-east coast of the Bay of Bengal includes some of the rainiest places on the face of the globe.

Although the Burmese coast has so moist a climate, the greater part of the moisture pouring in from the sea is precipitated on the rather high range of hills that extends along the entire length of this peninsula, at no great distance from the coast; so that as we ascend the Irrawaddy, the rainfall steadily diminishes, until in the far inland regions of Upper Burmah we get a climate reproducing, in many respects, that of north-western India, though of course to a much less marked degree. This change from extreme moisture to moderate dryness may be followed by comparing the three following climatic tables of stations in Burmah.

CLIMATIC TABLE OF BURMESE STATIONS.

Month	Rangoon, near Coast. Lat. 16° 30′ N.			Mandalay, Inland. Lat. 22° N.			Bhamo, Chinese Frontier. Lat. 24° 20′ N.		
	Mean Monthly Maxima	Mean Monthly Minima	Mean Monthly Rainfall	Mean Monthly Maxima	Mean Monthly Minima	Mean Monthly Rainfall	Mean Monthly Maxima	Mean Monthly Minima	Mean Monthly Rainfall
January ..	89·1	64·2	0·11	84·1	56·0	0·06	77·2	48·5	0·71
February ..	92·8	65·9	0·23	89·9	60·1	0·08	82·2	53·1	0·39
March ..	96·6	71·1	0·16	97·7	67·9	0·21	89·0	60·1	0·69
April ..	98·6	76·2	1·74	102·3	77·8	1·19	93·9	67·6	1·65
May	91·9	77·3	11·73	99·0	79·0	5·26	93·7	72·7	6·15
June ..	86·5	76·5	18·30	95·0	78·5	5·71	90·5	74·9	13·35
July	85·3	75·8	21·37	94·2	78·4	3·26	87·8	75·1	19·17
August ..	85·1	75·7	19·65	93·3	77·6	4·16	88·1	75·4	16·40
September ..	85·7	75·9	15·89	92·8	76·9	6·21	90·1	74·5	8·79
October ..	87·7	75·6	7·12	91·8	74·8	4·54	88·5	69·6	3·47
November ..	87·6	72·3	2·52	86·7	67·2	1·67	81·8	59·2	0·93
December ..	87·3	67·3	0·07	82·3	59·3	0·28	76·3	50·7	0·44
Year ..	89·5	72·8	98·89	92·4	71·1	32·63	82·6	65·1	72·14

Conditions of space make it difficult here to express the data in both scales, accordingly the English scale only is given. The higher rainfall of Bhamo as compared with Mandalay is attributable to its proximity to the great range of hills which divide Burmah from China.

Straits Settlements.—Singapore has, or had, a yacht club, "The Equatorial," the course for whose regattas was supposed to be "the Line," so that the climate of this colony is necessarily of the equatorial type. There is practically no seasonal change, as although the maxima of rainfall occur in March-April and December, the other months have also an amount of precipitation not far short of these specially rainy months. The annual range of temperature is under 18° F. (10° C.), and though the climate is rather moist, excessive heat is never met with; the mean maximum of April, the warmest month, being but 89° F. The main climatic facts may be gathered from the subjoined table:—

SINGAPORE. LAT. 1° 16′ N.; LONG. 103° 53′ E. OBSERVATORY A FEW FEET ABOVE THE SEA.

Month	Mean Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity %	Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January..	78·2	**25·7**	85·6	**29·8**	71·7	**22·0**	79	10·30	**261·6**	16
February	79·0	**26·1**	87·1	**30·6**	71·6	**21·9**	79	6·18	**156·3**	9
March ..	79·9	**26·6**	88·0	**31·1**	73·3	**23·0**	80	8·41	**213·7**	14
April ..	81·2	**27·3**	89·0	**31·7**	74·8	**23·7**	79	8·39	**213·5**	15
May ..	82·7	**28·2**	88·9	**31·6**	76·4	**24·6**	79	5·58	**141·3**	13
June ..	80·9	**27·1**	86·7	**30·4**	75·6	**24·3**	81	6·37	**161·7**	16
July ..	81·7	**27·6**	87·5	**30·8**	75·4	**24·1**	76	7·74	**196·6**	13
August ..	80·8	**27·0**	86·3	**30·2**	74·9	**23·8**	78	6·83	**173·0**	14
September	80·5	**26·9**	86·9	**30·5**	74·2	**23·5**	77	5·83	**148·2**	12
October	80·4	**26·8**	87·1	**30·7**	74·1	**23·4**	79	8·61	**218·8**	17
November	79·3	**26·3**	86·1	**30·1**	73·6	**23·2**	82	9·24	**234·5**	18
December	77·4	**25·2**	83·2	**28·5**	73·5	**23·1**	89	10·84	**275·5**	17
Year ..	80·1	**26·7**	86·9	**30·5**	74·0	**26·7**	80	93·99	**2387**	174
	Figures for 1896							Averages of 10 years		

During January and February the wind is mainly from the north-east, but varies greatly, often veering round to the north-west. The south-west monsoon, known here as the "Java winds," comes on about April and continues only to July, after which month, till November, the winds are again very variable, the most common directions being south-south-west, south-east, and west.

Considering its proximity to the Equator the climate is wonderfully pleasant, the nights being always cool enough to sleep at ease, and though there is generally a pleasant breeze, the island enjoys an almost complete immunity from storms.

Siam, owing to its geographical position, is to some extent preserved from the heat, rain, and devastating cyclones common in adjoining countries, the high mountains with which it is almost completely surrounded, cutting it off from most of their effects. The coolest month is December, though the absolute minimum may occur at any time from November to February; and the hottest, April.

The lowest temperature recorded during ten years by Staff-Surg. J. Campbell, R.N., from whose observations these notes are compiled, was 57° F. (13·9° C.), and the highest 97·5° F. (36·4° C.). December is the driest, and September the moistest month of the year, and hail fell once in fifteen years. Droughts are rare. The south-west monsoon becomes weak in September. Early in October northerly breezes set in, varying at first to east and west of north, and by November the north-east monsoon is established, to reach its strongest in December, and then gradually failing till early in March, when the "Kiti" breezes—south to south-south-west—usher in the monsoon. From May to August the winds are sometimes boisterous. The above remarks apply to Lower Siam and to Bangkok in particular, for which the table below, compiled from Campbell's figures, gives the main climatic data.

BANGKOK. LAT. 13° 58′ N.; LONG. 100° 34′ W. NEAR SEA-LEVEL.

Month	Mean Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity	Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January..	76·1	**24·5**	87·7	**30·9**	69·4	**20·7**	75	0·09	**2·4**	2
February	79·1	**26·2**	88·6	**31·5**	74·1	**23·4**	78	0·56	**14·2**	7
March ..	82·5	**28·1**	93·0	**33·9**	74·5	**23·6**	74	0·83	**21·4**	1
April ..	83·4	**28·5**	94·1	**34·5**	79·0	**26·1**	75	2·42	**61·1**	10
May ..	82·3	**27·9**	89·7	**32·0**	76·8	**24·8**	78	10·54	**268·0**	20
June ..	82·3	**27·9**	89·4	**31·8**	78·1	**25·7**	78	7·72	**195·7**	16
July ..	81·4	**27·4**	88·1	**31·2**	76·2	**24·5**	78	8·02	**204·0**	26
August ..	81·4	**27·4**	89·0	**31·7**	76·2	**24·5**	79	5·65	**143·5**	17
September	80·3	**26·8**	88·6	**31·5**	76·7	**24·8**	82	11·30	**287·0**	22
October ..	80·1	**26·7**	87·3	**30·7**	75·1	**24·0**	82	7·46	**189·3**	14
November	76·8	**24·9**	83·7	**28·8**	70·3	**21·3**	77	2·36	**59·8**	6
December	74·8	**23·8**	81·6	**27·6**	63·3	**17·4**	74	0·09	**2·4**	2
Year ..	80·1	**26·6**	88·4	**31·3**	74·1	**23·4**	77	67·04	**1703**	143

Some authorities make the rainfall of Bangkok considerably less, but Campbell's observations extended over several years and may perhaps be preferred. The delta of the Menam River is annually flooded between June and November, and the spring levels are close to the surface all the year round. North of the delta of the Menam is the Korat Plateau, some 700 feet above the sea-level, a wilderness of shadeless bush, interspersed with salt marshes. One of the main drawbacks of the country is the scarcity of potable water, the supplies both in the Menam delta and on the Korat being almost always brackish and a nearly certain cause of digestive disturbance for Europeans, who thus have to rely greatly on aerated waters imported from the Straits.

Upper Siam, on the other hand, enjoys a dry climate with cool nights, but speaking generally the climate is an exceptionally trying one for European residents.

Cochin China has a moist, hot climate. During the dry season, which lasts from November to April, the temperature varies from 95° F. during the day to 63° F. at night (35° to 17° C.), whereas during the rains, which last from May to October, the range of variation is only between 86° and 68° F. 30° to 20° C.); the relative humidity at this season reaching 89 per cent. Further north, in Tongking, the range of temperature is wider, from 99° to 18° F. (36° to − 7° C.). The rainfall is much heavier than in Siam; Saigon, lat. 10° 47′ N., receiving its maximum of 17·7 ins. (423 mm.) in September and a total rainfall of 74 ins. (1,873 mm.); while at Hue, lat. 16° 33′ N., the wettest month is October, with 26·15 ins. (664 mm.), and a total of 102 ins. (2,592 mm.). Further north, at Hai-fong, in lat. 20° 57′ N., the most rainy month is August, with 14·8 ins. (374 mm.). July falls but little short of this, but the total is less than that of the other two stations, amounting to no more than 64 ins. (1,627 mm.).

The change to the north-east monsoon in November is not unfrequently marked by sudden and devastating storms. The climate has a very bad reputation, malaria, dysentery of a peculiarly deadly type, and diseases due to internal worms, being very common, especially during the rainy season.

China.—Owing to the backward state of the country, there is singularly little information of a definite character available with respect to the enormous Chinese Empire, the entire southern half of which comes within the scope of the tropical climatologist. In the south, regular observations are carried on in the British colony of Hong Kong, and in the north at Zi-ka-Wei, near Shanghai, an admirably conducted observatory is conducted by the Jesuit missionaries, who so often enrol themselves as the pioneers of science.

Speaking generally, however, whether in the case of littoral or continental climates, those of China appear to compare favourably with localities of the same latitude in India and the Indo-Malay peninsula.

The following are the figures for the island of Hong Kong for the year 1901, as I am unable to discover any collated statistics.

HONG KONG. LAT. 22° 12′ N., LONG. 114° 13′ E. NEAR SEA-LEVEL.

Month	Monthly Maxima		Monthly Minima		Relative Humidity	Monthly Rainfall	
	F.	C.	F.	C.		Ins.	Mm.
January ..	68·5	**20·3**	62·5	**16·9**	83	0·68	**17·4**
February ..	59·5	**13·3**	50·5	**10·3**	48	0·76	**19·3**
March	67·9	**19·9**	60·4	**15·7**	77	1·27	**32·1**
April	75·4	**24·1**	69·1	**20·7**	89	9·03	**229·9**
May	81·8	**27·7**	73·7	**23·2**	85	14·10	**358·1**
June	85·9	**29·9**	78·2	**25·7**	80	2·33	**59·7**
July	87·0	**30·6**	78·5	**25·8**	81	5·58	**141·0**
August.. ..	85·7	**29·8**	76·9	**24·9**	84	14·00	**355·6**
September ..	86·0	**30·0**	76·4	**24·6**	76	3·89	**99·1**
October ..	82·6	**28·2**	73·6	**23·2**	68	2·50	**63·5**
November ..	75·4	**24·1**	64·9	**18·2**	64	0·77	**19·5**
December ..	66·9	**19·3**	57·5	**14·2**	66	0·83	**21·2**

In the *Journal of the Royal Army Medical Corps*, vol. i., No. 1, Major S. F. Clark writes: "The climate of Hong Kong varies in the different places. At the Peak, 1,500 feet above the sea, it is always bearable in summer, and is quite crisp in winter, an occasional film of ice being sometimes visible in the mornings. In fact, if one had not to descend to the lower levels for work, it would be no hardship to live at the Peak, where the fog is really the main trouble. Children do well up there, but get very white down below.

"In the city the summer is very trying. From May to

September, both inclusive, the sun is strong—reaching 94° or so in July and August—and the humidity of the air is practically at saturation point. With the breeze cut off by the Peak the situation is thus by no means pleasant, and cases of heat apoplexy always occur at this time. The temperature averages 86° to 88° during these months, and the nights also are stiflingly hot. By the help of punkahs, electric fans, rickshaws and chairs, the work of the colony goes on. The summer is also the rainy and typhoon season, and these visitations luckily cool the air for some days. The rain is very heavy at times, but of late years droughts have prevailed. For the other seven months the climate is not unpleasant, and in December, January and February, is quite cold, without reaching freezing point. The humidity of the air, however, is always considerable. This dampness of the air, especially foggy weather at the Peak, is very destructive to clothing, books, &c., and tin-lined boxes are essential. Ladies' garments require much care to preserve them from destruction."

It is, however, fortunately possible for most people to live at "the Peak," between which and the town there is frequent communication by means of cable tram.

Considering that Hong Kong lies well to the south of Calcutta, it must be confessed that the climate is wonderfully good, and one cannot but think that Major Clark would wish himself back in Hong Kong were he to negotiate an exchange to almost any station in the plains of India.

On the mainland, at Canton, the climate is much less uniform, the north-east wind of the cold season rendering the nights singularly cold for so southerly a position.

The China seas are visited by revolving storms of a most violent character, known locally as typhoons, but as in those of the Bay of Bengal, their more serious effects do not appear to extend far inland.

The Island of Formosa, with a mean annual temperature of 74·6° F. (23·7° C.), has a typically marine climate, the difference between the coldest and hottest months, February and June, being but from 67·7° F. (19·8° C.) to 81° F. (27·1° C.), or only 13·5° F. (7·3° C.). The south-west monsoon bursts towards the end of May, and the rainfall, especially in the north of the island, is very heavy and evenly distributed, though there is a distinct dry, winter season in the south, as may be seen by the contrast of the rainfall of the following two Formosan stations—Kilung, in lat. 25° 8′ N., and Takao Anping, in 22° 47′ N. (Hann).

RAINFALL IN THE ISLAND OF FORMOSA.

		Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Kilung	Ins.	17·53	14·98	14·98	8·68	10·74	9·33	7·72	7·53	16·53	9·84	11·61	11·63
	Mm.	445	397	379	22·0	237	237	196	191	420	249	294	294
Takao	Ins.	6·67	0·58	1·64	2·48	9·45	13·58	14·65	14·63	4·69	1·54	0·49	1·08
	Mm.	17	13	41	63	240	345	372	370	119	39	12	27

The total annual rainfall is 122 ins. (3,581 mm.) for Kilung, and 65·25 ins. (16·58 mm.) for Takao Anping.

Further north, the monsoon bursts somewhat later, very much in the same way as it does in India ; but here, again, the climate is much cooler than would be met with west of the Malay Peninsula in the same latitudes.

ZI-KA-WEI. LAT. 31° 12′ N.; TIME 8 HRS. 5 MINS. 43 SECS. EAST OF GREENWICH. ELEVATION OF OBSERVATORY, 22 FEET ABOVE THE SEA.

Month	Mean Monthly Temperature		Maximum Temperatures		Minimum Temperatures		Relative Humidity	Mean Monthly Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January ..	37·0	**2·8**	60·0	**15·6**	20·0	**- 6·7**	78	2·03	**51·8**	10
February	39·4	**4·0**	61·9	**16·6**	23·8	**- 4·9**	79	2·44	**62·0**	11
March ..	46·0	**7·8**	74·1	**23·4**	29·0	**- 1·7**	77	3·29	**83·6**	13
April ..	56·5	**13·6**	84·0	**28·9**	36·9	**2·7**	77	3·49	**88·8**	13
May ..	65·5	**18·6**	88·5	**31·4**	46·4	**8·0**	76	3·64	**92·0**	13
June ..	73·4	**23·0**	95·0	**34·9**	57·3	**14·1**	79	6·78	**172·0**	14
July ..	80·6	**27·0**	98·5	**36·9**	67·5	**19·7**	80	4·74	**120·1**	11
August ..	80·1	**26·8**	97·4	**36·3**	67·0	**19·4**	80	6·08	**154·6**	11
September	72·8	**22·7**	92·0	**33·3**	56·6	**13·7**	79	4·89	**124·3**	12
October ..	63·2	**17·3**	83·5	**28·6**	41·4	**5·2**	76	3·23	**82·0**	10
November	52·0	**11·1**	73·4	**23·0**	29·9	**- 1·2**	76	1·94	**49·2**	8
December	41·7	**5·5**	65·0	**18·3**	21·8	**- 5·7**	76	1·15	**29·2**	7
Year ..	59·0	**15·0**	99·4	**37·3**	20·0	**- 6·7**	78	43·68	**1109·1**	131

The above table, which is drawn up from the observations of several years, shows, apart from the remarkably low temperatures, an amount of both diurnal and annual variation that is very remarkable in a place so close to the sea. Strictly speaking, indeed, it should not come in the category of hot climates at all, but in the absence of other accurate material it is valuable for the purpose of showing how soon tropical temperatures are left behind as we proceed northward along the Pacific coast of Asia.

The Malay Archipelago.—Consists of a number of large islands situated on either side of the Equator, and generally too close to it to enjoy the benefits of a well-developed monsoon.

BATAVIA. LAT. 6° 11′ S.; LONG. 106° 53′ E.

Month	Mean Temperature		Absolute Maxima		Absolute Minima		Relative Humidity	Mean Monthly Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January ..	77·6	25·4	91·5	33·1	68·4	20·4	87·1	13·75	350	22·5
February .	77·6	25·4	90·5	32·5	69·1	20·7	87·5	12·56	319	20·7
March ..	78·5	25·8	90·6	32·6	70·3	21·2	85·9	7·53	191	17·4
April ..	79·4	26·3	90·5	32·5	70·3	21·2	85	4·78	121	14·1
May ..	79·5	26·4	91·1	32·9	70·3	21·2	83·6	3·48	88	9·2
June ..	79·4	26·3	90·5	32·5	68·6	20·4	83·1	3·64	92	9·1
July ..	78·5	25·8	90·0	32·2	67·0	19·4	80·8	2·53	64	6·9
August ..	78·9	26·0	92·4	33·4	67·0	19·4	77·7	1·49	38	8·0
September	79·5	26·4	94·0	34·4	66·0	18·9	77·5	2·74	69	7·3
October ..	79·7	26·5	95·0	35·0	69·0	20·6	79·0	4·19	106	10·0
November	79·1	26·2	96·0	35·6	68·2	20·2	82·0	5·08	127	13·7
December	78·2	25·7	92·5	33·6	70·0	21·1	84·8	9·03	229	19·0
Year ..	78·9	26·0	96·0	35·6	68·2	20·2	82·8	70·71	1,796	154·9

South of lat. 10°—12°, a north-west monsoon, developing in October or November, takes the place of the south-west monsoon appearing in May in northern latitudes, and when we are sufficiently far from the Equator to be clear of the zone of calms and variable winds, it is the development of this wind that determines the appearance of the rainy season.

This, however, does not so much affect the Malay Archipelago, as nearly the whole of it is within the zone of double annual rainy seasons, and the winds on which they depend to temper the tropical heat are mainly land and sea breezes of necessarily very variable direction.

The Dutch have long had a first-class observatory established at Batavia, the capital of Java, and their results being thus of the first value may be very well taken as a type of the weather conditions of the islands to the south of the Equator, while the table already furnished of Singapore will serve sufficiently to illustrate the northern portion of the Archipelago.

A mild, equable, damp climate, not so hot as would be met with at a corresponding distance north of the line, never cool, and equally free from excessive heat, but very enervating; and unfortunately the health records of these islands are by no means satisfactory.

From January to early April the winds are usually from the north-west, and from May to October north-east, the remaining two months of the year being characterised by winds of very variable direction.

The two following tables will give some idea of the temperature and rainfall of a few sites in this Archipelago, arranged progressively in their order north and south of the Equator.

As examples of places in this archipelago which chance to have a special interest for English-speaking people on both sides of the Atlantic, I give below fuller data of the climates of Manila in America's new acquisition of the Philippines, based on from 16 to 34 years of Spanish records; and of Port Moresley, in the newly established British colony in New Guinea, which naturally cannot as yet do more than furnish a single year's experience :—

MANILA. LAT. 14° 36′ N.; LONG. 120° 58′ E. NEAR SEA-LEVEL.

Month	Mean Monthly Temperature		Absolute Monthly Maxima		Absolute Monthly Minima		Relative Humidity	Mean Monthly Rainfall	
	F.	C.	F.	C.	F.	C.		Ins.	Mm.
January ..	77·0	**25·0**	93·0	**33·9**	62·1	**16·7**	77·7	1·19	**29·4**
February ..	77·7	**25·4**	95·7	**35·4**	61·0	**16·1**	74·1	0·41	**10·3**
March ..	80·4	**26·8**	95·9	**35·5**	63·3	**17·4**	71·7	0·74	**18·8**
April ..	82·9	**28·2**	99·0	**37·2**	66·0	**18·9**	70·9	1·14	**29·1**
May	83·3	**28·5**	100·0	**37·8**	71·1	**21·7**	76·9	4·20	**106·7**
June.. ..	82·0	**27·8**	97·0	**36·1**	70·9	**21·6**	81·5	9·62	**244·1**
July	80·8	**27·1**	94·8	**34·9**	70·0	**21·1**	84·9	14·57	**369·3**
August ..	80·8	**27·1**	94·3	**34·5**	69·1	**20·6**	84·4	13·87	**351·8**
September ..	80·4	**26·8**	93·7	**34·3**	70·5	**21·4**	85·6	14·93	**378·9**
October ..	80·4	**26·8**	94·8	**34·8**	68·7	**20·4**	82·6	7·54	**191·6**
November ..	79·0	**26·1**	92·1	**33·4**	64·9	**18·2**	81·6	5·13	**129·7**
December ..	77·4	**25·2**	91·9	**33·2**	60·3	**15·7**	80·7	2·13	**53·5**
Year ..	77·0	**26·8**	100	**37·8**	60·3	**15·7**	97·4	75·46	**1,916·6**

TABLE OF TEMPERATURES IN MALAY ARCHIPELAGO.

Place	Island	Latitude	Mean Annual Temperature		Coldest month			Hottest Month			Difference	
					Name	Temperature		Name	Temperature			
			F.	C.		F.	C.		F.	C.	F.	C.
Bayombong ..	Lugon	16° 29′ N.	76·1	24·5	December	70·8	21·6	May	80·0	26·7	9·2	5·1
C. Boliano	,,	16° 23′ N.	77·5	25·3	,,	73·6	23·2	,,	81·3	27·4	7·5	4·2
Manila	,,	14° 35′ N.	79·5	26·4	January	76·1	24·5	,,	82·9	28·2	6·6	3·7
Malion	,,	13° 9′ N.	77·6	25·4	,,	74·2	23·4	,,	81·6	27·6	7·5	4·2
Iloilo	Sebu	10° 42′ N.	79·8	26·6	,,	77·1	25·1	,,	82·4	28·0	5·2	2·9
Carlotta	Negros	10° 25′ N.	77·5	25·3	December	75·5	24·2	,,	80·6	27·0	5·1	2·8
Bohol	Bohol	9° 30′ N.	78·6	25·9	February	76·2	24·5	June	80·6	27·0	4·5	2·5
Sandakan	Borneo	5° 49′ N.	80·5	26·9	Dec.–Jan.	79·0	26·1	Apl.–May	81·9	27·7	2·9	1·6
Papar	,,	5° 49′ N.	77·6	25·4	,, ,,	76·1	24·5	June	79·3	26·3	3·2	1·8
Padang	Sumatra	0° 56′ S.	79·8	26·6	November	79·1	26·2	May	81·0	27·2	1·8	1·0
Palembang ..	,,	2° 50′ S.	80·6	27·0	January	79·8	26·6	,,	81·4	27·4	1·4	0·8
Baryermassing ..	,,	3° 34′ S.	79·9	27·1	December	80·0	26·7	,,	81·9	27·7	1·8	1·0
Amboina	Seram	3° 41′ S.	79·3	26·3	July	77·4	25·2	February	81·0	27·2	3·6	2·0
Lahat	Sumatra	3° 48′ S.	78·9	26·0	January	79·1	26·2	April	81·2	27·3	2·3	1·3
North Coast ..	New Guinea	4° 54′ S.	79·0	26·1	August	77·5	25·3	March	79·8	26·6	2·3	1·3
Batavia	Java	6° 11′ S.	78·6	25·9	January	77·5	25·3	May–Oct.	79·5	26·4	1·9	1·1
Buitenzorg	,,	6° 37′ S.	77·0	25·0	February	78·0	25·5	Sept.	77·7	25·5	1·8	1·0
Banjoewangie ..	,,	8° 17′ S.	79·9	26·7	July	78·9	26·0	April	81·2	27·3	2·3	1·3
South coast ..	New Guinea	9° 28′ S.	80·5	26·9	August	77·5	25·3	December	82·6	28·2	5·2	2·9

The remarkable uniformity of these climates, albeit with a slightly more distinct tendency to variation as one recedes from the Equator, are well illustrated in these tables, as also is the dependence of season on purely local conditions in these latitudes.

TABLE SHOWING MONTHLY RAINFALL OF LOCALITIES IN THE MALAY ARCHIPELAGO.

Place	Singkel, S.W. coast, Sumatra		Kota Raja, N. coast, Sumatra		Sarawak, N. coast, Borneo		Sandakan, British N. Borneo		Menado, N. Peninsula, Celebes	
Latitude ..	2° 11′ N.		5° 32′ N.		1° 28′ N.		5° 49′ N.		1° 30′ N.	
Longitude ..	97° 45′ E.		95° 20′ E.		110° 8′ E.		118° 12′ E.		124° 50′ E.	
Month	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.
January ..	11·23	285	5·98	151	27·17	690	21·43	544	18·78	478
February ..	10·68	271	3·13	79	23·67	601	10·33	262	13·27	337
March	14·64	372	3·32	84	10·14	257	7·53	192	10·67	271
April	15·97	406	4·58	116	10·04	255	4·37	111	8·08	205
May	14·45	367	5·55	141	9·09	231	5·32	135	6·58	167
June	13·18	335	3·28	82	8·73	222	8·32	211	7·08	179
July	11·46	291	4·38	111	4·78	121	9·62	244	4·93	125
August.. ..	15·28	388	4·84	123	8·86	225	6·98	176	4·78	121
September ..	16·75	426	7·29	185	7·78	198	10·08	256	3·24	82
October ..	20·16	512	7·48	190	9·92	252	10·07	255	4·93	125
November ..	19·64	499	8·24	209	13·56	345	16·45	418	8·08	205
December ..	16·37	416	9·17	233	25·12	653	19·14	486	16·45	418
Year.. ..	179·62	4,562	67·08	1,704	159·45	4,050	129·73	3,296	106·82	2,713

Place	Ternata, Small Island off Jilolo		Benkulen, S.W. coast, Sumatra		Bangawanji, Java		Kupang, N. coast of Timor	
Latitude ..	0° 47′ N.		3° 47′ S.		8° 13′ S.		10° 10′ S.	
Longitude ..	127° 23′ E.		102° 15′ E.		114° 23′ E.		123° 34′ E.	
Month	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.
January ..	7·83	199	12·40	315	7·57	192	16·15	423
February ..	7·98	201	9·83	249	7·57	192	15·03	404
March	6·30	160	11·34	288	5·38	138	7·60	193
April	10·33	262	10·35	263	4·08	104	2·38	60
May	8·89	226	10·33	262	4·97	126	1·85	47
June	8·89	226	9·15	233	4·62	117	0·38	10
July	5·38	137	7·13	181	3·03	77	0·17	4
August.. ..	4·73	120	9·48	241	2·48	63	0·13	3
September ..	4·07	103	9·82	249	2·67	68	0·04	1
October ..	6·58	167	14·22	361	2·60	66	0·47	12
November ..	8·32	211	13·53	344	2·77	70	3·34	85
December ..	9·28	236	13·60	349	7·97	202	10·44	265
Year.. ..	88·51	2,248	131·30	3,335	55·12	1,415	59·34	1,507

The gradual development of a dry season as one proceeds southward from the Equator, as well as the gradual diminution of the rainfall that accompanies it, is very instructive.

PORT MORESLEY, BRITISH NEW GUINEA. S.E. COAST.

Month	Mean Monthly Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Monthly Rainfall		Direction of Wind
	F.	C.	F.	C.	F.	C.	Ins.	Mm.	
January ..	89	31·7	91	32·8	75	23·9	11·68	296·7	N.W.
February ..	86	30·0	90	32·2	72	22·2	11·88	301·2	N.W.
March ..	86	30·0	90	32·2	74	23·3	10·15	257·8	N.W.
April ..	86	30·0	88	31·1	74	23·3	2·40	61·0	N.W. & S.E.
May ..	86	30·0	87	30·6	72	22·2	2·96	75·0	S.E.
June ..	83	28·3	87	30·6	71	21·7	Want	ing	S.E.
July ..	82	27·8	83	28·3	68·5	20·3	5·94	151·0	S.E.
August ..	84	28·9	82	27·8	68	20·0	1·45	36·8	S.E.
September	85	29·4	86	30·0	71	21·7	0·12	2·7	S.E.
October ..	84	28·9	87	30·6	71	21·7	0·16	4·0	S.E.
November..	88	31·1	88	31·1	71	21·7	0·60	15·2	S.E.
December..	88	31·1	91	32·8	73	22·8	6·88	174·8	N.W.

The rainfall, therefore, appears to be from 56-60 ins., and the reporter remarks :—

"On the sea coast, the experience so far gained seems to prove that the climate of the western portion (of the island) is rainy. Port Moresley is apparently near the centre of a dry belt that extends 100-150 miles along the coast. Eastward of this the climate becomes more rainy as far as the East Cape. The north-east coast, as far as Cape Nelson, is drier, and beyond this again, more rainy—Mamlaro is a wet district. As far as known, the mountain region is more rainy. Thunder storms are more frequent and mist and drizzle also prevail on the high lands."

Exploration in New Guinea is, however, a pursuit which requires the traveller to brave to an exceptional extent the dangers of poisonous snakes and other venomous vermin.

Capt. I. A. Lawson ("Wanderings in the Interior of New Guinea," Chapman and Hall, London, 1875) describes an apparently undoubted case of death from scorpion sting in an adult, and states that large numbers of Papuans are killed by them. He saw several scorpions ten inches long. The patient became comatose. After about three hours, thin watery, almost colourless, blood began to flow from his ears, eyes and nose, which exhaled a horrible stench, and the man died. He measured one scorpion thirteen inches long, and a second exceeded ten inches.

Australia.—The greater part, fortunately, of the island continent is typically "a white man's country," the temperature of latitudes south of the line being so much lower than those of the northern hemisphere that only the extreme northern part of the country comes within our limits.

One would expect, for example, Brisbane, lying in 27° 28′ S., to be very hot, but an inspection of the table below shows that it is only in the north of Queensland that one may expect to meet anything approaching a tropical climate.

Unfortunately the Queensland official statistics do not appear to have been collated, but the year chosen seems to be a fairly representative one. This deficiency is the more surprising as, in a country so often affected with destructive droughts, one would have expected that every effort would have been made to elucidate, by carefully drawn-up normal tables, the usual sequence of good and bad seasons.

BRISBANE, QUEENSLAND.

Month	Mean Temperature		Mean Maximum Temperature		Mean Minimum Temperature		Relative Humidity	Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	M.	
January..	72·2	**22·3**	80·9	**27·1**	63·4	**17·4**	66	1·40	**35·6**	10
February	76·7	**24·8**	86·2	**30·1**	67·2	**19·5**	64	0·75	**19·1**	4
March ..	79·7	**26·5**	88·9	**31·6**	70·4	**21·3**	62	1·38	**35·0**	10
April ..	78·4	**25·7**	87·0	**30·6**	69·8	**21·0**	66	2·67	**67·4**	7
May ..	74·3	**23·5**	84·2	**29·0**	64·4	**18·0**	61	0·63	**16·0**	2
June ..	69·7	**20·9**	80·5	**26·9**	58·9	**14·9**	64	0·17	**4·3**	7
July ..	64·7	**18·2**	75·9	**24·3**	53·5	**11·9**	68	0·47	**11·9**	3
August ..	63·0	**17·2**	75·1	**24·0**	50·8	**10·4**	69	0·06	**1·5**	2
September	60·4	**15·7**	71·1	**21·8**	49·7	**9·8**	70	0·55	**14·0**	9
October ..	60·4	**15·7**	71·5	**21·9**	49·3	**9·6**	67	0·98	**24·9**	10
November	67·0	**19·4**	76·9	**24·9**	57·1	**14·0**	71	1·30	**33·0**	7
December	68·9	**20·5**	78·6	**25·9**	59·2	**15·1**	64	3·25	**82·5**	9

Unfortunately, the greater part of the interior of the country is an almost waterless desert, the development of which, unless subterranean sources of water can be tapped, seems almost hopeless, and almost the whole west coast shares in this terrible disability, and would probably have remained as deserted as the interior but for the recent discoveries of its richness in gold. Even in the extreme north, at Port Darwin, the climate is by no means unendurable for a place within 12½ degrees of the line, and the mean rainfall, 63·21 ins., is very moderate for a place so situated.

PORT DARWIN, NORTHERN TERRITORY.

Month	Mean Temperature		Absolute Maximum		Absolute Minimum		Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.	Ins.	Mm.	
January	84·4	**29·1**	93·6	**34·3**	73·0	**22·8**	15·85	**402·6**	23
February.. ..	83·5	**28·6**	93·9	**34·3**	73·4	**23·0**	13·77	**374·8**	14
March	84·6	**29·3**	91·4	**33·0**	71·0	**21·7**	10·10	**256·5**	26
April	84·4	**29·1**	97·8	**36·5**	69·2	**20·7**	4·36	**110·6**	6
May	81·5	**27·5**	95·2	**35·1**	66·6	**19·2**	1·04	**26·6**	—
June	78·7	**25·9**	92·4	**33·5**	59·9	**15·5**	0·08	**1·7**	3
July	76·8	**24·9**	88·1	**31·2**	58·6	**14·8**	0·01	**0·3**	—
August	79·3	**26·3**	92·0	**33·3**	63·7	**17·6**	0·12	**3·0**	—
September ..	82·8	**28·2**	94·1	**34·5**	67·9	**19·9**	0·43	**10·9**	1
October	85·7	**29·8**	96·7	**35·9**	72·4	**22·4**	2·19	**54·5**	8
November ..	86·0	**30·0**	97·0	**36·1**	72·4	**22·4**	5·21	**132·2**	4
December ..	85·5	**29·7**	95·4	**35·2**	73·7	**23·2**	10·27	**260·4**	16

The climate of the tropical portion of Western Australia will be sufficiently indicated by the following table for Wyndham, in lat. 15° 27′ S.

Month	Mean Monthly Maxima		Mean Monthly Minima		Mean Rainfall Monthly	
	F.	C.	F.	C.	Ins.	Mm.
January	98·0	**36·7**	78·8	26·0	5·32	**134·7**
February	98·7	**37·0**	78·7	25·9	4·24	**106·8**
March	98·2	**36·8**	79·4	26·3	4·02	**102·8**
April	98·1	**36·7**	76·8	24·9	Nil	
May	93·1	**34·0**	71·2	21·8	Nil	
June	89·1	**31·8**	67·7	19·8	0·15	**3·8**
July	88·7	**31·5**	62·8	17·0	Nil	
August	91·8	**33·2**	66·8	19·3	Nil	
September	97·0	**36·1**	74·0	23·3	0·04	**1·2**
October	100·3	**37·9**	78·9	26·0	Nil	
November	101·3	**38·5**	80·3	26·8	4·32	**109·4**
December	100·1	**37·8**	80·4	26·9	2·47	**62·3**

The total annual rainfall here only amounts to 20·54 ins. (521·8 mm.); and Freemantle, in lat. 32° S., on the coast, only receives 28·15 ins. (715 mm.); and Coolgardie, far in the interior, but 7·18 ins. (181·7 mm.); but the temperature records of neither of the two last-mentioned places quite entitles them to be considered in the light of hot countries.

From 20° to 25° south latitude the coast is even drier; Cossach, in latitude 20° 40′ S., receiving but 9·3 ins.

(247 mm.), and Carnarvon, in latitude 24° 52′ S., but 7·83 ins. (199 mm.). In these localities the perceptible rainfall occurs in June and July. In the summer (January, February) some of these places are no doubt very hot, but the nights are nearly always fairly cool. In many of these places water is so scarce that a bath is a luxury scarcely attainable by any but the very rich, the precious fluid having to be eked out at what seems to us a fabulous price per gallon, or even pint. This difficulty is, however, being met in some places by enormous engineering works, and colonists may be met with who have a good deal to say in favour of these apparently inhospitable shores.

Pacific Islands.—The pages of Stevenson and Ralf Bolderwood have so familiarised us with the delights of these favoured spots—where it is always summer, but rarely oppressively hot—that it is probable that the general public have a better idea of their climates than is the case with almost any other tropical region. Owing to their comparatively small economic importance, it is, however, impossible to do more than supply a pair of tables illustrative of the climate of a few of the better-known spots.

TABLE OF TEMPERATURE OF PACIFIC ISLANDS.

Island or Place	Latitude	Warmest Month			Coldest Month			Difference	
		Name	Mean Temperature		Name	Mean Temperature			
			F.	C.		F.	C.	F.	C.
Kauai ..	22° 15′ N.	August	76·4	**24·6**	January	66·5	**19·2**	9·9	**5·5**
Honolulu ..	21° 18′ N.	August	77·5	**25·3**	January	69·5	**20·8**	7·5	**4·4**
Hilo ..	19° 40′ N.	Aug.–Sept.	74·4	**23·5**	January	71·5	**21·9**	2·9	**1·6**
Jaluit ..	5° 55′ N.	Jan.–Feb.	81·0	**27·2**	June	80·5	**26·9**	0·7	**0·4**
Apia	13° 49′ S.	Feb.–Mar.	78·6	**25·9**	July	75·5	**24·2**	3·2	**1·8**
Papiti ..	17° 32′ S.	March	78·5	**25·8**	July	73·5	**23·1**	4·8	**2·7**
Vanua Levu	16° 38′ S.	December	80·5	**26·9**	July–Aug.	76·0	**24·4**	4·3	**2·4**
Levuka ..	17° 4′ S.	December	79·5	**26·4**	July	74·5	**23·6**	5·2	**2·9**
Tana ..	19° 28′ S.	March	79·7	**26·6**	July	69·0	**20·6**	10·8	**6·0**
Tongatabu	21° 8′ S.	February	79·0	**26·1**	August	68·5	**20·3**	10·4	**5·8**
Noumea ..	22° 16′ S.	February	80·0	**26·7**	August	68·0	**20·0**	11·4	**6·7**
Oparu ..	27° 36′ S.	March	72·5	**22·5**	September	65·3	**18·5**	7·2	**4·0**

The places have also been selected so as to illustrate the changes in season we met with in passing from North to South, and indicate much the same sequence that has already been noticed in the case of the Malay Archipelago, but the temperatures are several degrees lower in the case of each corresponding latitude, so that, while the Malay Islands are stormy and trying, the Polynesian groups are amongst the most pleasant of the warm climates of the world. Except in the Marshall groups, and in some of the Fijis, the rainfall is moderate for localities situated so near the equator.

TABLE OF RAINFALL OF PACIFIC ISLANDS.

Month	Honolulu, Hawaii		Marshall Group		Apia, Samoa		Fiji, Qara Valu		New Hebrides, Tongatabu		New Caledonia, Noumea	
	Ins.	**Mm.**	Ins.	**Mm.**	Ins.	**Mm.**	Ins.	**Mm.**	Ins.	**Mm.**	Ins.	**Mm.**
January..	4·03	**102**	11·46	**291**	16·42	**417**	22·48	**571**	9·18	**233**	3·98	**101**
February	4·58	**116**	11·90	**300**	20·23	**514**	17·48	**450**	6·83	**173**	4·38	**110**
March ..	3·77	**96**	17·92	**455**	12·68	**321**	36·97	**932**	6·37	**162**	4·58	**116**
April ..	3·14	**79**	14·15	**359**	8·66	**220**	31·26	**794**	10·35	**263**	5·20	**132**
May ..	3·15	**80**	20·20	**513**	6·97	**177**	10·95	**276**	8·19	**208**	5·18	**130**
June ..	1·82	**46**	15·58	**396**	5·39	**137**	24·10	**612**	8·12	**206**	4·18	**106**
July ..	2·53	**64**	15·44	**392**	3·32	**84**	12·76	**324**	1·66	**42**	3·32	**84**
August ..	2·28	**58**	13·58	**345**	6·18	**157**	32·95	**835**	3·68	**93**	2·38	**60**
September	1·85	**47**	13·45	**342**	8·54	**217**	14·65	**372**	7·08	**180**	2·83	**72**
October ..	2·28	**58**	11·47	**293**	6·97	**177**	19·28	**490**	7·18	**182**	2·56	**65**
November	5·16	**131**	11·30	**387**	12·20	**310**	7·14	**181**	3·58	**91**	3·03	**77**
December	4·93	**125**	17·48	**444**	17·63	**447**	17·48	**444**	4·45	**113**	3·23	**82**
Year ..	39·45	**1,002**	177·87	**4,517**	125·15	**3,178**	247·85	**6,281**	76·62	**1.946**	44·68	**1,135**

Qara Valu has been selected as having the heaviest rainfall recorded in this part of the world, and it must not be imagined that such a chronic downpour is in any way typical of the Fiji Islands, most of which have a comparatively moderate rainfall; Bua with 98·35 ins. (2,497 mm.), and Lesuha with 97·15 ins. (2,465 mm.), being fairer examples; but there is the same tendency to a comparatively even distribution throughout the year.

These islands are, it is almost needless to remark, occasionally visited by terrible tornadoes, but are normally continuously under the influence of the trade winds, which here do not suffer from interruption, during the summer solstice, from disturbance due to the area of low pressure that originates from the superheating of land and water over Australia and the islands and confined seas that intervene between it and the Asiatic continent.

The American Continent.—Like the islands of the Pacific, climatic data in America are characterised by lower levels than are met with in the great land masses of Europe, Asia, and Africa. As a result of this we find that, although we know that New York can produce a most discreditable array of cases of sunstroke in the height of summer, it is only the extreme southern portion of the United States that really merits the title to belong to the category of hot climates. There are doubtless to be met with fiercely hot places in Mexico, and malarious foci in the isthmus of Darien, which may rival anything to be met with in the old world, but speaking generally, climates are generally milder than those of corresponding places on this side of the "herring pond."

Commencing with the Southern United States, all that need be described in the present work is the belt extending from California in the west to Florida in the east.

The climate of California is undoubtedly one of the finest in the world. Like the rest of the western seaboard of America, the rainfall is small, but there is always sufficient water for cultivation by the agency of irrigation; and the clearness of the atmosphere and genial temperature renders this State the ideal of the physician in search for health resorts. Apart, indeed, from the excitements of "euchre" and the germs introduced by the Chinese settler, it seems

Los Angeles, California.

Month	Monthly Means		Absolute Maxima		Absolute Minima		Relative Humidity %	Monthly Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January ..	54	12·2	87	30·6	30	−1·1	66	2·80	71·1	6
February ..	55	12·8	88	31·1	28	−2·2	69	2·82	71·3	6
March ..	57	13·9	99	37·2	31	−0·6	73	2·72	68·7	7
April	60	15·6	99	37·2	38	3·3	73	1·10	27·9	4
May	63	17·2	103	39·4	41	5·0	74	0·51	12·7	3
June	67	19·4	100	37·8	46	7·8	73	0·10	2·5	1
July	71	21·7	109	42·8	50	10·0	74	0·02	0·0	0
August ..	72	22·2	106	41·1	51	10·6	74	0·04	0·1	0
September ..	70	21·1	108	42·2	44	6·7	72	0·04	0·1	0
October ..	64	17·8	96	35·6	40	4·4	71	0·81	20·4	3
November ..	60	15·6	96	35·6	34	1·1	64	1·47	36·9	3
December ..	56	13·3	88	31·1	30	−1·1	65	3·28	82·7	6

difficult to understand why anyone should suffer illness in such a climate as that of Los Angeles, whose principal characteristics are epitomised in the above table. Let us hope, however, that "Ah Sin" has not driven the angels too far away for recall by the rapidly advancing sanitation of American civilisation.

With a total rainfall of only 15·43 ins. (392 mm.), and a remarkably high percentage of hours of sunshine, even during the rainy months, one begins to understand how it is that a Californian fellow-member of the Golf Club of Rome used to complain of the "gloom" of a Roman winter. The one drawback is the enormous daily range of over 50° F., which must be necessarily trying to delicate subjects who neglect obvious precautions; but avoidance of the fierce heat out of doors of the afternoon, and the chill that follows sunset, should suffice to neutralise this defect. Across the sierras, in Texas the rainfall remains very scanty, amounting to no more than 9·8 ins. (250 mm.) in the district of El Paso, but improves steadily as we approach the eastern frontier, where it reaches 52 ins. (1,320 mm.) at Galveston, on the coast of the Gulf of Mexico. This place is regarded as a health resort for the Southern States; Dr. Solly, the American authority on medical climatology, writes:—

"The climate of Galveston, in the Gulf of Mexico, is warm, mild and humid. Occasionally, there are winters when the temperature does not fall below 32°. During the past twenty years there have been thirteen years in which the temperature has not fallen below 24°, and but two years below 20°. The seasonal mean temperatures are: Winter, 55°; Spring, 69°; Summer, 83°; Autumn, 71°. The annual mean is 70°. Monthly mean for January, 53°; for July, 84°. The extreme temperature record is 98°, and the minimum 20°. The mean rainfall is 51 inches, distributed as follows: Winter, 11·5 inches; Spring, 10·2 inches; Summer, 13·3 inches; Autumn, 16·6 inches. The heaviest rain takes place in September, and the least in February and July. The mean annual relative humidity is 77 per cent.; for Winter, 81 per cent. Wind movement averages

11·1 miles, the prevailing winds being from S. and S.E. The highest winds occur in winter and blow from the N., but the average 'northers' of upper Texas are but little felt in the Gulf of Mexico."

Proceeding westward along the Mexican Gulf we find the climate grows steadily moister, New Orleans, which is placed very nearly in the middle of its northern coast, presenting the following climatic factors.

NEW ORLEANS. LAT. 29° 58′ N. LONG. 90° 11′ W.

Month	Monthly Mean Temperature.		Monthly Absolute Maxima		Monthly Absolute Minima		Relative Humidity	Mean Monthly Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January ..	58·8	**14·8**	82	**27·8**	15	**– 9·4**	79	5·17	**130·9**	11
February	58·1	**14·4**	82	**27·8**	25	**– 3·9**	81	4·56	**115·7**	10
March ..	62·0	**16·7**	84	**28·9**	30	**– 1·1**	76	5·35	**135·9**	9
April ..	69·0	**20·6**	88	**31·1**	38	**3·3**	76	5·28	**133·5**	8
May ..	74·6	**23·7**	92	**33·3**	53	**11·7**	74	4·76	**120·7**	9
June ..	80·3	**26·8**	97	**36·1**	58	**14·4**	78	6·49	**165·0**	14
July ..	82·2	**27·9**	99	**37·2**	67	**19·4**	78	6·50	**165·1**	16
August ..	81·5	**27·5**	96	**35·6**	63	**17·2**	79	6·02	**153·6**	14
September	78·3	**25·7**	95	**35·0**	56	**13·3**	77	4·70	**119·4**	11
October ..	69·8	**21·0**	90	**32·2**	40	**4·4**	74	3·25	**82·5**	7
November	60·7	**15·9**	85	**29·4**	30	**– 1·1**	79	4·30	**109·2**	9
December	55·5	**13·1**	81	**27·2**	20	**– 6·7**	80	4·38	**111·7**	4
Year ..	68·8	**20·4**	99	**37·2**	15	**– 9·4**	78	60·52	**153·7**	128

The amenity of the climate of Florida is proverbial, as the maxima rarely run so high, and the annual and daily range is much smaller than is the case further west, owing to the effect of the Gulf Stream, which sweeps out past its projecting shore. On this account there is an almost entire absence of frost, and the State has become celebrated for its cultivation of oranges, a fruit which is at once nipped by any approach to freezing point. Dr. Solly describes it as follows :—

"The climate is marine in character, and is very equable and temperate for its latitude. The mean annual temperature runs from 69° at Sanford to 79·8° at Jacksonville; for the winter, the variation is from 54·6° at Pensacola to 66·5°, at Jupiter. Frost, snow and ice are very rare. Annual rainfall varies from 53·19 inches at Pensacola to 57·16 at

Cedar Keys; of this, one half usually occurs in the summer. The mean relative humidity varies from 76 per cent. at Pensacola to 80 at Cedar Keys. In the winter months it is from 76 to 87 per cent. The total number of rainy days ranged from 103·8 at Cedar Keys to 124·1 at Pensacola, and the number of cloudy days in the same places was 66·8 and 84·5. Dr. Hall, while admitting the prevalence of malaria, states that there are many places quite free from it, and that it is generally diminishing."

Mexico.—Extending, as it does, completely across the southern portion of the North American Continent, the climate of Mexico presents the same sequence from the drought of the eastern to the moderately ample rainfall of the western coasts; and here too, there are places in the central highlands that are much drier than any to be found on either coast. These points are illustrated in the table on following page.

The corresponding data as to temperature are given below.

TABLE OF TEMPERATURES OF MEXICAN STATIONS.

Place	Mean Annual Temperature		Coldest Month			Warmest Month		
			Name	Mean Temperature		Name	Mean Temperature	
	F.	C.		F.	C.		F.	C.
Mazattan ..	74·5	**23·6**	January	66·1	**19**	July	81·6	**27·6**
Culiacan ..	76·5	**24·8**	January	65·0	**18·3**	July	84·5	**29·2**
Leon ..	65·5	**18·5**	December	56·4	**13·5**	May	73·6	**23·2**
Mexico ..	59·5	**15·4**	December	53·6	**12·0**	May	64·5	**18·1**
Puebla ..	60·0	**15·6**	January	53·1	**11·8**	May	64·6	**18·2**
Matamoros	73·5	**23·2**	January	62·6	**17·0**	July	84·2	**29·0**
Montery ..	70·4	**21·3**	January	54·6	**12·6**	June	82·0	**27·8**
Vera Cruz..	76·6	**24·8**	December	70·5	**21·4**	August	81·3	**27·4**
Cordoba ..	69·0	**20·6**	January	64·4	**18·0**	May	73·5	**23·1**

Central America and the Isthmus of Panama.—This portion of the American continent is notoriously unhealthy, especially along the only routes practicable for an inter-oceanic canal.

It is said that the construction of the railway across Panama cost a human life for every sleeper that was laid.

Much of this is due to malaria, but yellow fever also frequently attacked the workers, and it is to be hoped that as

Rainfall Table of Mexican Stations.

Place	Pacific Coast		Central Plateau								Atlantic Coast			
	Mazattan		Chihuahua		Leon		Mexico		Oxaca		Matumoras		Vera Cruz	
Latitude, N.	23° 11′		28° 38′		21° 7′		19° 26′		16° 57′		25° 49′		19° 12′	
Longitude, W.	106° 24′		106° 30′		101° 40′		99° 8′		94° 42′		97° 38′		96° 8′	
Elevation	30 ft.		4,650 ft.		5,850 ft.		7,400 ft.		5,150 ft.		63 ft.		48 ft.	
Scale	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.
January	1·34	34	1·49	38	0·36	9	0·16	4	0·13	3	1·58	40	0·39	10
February	0·24	6	0·28	7	0·34	8	0·24	6	0·55	14	2·34	59	0·55	14
March	0·24	6	0·0	0	0·36	9	0·59	15	0·59	15	2·44	62	0·60	15
April	0·04	1	0·24	6	0·28	7	0·59	15	1·77	45	2·24	57	0·13	3
May	0·28	7	1·38	35	1·14	29	2·02	51	3·94	100	2·22	56	4·26	108
June	1·85	47	**8·51**	216	4·88	124	4·09	104	8·64	219	3·63	92	12·48	317
July	6·54	166	6·04	153	5·68	144	4·09	104	4·09	104	2·37	60	**14·81**	376
August	**10·35**	257	5·24	133	**5·91**	150	**4·83**	123	4·26	108	1·66	42	8·74	222
September	8·63	219	1·08	27	5·07	129	3·97	101	**5·94**	151	**7·04**	179	11·62	295
October	3·15	80	1·14	29	1·69	43	1·68	43	2·92	74	4·45	113	9·03	229
November	0·48	12	0·0	0	0·39	10	0·43	11	0·39	10	4·47	114	3·24	82
December	0·91	23	0·08	2	0·36	9	0·16	4	0·03	1	2·24	57	2·03	51
Year	33·92	863	25·44	646	26·39	671	22·97	581	33·21	844	36·66	931	67·92	1,725

both these diseases are known to be capable of transmission only by the agency of mosquitoes, that a rational prophylaxis against the bites of these insects will form part of the sanitary programme of the huge work that is now being proceeded with. In any case, when the new canal comes to be finished it will behove passengers by the mail boats to provide themselves with mosquito nets for this portion of the voyage.

The north-east Trades dominate the Atlantic coast of these regions throughout the year, but on the Pacific side, during the summer months, a southerly breeze takes its place.

The rainfall is very heavy, but even here, in spite of the narrowness of the dividing belt of land, the comparative dryness of the Southern or Pacific coast is quite obvious, as may be seen from a glance at the table on the following page.

The rainfall, it will be noted, varies greatly owing to small local differences of environment, and includes at least one place far up on the world's list of the wettest spots.

The stifling heat and damp of Greytown used to be well known to naval officers of the last generation, and it is probably a fortunate circumstance for their successors that the harbour has now so silted up as to be useless, for at one time it was frequently visited by our men-of-war.

The corresponding temperature records, given below, do not run very high, but the places on the Atlantic shore are extremely enervating on account of the extreme dampness of the air.

Table of Temperatures in Localities in Central America.

Place	Absolute Mean Annual Maxima		Absolute Mean Annual Minima		Coldest Month			Warmest Month		
					Name	Mean Temperature		Name	Mean Temperature	
	F.	C.	F.	C.		F.	C.		F.	C.
San Salvador	93·4	**34·1**	56	**13·3**	December	70·2	**21·2**	April	75·2	**24**
Taboga Island	96·5	**35·8**	66·4	**19·1**	February	77·2	**25·1**	June	80·2	**26·8**
San José ..	88·5	**31·4**	50·2	**10·1**	December	65·6	**18·7**	May	68·7	**20·4**
Coban ..	88·3	**31·3**	40·2	**4·5**	December	62·3	**16·8**	May	68·8	**20·5**
Guatemala ..	87·5	**30·8**	45·6	**7·6**	January	62·0	**16·7**	May	68·5	**20·3**
Quezaltenango	76·4	**24·6**	26·7	**−3·0**	January	50·2	**10·1**	May	62·0	**16·7**
Belize ..	91·2	**32·9**	59·6	**15·4**	December	74·5	**23·6**	August	82·5	**28·1**
Colon ..	94·3	**34·5**	66·0	**18·9**	November	78·5	**25·8**	June	79·8	**26·6**
Gamboa ..	96·6	**35·9**	57·2	**14·0**	February	76·8	**24·9**	June	80·4	**26·8**

Rainfall Table for Central America.

Place	San Salvador		Taboga Island		Rivas		San José		Guatemala		Coban		Belize		Greytown		Colon	
Situation	Pacific Coast of Salvador		Pacific, off Panama		Costa Rica, near Pacific Coast		Costa Rica, near Pacific Coast		Guatemala, Inland		Guatemala, Inland		Atlantic Coast, British Honduras		Atlantic Coast, Costa Rica		Atlantic Coast, Panama	
Latitude, N. ..	13° 39′		8° 52′		11° 30′		90° 56′		14° 38′		15° 30′		17° 32′		10° 30′		9° 22′	
Longitude, W.	89° 13′		79° 31′		85° 47′		84° 8′		90° 31′		90° 25′		88° 10′		83° 22′		79° 55′	
Elevation (feet)	2,970		near sea-level		1,500		3,600		4,810		2,500		near sea-level		near sea-level		near sea-level	
Scale	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm
January ..	0·07	**2**	0·48	**12**	0·38	**10**	0·38	**10**	0·42	**11**	5·36	**136**	5·78	**147**	21·39	**543**	1·88	**48**
February ..	0·07	**2**	0·03	**1**	0·01	**2**	0·13	**3**	0·13	**3**	4·58	**116**	3·08	**78**	5·78	**147**	1·49	**38**
March	0·59	**15**	0·16	**4**	0·19	**5**	0·83	**22**	0·88	**20**	3·67	**93**	1·54	**39**	4·75	**120**	1·30	**33**
April	1·54	**39**	0·87	**22**	0·33	**8**	1·17	**30**	2·38	**60**	2·44	**62**	1·54	**39**	10·39	**264**	2·65	**68**
May	7·83	**199**	**5·27**	**134**	7·53	**191**	7·98	**203**	4·97	**126**	7·22	**183**	3·24	**83**	12·73	**323**	11·40	**290**
June	10·01	**255**	5·17	**131**	11·11	**282**	**10·16**	**258**	**10·36**	**263**	**12·47**	**317**	8·18	**208**	16·63	**422**	13·67	**347**
July	**13·22**	**336**	4·43	**112**	7·47	**190**	7·98	**203**	9·18	**232**	12·22	**310**	**9·09**	**231**	29·87	**760**	14·14	**359**
August	11·58	**293**	5·67	**144**	8·13	**206**	9·81	**249**	9·28	**236**	8·28	**210**	8·18	**208**	20·03	**509**	**14·64**	**372**
September ..	11·34	**288**	**7·22**	**183**	9·42	**239**	12·13	**308**	**9·73**	**247**	9·53	**242**	8·63	**219**	9·29	**236**	12·40	**315**
October.. ..	6·66	**169**	6·83	**173**	**16·88**	**429**	**12·68**	**322**	7·38	**187**	**9·82**	**249**	**12·68**	**322**	14·42	**366**	13·54	**345**
November ..	2·60	**66**	5·54	**140**	3·88	**99**	4·57	**116**	0·78	**20**	8·90	**226**	9·14	**232**	20·96	**530**	**23·18**	**589**
December ..	0·48	**12**	4·73	**120**	1·48	**38**	2·10	**53**	0·24	**6**	6·66	**169**	7·08	**180**	26·57	**675**	11·98	**304**
Year	65·97	**1,676**	46·37	**1,178**	66·88	**1,699**	70·97	**1,777**	55·55	**1,411**	98·94	**2,313**	78·18	**1,986**	192·67	**4,895**	122·37	**3,108**

The West Indies.—These islands are all under the influence of the north-east Trades, and enjoy a mild but rather moist climate, with comparatively little variation through the year. Nearly all of them are extremely healthy for places in the Tropics, although they are occasionally visited by devastating outbreaks of yellow fever.

The Americans have, however proved, in the case of Havana that it is quite possible to reduce the risk of this disease to a minimum by the adoption of appropriate measures against the mosquitoes that carry the disease, and it ought to be possible for any one, who takes the matter in earnest, to insure himself almost completely against this danger.

In the north, among the lesser Antilles, the Trade wind has an almost purely easterly direction. During the months from June to November terrific revolving storms, known as hurricanes, are of not uncommon occurrence and constitute one of the gravest drawbacks to cultivation, besides often causing much injury to life. So enormous is the force of the wind during these visitations that even objects of great weight and small surface are set in motion, it being an absolute fact that huge Admiralty anchors have been shifted from the position in which they lay in the dockyard at Port Royal in Jamaica.

HAVANA, CUBA. LAT. 23° 9′ N.; LONG. 82° 23′ W. NEAR SEA-LEVEL.

Month	Mean Temperature		Absolute Maxima		Absolute Minima		Relative Humidity	Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January ..	70·3	**21·3**	84·4	**29·1**	52·3	**11·3**	75	2·71	**68·7**	7·5
February .	72·0	**22·2**	87·6	**30·9**	51·4	**10·7**	73	2·27	**57·2**	5·7
March ..	73·2	**22·9**	91·4	**33·0**	55	**12·8**	70	1·83	**46·0**	5·5
April ..	76·1	**24·5**	93·6	**34·3**	52·9	**11·6**	69	2·83	**72·0**	4·6
May ..	78·8	**26·0**	99·0	**37·2**	64·4	**18·0**	71	4·47	**113·2**	9·3
June ..	81·5	**27·5**	97·7	**36·5**	69·1	**20·6**	76	7·16	**181·7**	12·8
July ..	82·4	**28·0**	100·6	**38·2**	71·2	**21·8**	74	5·06	**128·5**	12·7
August ..	82·2	**27·9**	98·6	**37·0**	69·8	**21·0**	75	6·02	**153·1**	12·6
September	80·7	**27·0**	96·1	**35·6**	70·9	**21·6**	79	6·71	**171·0**	15·4
October ..	78·1	**25·7**	91·9	**33·2**	61·9	**16·6**	78	7·42	**188·5**	15·1
November	75·3	**24·0**	88·7	**31·5**	56·5	**13·6**	77	3·08	**78·3**	10·2
December	71·4	**21·8**	86·0	**30·0**	51·8	**11·0**	74	2·15	**54·6**	8·5
Year ..	76·3	**24·8**	100·6	**38·2**	51·4	**10·8**	74	51·73	**1313·5**	119·9

It is unfortunately impossible, from considerations of space, to do more than give a few examples of the climatic conditions to be met with, but those selected may suffice to give a general idea of what may be expected, as no very great differences will be found, in spite of the large area over which these islands are scattered.

Jamaica, a table for which is given below, has a rather heavier rainfall of 70 ins. (1,778 mm.), but not so high as that of Martinique, 94·5 ins. (2,399 mm.), though even this cannot be considered high for a tropical climate. Of the other islands, Nassau in the Bahamas has 54·41 ins. (1,382 mm.); Port Au Prince, Haiti, 55 ins. (1,397 mm.); St. Croix, 46·56 ins. (1,183 mm.); St. Kitts, 51 ins. (1,295 mm.); Guadeloupe, 64·4 ins. (1,635 mm.); and Barbados, 57·74 ins. (1,467 mm.) —figures which serve well to indicate the general uniformity of climate throughout the group.

The table for Jamaica is as follows, but it must be remembered that most of the troops are now quartered at camps at a moderate elevation above the town, where it is considerably cooler than at the sea level.

KINGSTON, JAMAICA. LAT. 17° 50′ N.; LONG. 76° 42′ W.

Month	Mean Monthly Maxima		Mean Monthly Minima		Mean Relative Humidity %		Mean Monthly Rainfall	
	F.	C.	F.	C.	7 a.m.	4 p.m.	Ins.	Mm.
January	86·2	**30·1**	66·7	**19·3**	84	63	3·79	**96·4**
February	85·3	**29·5**	67·0	**19·4**	81	65	2·62	**66·5**
March	85·4	**29·6**	67·8	**19·9**	84	65	2·86	**73·0**
April	86·5	**30·3**	71·1	**21·8**	83	66	4·50	**114·3**
May	87·8	**31·0**	73·2	**22·9**	73	70	9·56	**243·0**
June	89·0	**31·7**	73·4	**23·0**	72	66	4·77	**121·1**
July	89·8	**32·0**	73·3	**22·9**	73	60	6·51	**165·6**
August	89·9	**32·1**	73·3	**22·9**	80	63	7·12	**181·0**
September ..	89·3	**31·8**	74·1	**23·4**	83	68	10·37	**263·0**
October	88·0	**31·1**	73·5	**23·1**	88	69	6·50	**165·1**
November.. ..	87·3	**30·7**	70·9	**22·2**	85	68	6·53	**176·0**
December.. ..	85·6	**29·8**	68·2	**20·2**	83	58	5·53	**140·0**

Even Trinidad, the most southerly of all the islands in no way rivals the East Indies either in temperature or rainfall, the total of the latter being 65·5 ins. (1,663 mm.). Its hottest months, March and September, have a mean temperature of 78·5° F. (25·8° C.), and its coldest, February, of 75·4° F. (24° C.); the absolute extreme temperature of the year being 89·5° F. (31·9° C.) and 64° F. (17·9° C.). The highest temperature for any island is 100° F. (37·8° C.) at Havana, but from its landlocked position this place appertains more to the climatic conditions of the mainland than to the islands in general.

South America.—The greater part of the tropical portion of the southern division of the western continent comes within the influence of the north-east Trades, which sweep up from the sea an enormous volume of watery vapour, which is precipitated gradually as the air current passes across the land. The second great factor in the determination of its climate is the position of the enormous mountain range of the Andes, quite close to the western coast, and of such a height as to cut off practically the last drops of moisture brought by the Trades, so as to leave the narrow belt of country between the Andes and the Pacific with a rainfall so scanty as to be in some instances almost negligible, as is the case with Lima, amounting to little more than an inch and a half in the year. So vast, however, is the amount of moisture imported by the Trades that the supply lasts out well, quite to the foot of the Andes, the rainfall of Manaos, half-way across, being rather greater than that of the east coast; but once the mountains are passed the change is abrupt and enormous. Unfortunately, however, when one sets one's self to plot out the change as represented by a line of observations carried across the continent, one finds one's self at once met by the difficulty that there is very little exact information to be obtained, as the all-absorbing interests of the ever-changing political barometer leaves the population little time to study the mercurial instrument, and they appear to be much fonder of playing with repeating rifles than with aneroids. Practically speaking, there is little exact information to be obtained for places at any distance from the coast, and on this account the tables given below refer almost exclusively to the littoral regions, and any attempt at anything beyond remarks of the most general character is out of the question.

Quite at the southern boundary of our limits we have the first-class observatory of San Paolo, which although but little outside the geographical, tropical zone, enjoys a temperature which shows that we are rapidly leaving warm climates behind, for the climate is already milder than most localities in the subtropical zone of the old world.

SAN PAOLO. 23° 33′ S.; 46° 38′ W. E.F., 2,400.

Month	Mean Monthly Temperature		Mean Monthly Maxima		Mean Monthly Minima		Relative Humidity	Mean Monthly Rainfall		Number of Rainy Days
	F.	C.	F.	C.	F.	C.		Ins.	Mm.	
January ..	68·2	**20·1**	77·2	**25·1**	61·7	**16·5**	86	7·08	**180**	18
February..	68·9	**20·5**	78·8	**26·0**	62·7	**17·0**	86	8·23	**208**	12
March ..	67·4	**19·6**	77·2	**25·1**	61·8	**16·6**	87	5·96	**152**	19
April ..	63·5	**17·5**	73·4	**23·0**	57·5	**14·2**	87	2·84	**72**	14
May ..	61·0	**16·1**	72·0	**22·2**	52·3	**11·2**	80	1·90	**48·3**	6
June ..	56·8	**13·8**	69·7	**20·9**	47·5	**8·6**	80	0·48	**12·3**	4
July ..	61·0	**16·1**	71·0	**21·7**	52·8	**11·6**	78	1·93	**48·9**	10
August ..	61·0	**16·1**	69·7	**20·9**	55·2	**12·9**	83	2·30	**58·4**	17
September	62·0	**16·7**	72·8	**22·7**	55·0	**12·8**	81	1·02	**26·2**	7
October ..	65·8	**18·8**	78·0	**25·6**	58·5	**14·7**	79	0·77	**20·0**	5
November .	64·4	**18·0**	76·0	**24·4**	57·2	**14·0**	79	3·57	**89·5**	14
December .	80·5	**26·9**	79·0	**26·1**	63·5	**17·5**	84	8·74	**222**	23

With a total rainfall of 44·77 ins. (1,137 mm.) and absolute extremes of temperature of 98° F. (36·5° C.) and 55° F. (12·9° C.), the climate, though perhaps not bracing, can never be unpleasant. The shore is here washed by a warm southerly current from the equatorial regions, whereas on the west coast the inshore current is a northerly one from the antarctic regions. On this account it is necessary to go a good deal to the geographical north to select a place on the west coast for comparison of the rainfall in the same isotherm.

MOLENDO. LAT. 17° 5′ S.; LONG. 72° 0′ W. (THE PORT OF AREQUIPA IN SOUTH OF PERU.)

Month	Mean Monthly Temperature		Mean Monthly Maxima		Mean Monthly Minima		Monthly Rainfall	
	F.	C.	F.	C.	F.	C.	Ins.	Mm.
January	72·3	**22·4**	79·4	**26·3**	66·7	**19·3**	0	**0**
February	72·8	**22·7**	79·5	**26·4**	67·5	**19·7**	0·08	**2**
March	71·5	**21·9**	78·0	**25·6**	66·0	**18·9**	0	**0**
April	68·2	**20·1**	74·8	**23·8**	63·4	**17·4**	0·08	**2**
May	65·8	**18·8**	72·7	**22·7**	62·8	**17·1**	0·17	**4**
June	63·0	**17·2**	68·5	**20·3**	57·8	**14·3**	0·6	**1**
July	60·9	**16·0**	66·0	**18·9**	55·7	**13·2**	0	**0**
August	59·5	**15·3**	65·0	**18·3**	54·7	**12·6**	0·23	**6**
September	61·2	**16·2**	67·0	**19·4**	56·0	**13·3**	0·06	**1**
October	63·3	**17·4**	70·0	**21·1**	57·3	**14·1**	0·08	**2**
November	66·3	**19·1**	73·0	**22·8**	60·2	**15·7**	0·08	**2**
December	70·8	**21·6**	78·2	**25·7**	64·7	**18·2**	0·06	**1**
Year	60·4	**19·1**	72·7	**22·6**	61·0	**16·1**	0·83	**21**

Table of Temperature Data of Places in South America.

Place	Latitude	Longitude	Elevation in Feet	Mean Temperature of Year		Maximum Temperature of Year		Minimum Temperature of Year		Hottest Month			Coldest Month		
										Name	Mean Temperature		Name	Mean Temperature	
				F.	C.	F.	C.	F.	C.		F.	C.		F.	C.
Northern Coast, on Atlantic Seaboard.															
Caracas, Venezuela	10° 30′ N.	66° 55′ W.	3,000	71·2	**21·8**	79·7	**26·5**	57·8	**14·3**	May	74·0	**23·3**	January	68·5	**20·3**
La Guayra, port ..	10° 37′ N.	67° 0′ W.	—	78·2	**25·7**	—	—	—	—	September	80·7	**27·0**	Feb.—Mar.	75·7	**24·3**
Tovar	10° 26′ N.	67° 20′ W.	6,000	58·0	**14·4**	—	—	—	—	April	59·5	**15·3**	January	54·5	**12·5**
Western Littoral—Columbia, Ecuador, and Peru.															
Medellin	6° 10′ N.	75° 45′ W.	4,676	70·0	**21·1**	85·0	**29·4**	56·5	**13·6**	February	71·0	**21·7**	November	68·5	**20·3**
Bogota..	4° 35′ N.	74° 14′ W.	8,650	58·0	**14·4**	72·0	**22·2**	45·8	**7·7**	Mar.—April	58·7	**14·8**	July	56·8	**13·8**
Quito	0° 14′ S.	78° 32′ W.	9,300	56·3	**13·5**	73·5	**23·1**	38·2	**3·4**	Dec.—Jan.	56·7	**13·7**	Sept.—Oct.	56·2	**13·4**
Antisana	0° 21′ S.	78° 6′ W.	13,200	40·8	**4·9**	52·0	**11·0**	21·0	**- 6·2**	January	43·2	**6·2**	July—Aug.	37·3	**3·0**
Guayaquil	2° 10′ S.	79° 56′ W.	—	80·7	**27·0**	95·0	**35·0**	66·2	**19·0**	January	83·4	**28·5**	July	77·8	**25·5**
Lima	12° 4′ S.	79° 21′ W.	530	66·2	**19·0**	88·2	**31·2**	48·5	**9·2**	February	73·7	**23·2**	July	59·0	**15·0**
Anca	18° 25′ S.	70° 22′ W.	—	67·5	**19·7**	82·4	**28·0**	56·0	**13·3**	Dec.—Jan.	71·7	**22·0**	August	63·2	**17·3**
Salta	24° 46′ S.	65° 24′ W.	4,000	63·2	**17·3**	109·4	**43·0**	23 0	**- 5·0**	December	72·2	**22·3**	June	50·8	**10·5**
Copiapo	27° 22′ S.	70° 23′ W.	1,200	61·5	**16·4**	87·3	**30·7**	37·4	**3·0**	January	69·8	**21·0**	July	53·2	**11·8**
North-East Coast—British Guiana.															
Georgetown	6° 50′ N.	58° 8′ W.	—	79·0	**26·1**	90·0	**32·2**	70·0	**21·1**	Sept.—Oct.	80·7	**27·0**	Jan.—Feb.	77·5	**25·3**
Dutch Guiana.															
Burnside	5° 53′ N.	50° 23′ W.	—	78·7	**25·9**	92·8	**33·8**	68·7	**20·4**	October	80·0	**26·7**	February	77·3	**25·2**
Paramaribo	5° 44′ N.	50° 13′ W.	—	78·7	**25·9**	94·4	**34·6**	67·8	**19·9**	September	80·8	**27·1**	January	77·2	**25·1**

TABLE OF TEMPERATURE DATA OF PLACES IN SOUTH AMERICA.—*Continued.*

Place	Latitude	Longitude	Elevation in Feet	Mean Temperature of Year		Maximum Temperature of Year		Minimum Temperature of Year		Hottest Month			Coldest Month		
										Name	Mean Temperature		Name	Mean Tempera ture	
				F.	C.	F.	C.	F.	C.		F.	C.		F.	C.
French Guiana.															
Cayenne	4° 56′ N.	52° 18′ W.	—	79·5	**26·4**	94·4	**34·6**	68·0	**20·0**	Sept.—Oct.	81·4	**27·4**	January	77·5	**25·3**
Brazil, Amazon Coast.															
Para	1° 30′ S.	48° 24′ W.	—	78·5	**25·8**	—	—	—	—	June	79·5	**26·4**	January	77·7	**25·4**
Interior of Brazil.															
Manaos	3° 8′ S.	60° 0′ W.	150	79·0	**26·0**	—	—	—	—	November	79·8	**26·6**	April	77·0	**25·0**
San Antonio.. ..	9° 5′ S.	64° 0′ W.	—	78·0	**25·6**	—	—	—	—	October	79·4	**26·3**	June	76·8	**24·9**
Peruvian frontier ..	11° 30′ S.	68° 30′ W.	650	77·4	**25·2**	—	—	—	—	December	80·0	**26·7**	June	72·2	**22·3**
Cuyaba	15° 36′ S.	56° 7′ W.	700	77·5	**25·3**	105·8	**41·0**	48·2	**9·0**	Sept.—Oct.	80·7	**27·0**	June	69·5	**20·8**
Uberaba	19° 44′ S.	47° 45′ W.	2,600	70·3	**21·3**	96·8	**36·0**	36·5	**2·5**	February	74·2	**23·4**	July	64·0	**17·8**
Western Central Brazil.															
Pernambuco.. ..	8° 4′ S.	34° 51′ W.	—	78·5	**25·8**	97·5	**36·4**	64·5	**18·1**	February	81·7	**27·6**	July	73·7	**23·2**
Victoria	8° 9′ S.	35° 27′ W.	550	76·7	**24·8**	99·4	**37·4**	57·3	**14·1**	February	79·5	**26·4**	July	72·8	**22·7**
Colony of Isabella..	8° 45′ S.	35° 42′ W.	750	74·2	**23·4**	91·2	**32·9**	56·2	**13·4**	February	76·5	**24·7**	July	70·0	**21·1**
Bahia	12° 59′ S.	38° 36′ W.	200	77·8	**25·5**	89·0	**31·7**	70·7	**21·5**	February	80·8	**27·1**	July	73·7	**23·2**
Rio Janeiro	22° 54′ S.	43° 10′ W.	200	72·5	**22·3**	97·7	**36·5**	55·2	**12·9**	February	77·2	**25·1**	July	67·5	**19·7**
Joinville	26° 19′ S.	49° 43′ W.	—	68·0	**20·0**	—	—	—	—	February	75·5	**24·2**	July	61·5	**16·4**
Villa Formosa ..	26° 13′ S.	58° 5′ W.	250	70·2	**21·2**	100·3	**38·0**	37·7	**3·2**	January	79·2	**26·2**	July	61·3	**16·3**

In contrast with the fairly liberal rainfall of the east coast we find places almost as rainless as Waddy Halfa in the Soudan.

Arequipa, *e.g.*, though situated high up on the Andes, is nearly as dry as Lima, but receives a few trifling showers during the height of summer and autumn (January to March).

AREQUIPA. LAT. 16° 24′ S.; LONG. 71° 30′ W. E.F., 7,680.

Month	Mean Monthly Temperature		Relative Humidity	Monthly Rainfall	
	F.	C.		Ins.	Mm.
January	56·5	**13·6**	65	1·08	**27**
February	55·4	**13·0**	69	5·28	**134**
March	56·0	**13·3**	—	0·84	**21**
April	53·2	**11·8**	71	0	**0**
May	49·0	**9·4**	—	0	**0**
June	47·5	**8·6**	44	0	**0**
July	51·0	**10·6**	45	0	**0**
August	53·0	**11·7**	52	0	**0**
September	56·0	**13·3**	55	0·03	**1**
October	56·7	**13·7**	59	0	**0**
November	57·2	**14·0**	—	0	**0**
December	56·8	**13·8**	65	0·03	**1**
Year	54·2	**12·3**	59	7·28	**185**

These Western figures must serve as a specimen, though only for a single year; for as already remarked, meteorology is but fitfully studied in South America.

Many towns and districts, especially on the northern and eastern coasts, are at a considerable elevation above the sea, and in estimating the probable climate of such localities the following scale of diminution of mean temperature for height in the equatorial Andes may be of service:—

Elevation in Feet	Sea-level	1,500	4,500	7,000	10,000	13,000	17,000	20,000
Temperature F.	80°	77°	68°	59°	50°	40°	32°	20°

Or expressed in the metric system:—

Elevation in Metres	Sea-level	490	1,420	2,340	3,270	4,190	5,120	6,040
Temperature C.	27°	25°	20°	15°	10°	5°	0°	—5°

The tables given on pages 92,93, compiled from Hann's "Klimatologie" include some of the better-known sites in South America, but it will be observed that we are wofully wanting in detailed information as to places in the interior, by far the majority being places on the coast.

The small variation and remarkable uniformity of temperature in places spread over so large an area, when situated at all near the same level above the sea, is very remarkable, as also is the fact that nothing approaching the excessive temperature of Africa, the other great Southern Peninsula, is to be met with here.

Guiana, Venezuela, and the other countries of the north and north-eastern coasts, are no doubt steamy and unhealthy, but the greater part of Brazil seems to possess a climate by no means prohibitive of European energy, though doubtless the deltas of the great rivers, like similar situations elsewhere, are best avoided from the point of view of health.

Tables of the rainfall of a few places in each of the regions included in the preceding table will be found below:—

RAINFALL IN PLACES ON N. AND N.E. COAST, SOUTH AMERICA.

Place ..	Cartagena, Colombia		Caracas, Venezuela (3,000 ft.)		George Town, Brit. Guiana		Paramaribo, Dutch Guiana		Cayenne, French Guiana		Para, Brazil	
Month ..	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.
January ..	0	0	0·37	9	6·92	176	9·93	252	14·23	361	11·97	303
February .	0	0	0·33	8	4·88	124	6·12	155	12·43	316	11·02	280
March ..	0·19	5	0·28	7	5·42	138	7·48	190	15·53	394	12·98	329
April ..	0·13	3	1·03	26	6·43	163	9·82	249	15·16	385	13·37	340
May ..	5·18	132	2·17	55	10·95	279	11·97	304	19·25	489	7·64	194
June ..	4·83	124	4·57	116	11·96	303	11·88	300	14·84	377	4·18	106
July ..	3·12	79	4·82	122	9·07	230	9·27	235	6·64	169	2·78	71
August ..	5·0	127	3·63	92	7·02	178	7·08	180	2·68	68	2·04	52
September	7·23	184	5·37	136	2·60	66	2·68	68	1·12	28	2·63	67
October ..	10·95	279	5·02	128	2·38	60	2·83	72	1·33	34	2·44	62
November	5·37	136	2·60	66	5·68	144	4·03	102	4·72	120	3·52	90
December	0·98	25	1·03	26	10·92	277	9·48	241	10·64	270	5·08	129
Year ..	43·67	1,094	31·14	791	84·23	2,138	92·43	2,348	118·53	3,011	79·64	2,023

Rainfall, Western Littoral—Colombia, Ecuador and Peru.

Place ..	Medelin, Colombia		Quito, Ecuador		Lima, Peru		Iquitos, East Slope of Andes		Salta, Peru		Tucuman, Peru	
Month	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.
January ..	2·18	55	3·24	82	0·07	1	10·24	260	5·68	144	7·38	187
February .	2·52	64	3·88	99	0	0	9·83	250	5·44	138	6·63	168
March ..	5·28	134	4·84	123	0	0	12·24	311	4·64	118	6·27	159
April ..	6·93	176	6·95	177	0	0	6·48	165	0·92	23	1·78	45
May ..	7·77	197	4·62	117	0·13	3	10·00	254	0·37	9	1·14	29
June ..	6·62	168	1·33	34	0·37	9	7·43	189	0·03	1	0·52	13
July ..	4·13	105	1·08	27	0·39	10	6·53	167	0	0	0·52	13
August ..	5·13	130	2·22	56	0·33	8	4·62	117	0·07	2	0·23	6
September	6·42	163	2·57	65	0·27	7	8·70	221	0·27	7	0·63	16
October ..	7·37	187	3·87	98	0·13	3	7·24	184	0·48	12	3·14	79
November	5·87	149	3·97	101	0	0	8·52	216	1·88	48	4·33	110
December	2·67	68	3·57	91	0	0	11·47	291	2·93	74	5·75	146
Year ..	62·88	1,596	42·13	1,070	1·64	41	103·33	2,625	22·64	575	38·23	971

Rainfall, Interior and East Coast.

Place ..	Merida, Yucatan—Interior		Manaos, Brazil—Interior		Cuyaba, Brazil—Interior		Pernambuco, Coast, Brazil		Bahia, Coast, Brazil		Rio Janeiro, Coast, Brazil	
Month	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.	Ins.	Mm.
January ..	1·02	26	9·37	238	10·03	255	4·34	110	3·58	91	4·68	119
February .	0·53	13	9·84	250	8·58	218	5·98	152	3·43	87	4·34	110
March ..	0·70	1	11·88	301	8·70	221	5·92	150	7·87	200	5·38	137
April ..	0·17	4	13·08	332	3·52	90	10·96	277	14·34	364	4·57	116
May ..	0·96	24	7·33	186	2·14	54	14·81	378	12·28	312	3·63	92
June ..	5·88	149	6·02	153	0·72	18	15·18	386	11·54	293	1·85	47
July ..	3·86	98	2·88	72	0·34	8	28·27	718	8·98	228	1·64	41
August ..	7·76	197	2·40	61	0·37	9	12·60	320	4·93	125	1·85	47
September	4·50	114	1·74	44	3·63	92	6·83	173	3·15	80	2·28	58
October ..	2·95	75	4·13	105	4·27	108	1·03	26	4·88	124	3·08	78
November	4·12	104	7·65	194	7·68	195	1·14	29	6·83	173	4·28	109
December	1·24	31	10·48	266	8·67	220	2·04	52	3·63	92	5·43	138
Year ..	33·86	860	85·12	2,202	59·00	1,498	117·00	2,971	85·39	2,169	43·00	1,091

Bermuda (St. George), lat. 32° 22′ N., long. 64° 30′ W.—This group of Islands is becoming a favourite health resort with Americans, who are able in a couple of days (600 sea miles) to exchange the turmoil of Wall Street for the holy calm of the Atlantic. The climate is extremely pleasant, without being too relaxing, the mean temperature of the year being 69·4° F. (20·7° C.).

Jan.	April	August	October
62° F. (16·6° C.)	64° F. (17·8° C.)	79° F. (26·2° C.)	69·5° F. (20·7° C.

The month of March, with a mean of 61° F. (16° C.), is cooler than February, and the absolute annual extremes of temperature are 91·5° F. (33° C.), and 43° F. (6° C.). The relative humidity stands very constantly about 70 per cent., and the cloudiness of the sky rather higher. The general direction of the wind is S.W., bearing more to the north in winter, and southerly in summer and autumn. There are on the average 159 days on which rain falls during the year, producing a total of 45·28 ins. (1,150 mm.) of rain; the most rainy month being October, and the least so April and June. There is very little variation during the twenty-four hours, so that the climate is well suited for delicate chests.

These islands depend for water almost entirely on rain caught and stored in tanks, so that the amount obtained during the last shower is said to be one of the main subjects of conversation and interest among the islanders.

Madeira (Funchal). Lat. 32° 37′, Long. 16° 55′ W.—Situated off the coast of Africa, in nearly the same latitude as the preceding, this well-known health resort has a slightly lower mean annual temperature of 65·5° F. (18·6° C.); the mean of the coldest month, February, being 59·6° F. (15·4° C.), and of the hottest, August, 72·7° F. (22·6° C.)

During twenty-five years the absolute extremes of temperature were 90·7° F. (32·7° C.) and 43·6° F. (6·5° C.). The air is drier than that of Bermuda, the relative humidity averaging 68 per cent.; March, with 65 per cent., being the driest, and July, with 70 per cent., the moistest month.

The amount and distribution of the rainfall is as below:—

	Jan.	Feb.	Mar.	Apl.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Rainfall Ins. ..	4·18	3·18	2·87	2·13	0·92	0·53	0·03	0·08	0·67	2·38	5·28	4·67
Rainfall Mm. ..	106	81	73	54	23	13	1	2	17	60	134	119
No. of rainy days..	10·7	8·6	9·4	7·3	5·3	2·3	0·8	1·0	3·3	7·9	10·5	11·6

The total rainfall is thus under 27 inches, and owing to the occurrence of east winds coming from the African desert, the air often becomes very dry during its continuance. Madeira has earned a high reputation for the treatment of cases of consumption, but has been less recommended for such cases since the introduction of the open-air treatment; and it should be recognised that neither this nor any other climate can do more than retard the progress of advanced cases. It is an excellent country, however, in which to live in the open air, and cases that find Funchal too relaxing can obtain a somewhat more bracing climate on the higher ground of the interior of the island.

In any case Madeira forms an excellent resort for those who, without being actually ailing, find themselves unable to withstand the damp and cold of our English winters.

Notes on the Observation of Meteorological Data.

Few houses will now be found without a thermometer and barometer, and many people are fond of keeping a register of their observations. Moreover, where the observer chances to be stationed in an out-of-the-way place, even a casual domestic register of this sort may be of considerable value. . . . The instruments required are the wet and dry bulb thermometers, a rain gauge, and a barometer.

Those who have to move about in the backwaters of civilisation, will probably find the mercurial barometer rather a "white elephant," as it requires great care and attention whenever it is necessary to move it; and for such, a good aneroid is a more desirable possession. It is, of course, important that the instrument should be compared, whenever opportunity occurs, with a standard mercurial instrument; but for merely observing extent of fluctuation an aneroid is quite accurate enough for all practical purposes. The rain gauge must of course be set up in some open and unsheltered position near the ground level, and the thermometers should be hung in a north verandah (for the northern hemisphere) against a piece of felt which will help to protect them from the heat radiated from the wall. The aneroid, on the other hand, may be hung in any position where it is well protected from the weather—on the ground-floor. The direction of the wind can easily be observed by means of a small triangular flag or burgee hoisted to a pole, which, unless the neighbourhood be a very open one, is best lashed up in a tree so as to project above its branches.

Those, however, who desire to take up the study of their local meteorology seriously, will do well to obtain a little pamphlet, entitled "Hints to Meteorological Observers," by W. Marriott, published at 1s. 6d., under the auspices of the Royal Meteorological Society, by E. Stanford, 12, Long Acre, W.C., which contains complete instructions on the subject.

From the point of view of the tropical resident, it is unfortunate that some of the tables in this publication are hardly carried high enough, but the instructions will enable anyone to amplify them. On this account, I append a table for calculating relative humidity of a less elaborate sort, but more extended than that furnished in the pamphlet, as this is one of the most important of all climatic factors from a sanitary point of view.

The table is only worked out to half degrees of difference between the wet and dry bulb instruments, and for the most part to 4° intervals of the dry thermometer, but it is easy, by reading between the lines, to fill up the gaps, where any marked interval exists; and it will be observed that at the lower right-hand corner of the second table, the numbers progress in regular arithmetical progression, so that it is not difficult to infer the percentages in cases of somewhat higher degrees of temperature and dryness.

Table for Calculating the Relative Humidity of the Atmosphere % by the Dry and Wet Bulb Thermometer.

Difference of Wet and Dry Bulbs	Reading of the Dry-Bulb Thermometer.										Difference of Wet and Dry Bulbs
	32°	34°	36°	38°	40°	44°	48°	52°	56°	60°	
0·5	92	94	95	95	96	96	96	96	97	97	0·5
1	87	89	91	91	92	92	92	93	93	93	1
1·5	81	84	86	87	88	88	88	89	89	90	1·5
2	76	80	82	83	84	84	85	86	87	88	2
2·5	70	75	78	79	80	81	82	83	83	84	2·5
3	65	71	74	76	76	78	79	80	81	82	3
3·5	60	66	70	72	73	75	76	77	78	79	3·5
4	56	62	66	69	70	72	73	74	75	76	4
4·5	52	58	62	65	66	69	70	71	72	74	4·5
5	48	55	59	62	63	65	67	69	70	71	5
5·5	45	52	56	59	61	62	64	65	67	69	5·5
6	41	49	53	56	58	60	62	63	65	66	6
6·5	38	46	50	53	55	57	59	61	62	64	6·5
7	35	43	47	50	52	55	57	59	60	62	7
7·5	32	40	44	48	49	52	54	56	58	60	7·5
8	30	37	42	45	47	50	52	54	56	58	8
8·5	29	35	40	42	44	48	50	52	54	56	8·5
9	27	33	38	41	42	46	48	50	52	54	9
9·5	25	31	36	38	40	43	46	48	50	52	9·5
10	23	30	34	36	38	41	44	46	48	50	10
10·5	21	28	32	34	36	40	42	44	46	48	10·5
11	19	26	30	32	34	38	40	43	45	46	11
11·5	17	24	28	30	32	36	38	41	43	45	11·5
12	16	23	27	29	31	34	36	39	41	43	12
12·5	15	21	28	27	29	32	34	37	39	42	12·5
13	14	20	24	26	28	31	33	36	38	40	13
13·5	13	18	23	25	27	30	32	35	36	38	13·5
14	12	17	22	24	25	28	30	33	35	37	14
14·5	11	16	21	22	24	26	29	31	34	36	14·5
15	10	15	20	21	23	25	28	30	33	35	15
15·5	10	14	18	20	22	24	26	28	31	33	15·5
16	9	13	17	19	21	23	25	27	30	32	16
16·5	8	12	16	18	20	22	23	26	29	31	16·5
17	7	12	15	17	19	21	22	25	27	30	17
17·5	7	11	14	16	18	20	21	24	26	28	17 5
18	6	10	13	15	17	19	20	23	25	27	18
18·5	—	—	—	—	—	—	19	22	24	26	18·5
19	—	—	—	—	—	—	18	20	23	25	19
19·5	—	—	—	—	—	—	17	19	21	24	19·5
20	—	—	—	—	—	—	17	18	20	23	20

TABLE FOR CALCULATING THE RELATIVE HUMIDITY OF THE ATMOSPHERE %
BY THE DRY AND WET BULB THERMOMETERS.

Difference between the Wet and Dry Bulbs	Reading of the Dry Bulb Thermometer.										Difference between the Wet and Dry Bulbs
	64°	68°	72°	76°	80°	84°	88°	92°	96°	100°	
0·5	97	97	97	97	98	98	98	98	98	98	0·5
1	94	94	94	95	95	95	95	95	95	95	1
1·5	91	91	92	93	93	93	93	93	93	93	1·5
2	88	89	89	89	90	90	91	91	91	91	2
2·5	85	85	86	87	87	87	88	88	88	89	2·5
3	82	83	83	84	85	85	85	85	86	87	3
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