Some Observations concerning Malaria (especially as met with in Indian Practice)

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Some Observations Concerning Malaria

Utterly unknown in the Arctic and but feeble in the temperate zones, malaria acquires its greatest intensity and works the most deadly havoc in the torrid zone and in lands adjacent to the tropics. As regards geographical distribution it girdles the globe. It is ripe in portions of Southern Europe, and sometimes manifests itself in the Central and Northern parts of the Continent. It still lingers in certain places in our own islands, notably in the Hinxloshire Fens and in the Kentish Marshes, but it is greatly circumscribed in its area and has lost so much of its virulence that these parts of the country too will, doubtless, be free from Malaria as other districts now are, in which it was once a deadly scourge. In this connection it is curious to note that though malaria is decreasing an
unfortunate habit to which it gave rise in the past still obtains in Lincolnshire. Opium seems to have been largely used as a prophylactice, and I am assured by a friend who has knowledge of the facts that to this day on any market day in Lincolnshire a number of people purchase the Opium; so numerous are the customers that the local druggist keep the medicine ready made up in penny packets.

In Europe as in our own country, malaria is found chiefly in marshy districts, along the course of rivers, especially those as are apt to inundate their banks, while in northern regions it limits itself to moist situations, in the South of Europe it does not so confine itself, but is to be found in situations not ordinarily marshy,

In North America we find it prevalent— in northern latitude,
as in the northern part of Europe, in swamps and marshes, places and lands subject to inundations, but as we go from north to south we find that malaria is no longer confined by such conditions, it becomes alike more general in its habitat and more virulent in its effects, until we find it is focussed in its fullest intensity in the tropical and sub-tropical regions of America North, Central, and South. As we go to the south through South America it gradually shades away as regards its prevalence and intensity, and we find the conditions of its existence far south to be identical with those in the northern portion of the New World. Asia and Africa show us the same poison existing under the same conditions as those detailed above. It is the source of India and of China, of Burmah and the Malay Archipelago. We meet with it in Australia, in short it prevails in every land from the equator to within five or six degrees of the Arctic and Antarctic circles.
According to M. Brandul the northern limit of malaria is the isotherm line of 5° C. (41. Fann). He states that malarial fevers have been rife at Septe in Sweden, 60° 40' N. latitude, and he has heard of them even farther north than that. The southern limit is still uncertain, and has been variously given at from 25° to 30° S. latitude.

Not one, is malaria world wide in its distribution it is the most deadly scourge of mankind. It slays directly or indirectly fully two thirds of those who go abroad from our own home land; it is "the chief cause of sickness and mortality over a large portion of the earth." Official records show Sir J. Fayrer "afford proof that it causes an amount of sickness and mortality which is hardly credible, and in some years almost challenges comparison with the Black Death which ravaged Europe in the 14th Century and destroyed a fourth part of the whole population." While Sir Cornish Sanitary Commissioner of Madras Presidency observes concerning malaria that "fevers are
The more philanthropists colonised, the less we heard of them. The primary ones in the interior, dispersed, represented but a small portion of the whole. The constitution of the South, the Great Enemy, has been appeasing, even to within a few years. Fewer, but those annuals, yearly, now destroy the health of the earth, though not as small a part as before. Dr. MacFaul was the great enemy; well may the earth follow it in another's path. Many people in India, China, Burma, etc., together. To put it in another way, the whole world has followed no less than 100 years.
because it complicates almost every disease he has to treat. My own experience has extended to nine years of Indian practice. During this time Alfred have been in charge of the American Medical Mission. Amritsar in the Punjab is one of the most malaria-stricken places in North India. By far the larger proportion of cases that Alfred had to treat have been malarial. In the year 1890 (the last of my charge) a healthy year, about 52,000 visits were paid to the hospital (new patients about 30,000) and out of the 52,000 visits at least 35,000 must have been by patients suffering from primary malarial fevers, or diseases resulting ascendantly from malaria.

What is malaria is therefore a most important question, and as MacCulloch tersely observes, perhaps the best as the most account of the nature of malaria would be an acknowledgment of utter ignorance. Despite the many researches made our knowledge cannot yet be considered adequate, nor can we be said yet definitely to
have found the poison of malaria. We have advanced from the theory of an earlier day which sought the explanation of the phenomenon of "marsh measm" either directly in marshes and the vegetation, or in excess production of March lows, or phosphinated hydrogen, or other gases, in deficiency of hydrogen or excess of ammonia. To these theories it is a sufficient reply that excess or diminution of the gases mentioned cannot be shown to give rise to the peculiar conditions observed in malaria.

As regards marshes themselves and the vegetation connected therewith Boudel showed by experiments made first on a sheep and then on himself and then on others, with chlorella obtained from marshy pools, water from marshes containing microzoa, microspores, filamentous bacteria obtained from our over marshy places, that these substances did not cause intermittent fevers. The microorganisms varied in genera and species with place time day and season. None of these things are malaria
Then there is the theory of Dr. Munro according to which malaria is in some vague way the product of "certain electrical conditions" and general telluric influences, but no one as much as these conditions and influences have never been as yet precisely indicated. This theory cannot well be discussed.

Another theory, that of Oldham, is, that there is no such specific poison as malaria, but that the fever termed "malarial" are, to epitomise this theory, due to cold or chill after exposure to great heat, especially, after exhausting labour. Fraser, among others, is arrayed against this theory, there masses of people in many countries are subject to chills, who nevertheless are not subject to malaria, in some lands, e.g. Britain, malaria has almost disappeared, though at one time very, very, but chills are as frequent as ever they were; and the fact that the specific train of symptoms which evidence an attack of malarial poisoning, the
peculiar fever, anaemia, tinged skin, disorganised blood, and the organic changes in the spleen and liver, do not follow a mere chill, but they do malaria; may serve as example, of the meeting to Oldham's hypotheses, as also may the fact that in malarial lands not only those who labour hard and are exposed to the sun and get chilled while exhausted yet fever, but those also who are in no way under the conditions mentioned above, such for example as little children.

In 1866 Dr. Salisbury of Ohio, gave a new direction to the theories concerning the cause of malaria by announcing the discovery in the valleys of the Ohio and Mississippi, of a special palmetta associated with cells and sporules of Mervenzi, which he thought was the cause of malarial disease and by experiments made he stated he had succeeded in communicating malarial fever to individuals with these algae.
It thus came to be thought though these results were not accepted, that some form of micro-organism might be the efficient cause of Malaria.

In 1879, Klebs, Tommasi-Crudeli, Celli and others as the result of their observations in the Roman Campaign announced the discovery of a microbe (spores) consisting of numerous moveable shining spores, with length and width about nine micro-millimetres in diameter. They named the Bacillus Malariae.

It exists in the soil, water, air of malarias localities in great quantities. The conditions necessary for its development are (1) a temperature not lower than 20°C, humidity, and a supply of oxygen. Given these conditions it rapidly develops spongyous bacilli, and these spores are found in the blood, spleen and marrow of the bones of those dying from malarial fevers. These observers investigated further. They were able experimentally to inoculate rabbits from soil washed...
and bacillus cultivations. In 24 cases Cruickshank reports that he has found the bacillus in the blood during the stage of invasion by intermittent fever, at the height of the hot stage spores only can be found, and these subsequently give rise to a fresh crop of bacilli. The bacillus does not seem to be found in all marshes. The germs are to be found in soils which have never been marshy and some of which are very poor; they need only a very slight degree of moisture for life, and if any one of the factors required for production be wanting—(Temperature of 20°C, Oxygen and humidity) malaria production ceases, and it is also to be noted that though in marshes in the mud of which the Malaria Bacillus exists, there also exists with it a septic ferment, yet the coexistence is fortuitous and necessary, for according to Cruickshank all putrescent phenomena cease when the Malaria Bacillus has increased sufficiently to cause pernicious fevers, so that malaria
does not depend for its action on the putrefactive ferment. These observations throw light upon some of the known facts of malaria: its occurrence at heights that it is not generally connected either with putrefaction, marshes, ponds or rich soils. A number of observers in Italy—Lange Marcheppa, Lubons and Kelsch and Rieper in Algeria have confirmed the statements of Klebs and Crucelli; but these cannot be said to be accepted. The bacillus has not yet been found in Bengal the chosen home of malarious disease. Dr. Sternberg of the United States Army is unable to confirm the views of the Italian observers, after a series of careful experiments made at New Orleans. He found numbers of minute organisms in swamp mud closely resembling those in the Roman Campagna, while the evidence is not exclusive that these cause the specific symptoms of malarial fevers. The evidence of Klebs and
Crudele cannot be accepted because the temperature curve of the rabbits operated on has in no case exhibited a marked and paroxysmal character; because healthy rabbits sometimes exhibit diurnal variations of temperature as marked as those shown in their charts; because changes in the spleen such as they describe are not evidences of death from malarial fever as much as similar changes occur in rabbits dead from septicaemia produced by the subcutaneous injection of human saliva, and because the dark coloured pigment in the spleen and marrow of bone cannot be taken as evidence of death from malarial fever as much as this is frequently found in the spleen of septicaemic rabbits — but Dr. Sternberg admits that there is nothing in his experiment to show that the so-called malarial bacillus or some allied organism is not the cause of intermittent fever, while the hypotheses that it is explains many of the facts of malarial disease.
In 1881 Laveran published his researches and thereby originated what may be termed the Protozoa or parasitic theory of malaria. He claimed to have observed in the blood of malarious subjects, in connection with the red corpuscles, rapidly moving filamented spherical organisms. The diameter of these bodies about equals that of a red corpuscle, the filaments being about three or four times their diameter. A second series of bodies were also found. These were pigmentless (as also are those described above) finely granular or transparent and in shape spherical or irregular. Their diameter is too of a micromillimètre; they are uninucleated and motile less. They appear to be the ultimate stage of the filamented bodies. There was yet another series of bodies, cecal motile less, and these are evidently changed blood corpuscles. There can be no doubt the flagellated bodies are living organisms, encysted at first then becoming free with mobile filaments. They also change the blood corpuscles. The parasite is seen to attack itself to a red corpuscle. In the blood we get
Various changes the chief of which are: (1) Red corpuscles with pigment granules and one or more vacuoles (2) pigmented leucocytes (3) free masses of pigment derived probably from the destruction of the organisms.

Laveran found the conditions described in 180 out of 192 cases of malaria in North Africa. Quinine even in small quantities destroys the parasite. The liver and the spleen are as it were the banks in the body in which the organism is stored up. After the death of the patient the parasites rapidly perish, break down and become indistinguishable, but pigment is found very widely distributed, and it may be found destructing the capillaries.

According to this view the phenomena of malarial fevers would result from the disorganization of the blood, and from the effects of that disorganization on the various nerve centres. It would certainly explain many of the symptoms of malaria in the individual, the grave anaemia, liver and spleen lesions, even lingering, pigmentation and that grave dysenteria melanaemia.
in which free masses of pigment are found in the blood. Extending when the life history of these animals (of which we at present know absolutely nothing) has been elucidated we may get light on the broad facts of malaria production generally, and their mode of by which the parasite gains access to the blood. Laveran's researches have not yet been accepted; Lewis Cunningham has described what appear to be very similar organisms in the blood of healthy animals such as the rat and the dog. Further enquiry is needed; the latest researches of which I have knowledge are those of Dr. Patrick Hehir (M.D. F.R.S.E.) pathologist at the Hyderabad Medical School. The observations are most elaborate and thorough and of the greatest interest and importance. Dr. Hehir records them in a monograph of 27 pages entitled "Microscopical Observations on the Haematozoan of Malaria." The work was published in March of this year in India, and is not as yet obtainable in this country. Dr. Hehir has
isolated Lanercost's malarial parasites and after carefully scrutinising and testing the researches of this investigator he adopts the classification of Microphansaw and calls it the Haemotomones Malanae, while the following definition is given of: (1) Body plasctic round or globose: no differentiation of protoplasm, which contains pigment grains; flagellae variable from one to four, highly poly, morphee occurring in amoeboid form. (2) Crescents and the elongated form; (3) Sporocysts, cellular, free pigmented bodies, and "to these divorced add," says Dr. Heber. (4) "Sporae; (5) Stellate and cuneiform bodies and (6) flagellae." Dr. Heber dwells on the diagnostic value of his observations in differentiating the various types of malarial fever. He places great stress on this, the presence of the parasite merely indicative apromisees to malarial disease. When the germ has been introduced into the system, certain.
other conditions are essential for its further development. Dr. Dutin traces out argumentatively, and also by demonstration, the connection between clinical manifestations of malarial fever and the habits of the parasite in the early stages. According to him, if a pure remittent the malarial parasite is to be found, while in that of enteric it is not, and this is of much clinical significance in India, and it is further stated that when enteric fever attacks a subject in whom malarial germs exist, these either disappear or become quiescent for a time. Dr. Dutin confirms the assertion made by others, L. Rudelli, Cunene et al., that the parasite is found as a constant inhabitant of patients suffering from malarial poisoning in malaric, neuralgias, dysenteric, haematuria, lymphatic affection, when there are of malarial origin. Referring to the action of quinina, Dr. Dutin says "quinine effects the disappearance or disintegration of both
the free ameboid bodies and the pigment granules, that is the spores: this
have repeatedly proved by irrigation experiments. It would be hard
to overrate the importance of these observations, if they receive further confirmation.
Though we have not yet arrived at definite knowledge of Malaria, and
the cause must still be deemed uncertain, we seem to be within measure-
able distance of it. At present the sum of our knowledge seems to be
this that Malaria is an earth-born poison; that it appears to proceed from
diseased elements which exist in soil and nourish animal and vegetable
life, if the sick elements be allowed to lie fallow or are not fully exposed in the growth of healthy vegetation;
that under such circumstances mala-
aria is produced if certain conditions
of temperature, moisture and air be favourable: though the precise nature
of this poison is still indeterminate. The
conditions under which Malaria is evolved, and certain other practical facts concerning it are well known.
As a general rule (for altitude may have a modifying effect) marshy places, low lands, lands subject to inundation are the chosen haunts of malaria. Deep rich, absorbent soils, argillaceous or alluvial, are in my experience another favourite abode of the poison. This also flourishes in bottoms, valleys, and confined places, as a plain hemmed in by hills, or hemmed in on the side by prevailing winds, so that stillness and stagnation are produced. The type of places enumerated is usually rich in organic remains, malaria will flourish the more if there is a luxuriant vegetation; for one thing in tropical land this species implies abundance of moisture, and in proportion as any of these habitats of the poison are inundated, will its virulence be.

Rivers and Streams in India, almost from the sources, through all their course down to their mouths, are one of the great haunts of malaria, and a prime factor in its production. I use the term malaria conventionally,
They wind sluggishly, through the vast plains, the face is featureless, the land is flat. They permeate the soil with their water, which percolates to considerable distances, they inundate vast tracts of country when in flood. During summer the dry up so that the larger rivers become confined to one channel, and that not of very great depth or width, whereas in the rains they are mighty torrents, covering vast areas of the flat land. Thus the Beas, one of the rivers of the Punjab, is in summer a stream not 3 yards wide, in the rains it is a river a mile broad from bank to bank, deep and furious, and it inundates a strip of land nearly 18 miles long, at one part of its course. Another, the Ravi which is fordable in summer, being only waist deep, after rain becomes nearly 3 miles in width, the Indus which is but a quarter furlong wide in the hot season, becomes
18 miles wide at Dera Ghazi Khan, and
takes 12 hours, and in reply from 18
and 24 to 25 to cross from bank to bank. On
its last great flood in 1891, in one
portion of its course this river inundated
close upon 700 miles of country. As it
receded, vast lagoons were left, and
as they slowly evaporated, during five
months, malarial disease became very
ripe. During the rains, every quarter
becomes a stream, every stream a river,
and the large rivers look like seas.
and it is not while the rains are that
the unhealthy time is, but when
the inundated lands began to dry.

The permeation of adjoining lands
by the waters of a river, apart from
inundation, has not received notice.
It is a great factor in rendering unhealthy
tracts of land through which the river
flows, when there are neither rains nor
floods. The distance from the banks to
which water permeates will depend
on the nature of the soil. I have seen wells
affected a mile and a half from the river.
As these rivers run into the sea, large
quantities of earth carried many hundred miles
from the uplands are deposited and islands formed.
currents all up the mouths and cause bars to form, which rise in time to but a little above sea level. The land on the other side of these bars is below sea levels. In times of storms or high tides, the waves dash over the sand barrier and so large tracts of country become converted into shallow salt water lakes which are fruitful sources of malaria. In addition if we think of the amount of organic matter an Indian river has in solution, of the filth that drains into it, the carcasses consigned to it, we shall see that apart from its malaria-producing power our Indian river is a serious danger to public health, for it constitutes alike the drain and the water supply, probably, if the districts through which it passes.

The second great malaria producer in India is the jungle which clothes the sides of low hills, the valleys and the plains. There is a great difference between a forest and a
jungle. The former consists of lofty trees, the latter, not of trees but of grass, small shrubs, succulent plants, forming a dense undergrowth. The soil is rich, and under cultivation, it has a dense mass of vegetation, a moist stagnant atmosphere, and a soil which after heavy rain has much water, and for the roots of these plants retain the water, from rain and part with it slowly. Destructive floods have resulted in India and Austria and other countries from the clearance of underwoods. As rain falls on a bare slope it runs off, and the natural waterways are flooded but when it falls on a hillside clothed with jungle it is retained and runs away very slowly, so that practically, as regards malaria production the hillside becomes as it were a morass, which as it dries, becomes a source of malaria. Apart from rain, there are very heavy dew, which keep up the process. Those who have not been
been in India can have no conception of the extraordinary heavy dew. Then, wet the ground as rain would do, and when camping entire district make a tent so wet that it is impossible to strike it, or make a move until the sun has dried it.

The water retaining power of plants is very great; thus maize (Zea mays) under pressure absorbs up to five times their own weight of water. Sphagnum (peat moss) 7 times their own weight, and leaf mould in a middle aged Beech forest can actually absorb and retain no less than five inches of rainfall. In a jungle not only is malaria produced, there is no check to its dissemination, the winds blow it in all directions.

One of the most deadly regions in the world is a strip of country at the foot of the Himalayas, in breadth it is about 50 miles and extends many hundred miles in length. It is covered with dense jungle, is a rich fertile soil with abundance of
both surface and subsurface water, and the temperature is high. The result is malaria; production of the most intense kind, so that the district has been abandoned and uninhabited for many years. Government has made many efforts to reclaim it but as yet only with very questionable success. Roads have been made, canals cut, railways proceed and villages have been planted, the fight with malaria has been steadily carried on with a fearful sacrifice as a result of human life. "There and there" writes an Indian Civil Servant "a lodgment is effected and the pestilential influences driven back but for every position that is so stormed hundreds of lives are thrown into the breach. New colonies are continually being planted and blended and extinguished. The teeming population from the south persistently sends out fresh parties of emigrants who bring their ploughs and cattle and household gods and build themselves houses, sometimes succeeded sometime,
The influence of a forest is somewhat different. If we take as an example what foresters term a 'high forest' (that is one in which the trees have sprouted from seedlings, and are much about the same age) we find at the earlier and middle period of life the crowns of the trees form a dense canopy overhead; the ground is covered with humus that is leaf mould undergoing decomposition, and is shaded by the trees alike from direct and oblique rays of the sun, and the crowns further intercept directly no less than 1/4 of the total rainfall. Air does not get access to soil, and our currents are much broken. Such a forest has a marked
effect on the surrounding country. It tends to moderate extremes of heat and cold, to render the climate of the locality more equitable. The forest is cooler by day and warmer by night than the surrounding country, it is warmer in winter and cooler in summer. Observations made by forest officers in Germany, and France showed the following results. They took 3 stations in the forest: the 1st 5 feet below ground, the 2nd five feet above ground and the 3rd in the crowns of the trees. Similar forest stations were taken outside the forest.

As compared with the corresponding outside station, the temperature of the low forest station (No 2) was 1.49 less than that of the high station (No 3) 0.41 less than outside. In winter the range of the low station was 2.54 less, and 0.61 less than the range outside. The crown station was lower than outside in summer by 1.48 and warmer in winter 0.5.

The minimum difference of the diurnal variation was at night with low
forest station when it was 10.87 less than outside in summer— the range being from 3°.15 in summer to 9°.95 in winter. At 8 a.m. the law forest station was in summer less than the outside one by 1°.49, and in early afternoon (the hottest part of the day) it was less by 3°.91, and at 5 P.M. it was 1°.89 lower. As an average of the maximum of the forest temperature, the low station in July was 5°.87 less than outside and in Winter it was warmer by a minimum average of 2°.70.

As regards the underground station, the temperature 4 feet below the surface in the forest station was from 4°.14 to 3°.13 less than outside in summer. The climate of a forest tract is therefore more equable than that of a non-forest tract. The mean temperatures of air and soil are lower in the forest than outside, and (apart altogether from the question grain-raise which is connected with forest) these things are in themselves great advantages in an Eastern land. As regards malaria—
production as we have seen the soil is shaded both from direct and oblique sunlight, and is also protected from our currents. Malaria production cannot be as a rule very vigorous, and unlike the jungle, the forest when developed is not distributed broad cast over the land, but is intercepted by the forest trees, which the jungle lacks.

The forest man, under some circumstances, can be dangerous, perhaps even deadly, to those passing through it, but it will not at this stage of its growth be lethal; the health of trees of country as the jungle does. Later, on however circumstances change, the trees thin out in course of time, the canopy overhead is interrupted, the crowns of the trees that are left instead of being dense and compact spread out on all sides. Mosses begin to disappear and grass replaces these places. Sun and air now begin to play on the humus and soil, which receives almost all
the rainfall, the condition begins
to approximate more closely to
the ordinary jungle, and the forest
may then become as a focus of infection for a district, because
of malaria production and distribution
as any jungle could be. These
points I have had occasion to note
many times; in malarious tracts
people dwelling in dense forests
seemed to have an immunity from
malarial fevers, as compared with
those who dwell in tracts where
the forest had become like a
sparsely timbered park. I have
been writing of ordinary forests; these
are special wet-clay woods which
are very pernicious in their effects
but the cause of the trouble is not
the wood but the wetness; the
soil is usually a rich absorbent clay,
the vegetation is rank, and there
is no drainage and so the factors
of malarial production are present in
abundance; such a place would be deadly, even if there
were no wood. Alike in forest, jungle, and ordinary
land in the East, there is one factor present, which though it may have no share in the production of malaria, yet of import in the detection of the air, the lowering of vitality, and the predisposition to disease. Refer to the superabounding, teeming animal life, more especially insect life. So say that insects swarm is but feebly to express it. Have seen clouds of mosquitoes so dense as really to appear a heaving solid mass in the air, much as a very large number of struggling fish might look in an utterly inadequate supply of water. After the first rain, the queen of some species of ant, which I have not been able to define, issues from the ground. She is about half an inch in size and has two wings like those of the "Tiphia derracea" or "Cancer," and after her hymenal flight, she drops the wings, and having been impregnated returns into the earth to fulfill her function as the mother of future colonies. To give some conception of the number of these
insects I may mention, that after a July rainy day, in the evening, these queens began to issue from the ground, myriads must have been carried by birds, which were keen, devouring them on all sides, yet in the morning in one room in my house, the gasmer like wasps which had been dropped when swept together formed a heap two feet in height, and about two and a half feet in circumference. This is but one insect, there are others in hundreds as regards species, and utterly beyond all computation as regards numbers. Ants, beetles, butterflies, gnats, hornets, flies, wasps; a swarm, plandrops, reptiles re. re. I'm sure think of the death and decay and extermination of this vast animal life we see, how jungle and marsh, forest and land are saturated with decaying animal matter, which though it may have no share in the actual evolution of malaria has its own share in lowering public health, and so as it were paving the way for the ravages of malaria.
It is an axiom in the Punjab, that any low lying land, with a quick luxuriant vegetation and a superabundance of insect life is bound almost of a certainty to be pestilential to the health of the jans who may have to do with it, and will certainly give rise to them serious outbreaks of malarial disease.

Clearance of earth, cultivation, and cutting down of forests, do not necessarily remedy the evils from which a tract of country suffers through Malaria. It is possible and has often happened that the outbreaks of disease are greatly intensified. Malarial soil covered by leaf mould, protected from air and sunlight by forest trees, becomes so tenacious also from moisture, with trees over it to intercept malarial exhalations is manifestly less dangerous to a community than the same soil, denuded of its trees, exposed to rain and sun and air. It is far more dangerous to have such a soil covered with grass and jungle.
than with trees. The danger in all clearing operations is that when the protecting trees have been removed, a soil saturated with malaria, with animal remains and the accumulated load of vegetable matter, is placed under the most favourable conditions for the development of malaria; and the result is that places which had little or no fever become fever-stricken, those which were affected by milder forms of fever become pestilential. Sir Joseph Fayrer remarks: "It (malaria) often appears with great intensity, after excavation and turning up of soil in land which has been recently broken up, or that has recently been denuded of jungle... The worst malarial dysentery that I have ever seen followed the clearing of some jungle during the last Burmese war." As regards cultivation and upturning of soil there is a need of caution, for experience has shown that the danger of malarial poisoning is very great and serious. Mares of earth are exposed to the sun.
and air, and a slight wetting or a passing shower renders them deadly centres of disease. This has often been exemplified, there was a great outbreak of malaria in Paris when the Canal St Martin was excavated. A most fatal fever devastated Hong Kong, when the hill behind the city (Victoria) was broken up for building purposes. Havana was ravaged by malaria when the harbour works were constructed, and in my own experience the laying out of some 80 miles of new railway, which entailed a good deal of earth work, was characterised by severe malarial fevers. Much records that after forests had been cut down, malaria prevailed very extensively in Pennsylvania, and was at first attributed to cultivation—here we have forests cut down, and space broken up—Drainage, clearances, cultivation will eventually win the day against malaria, but to avoid hazard and loss of life, it is necessary, these matters be done with caution. I am certain that cleaning and cutting should be very gradually done; ground never broken but soon before
while the trees are still standing, a system of what is technically known as "forestry with field crops" should be followed. And as regards building, excavating, and all operations which require breaking up spoiit, it is most impor-
tant that these should be carried on when there is no chance of rain; and as much as the phases are very regular in Eastern lands of the time may be easily chosen.

Tropical We have hitherto considered malaria as it is produced in jungles, and low lying lands, in rich fertile soils; but it is as prevalent and fatal in the high arid sandy ground of the Deccan, in the breezy upland plains of the Punjab, in desert Scinde, in Deccalpore, in the Peshawar valleys, in many a place, without either marsh or jungle, and infact in some without any vegetation whatever.

We owe it to Dr. Cruddell's researches that the idea of marsh production of malaria has, as the sole condition been dismissed from our minds.
and other clues placed in our hands. While the old belief in malarial fever dominated, it was impossible to explain rationally the outbreaks of fever in the areas near the Punjabs and North India, in the dry soil of Extreme Madaura, where the British army was decimated during the Peninsular War, by malaria, and in other similar instances. We now know that every slight degree of moisture suffices for the production of malaria, and it is to be remembered that lands apparently arid may, in reality, be full of enormous vegetation. Many a hundred-mile tract of land in India, now smiling with rich harvests, was but arid waste before the British irrigation canals were made, and were irrigation works to cease a few months would see that fruitful level barren desert again. In an earlier part of this treatise I have mentioned a great inundation of the Indus which covered some 700 miles of desert land. Under the influence of the water, that land showed evidence of vegetation.
energy which was astonishing.

The slight amount of moisture needed may be supplied by dew or rain, but most often I imagine it is by the subsoil water.

Subsoil water is a potent factor in malaria production. The fact that it is constantly rising and falling has not as far as I know been noted, and yet it must have very great effect in generating malaria. An example will illustrate my meaning. In America the subsoil water is at 10 feet below ground. Irrigation is by wells (partly) after 6 hours watering from a well I noted the well had fallen 4 feet so that the subsoil water level was now 14 feet instead of 10. In 6 more hours the well again rose to its old level of 10 feet. During these hours we had a depth of 30 feet of 4 feet below ground which was practically drying after having been moistened, and if we think of these around the wells of the district, it gives us many square miles of malaria producing.
land. Recent researches of French and German forecasters show that the soil is continually absorbing and exhaling air; thus has most important bearings alike on fertility and plant life. The depth of penetration of soil by air must depend on the nature of the soil and has not yet been accurately ascertained. In my opinion the superincumbent pressure of the atmosphere on soil, must of necessity, drive air into the soil, repeatedly, if there be at all porous, and in a porous soil air will make its way. As a result, forced in until checked at the subsoil water level. We thus have moist soil acted on by air. Apart from the absorption of air by soil and the forces referred to above, air has abundant access to the lower strata of soil through the cracks and rifts which abound in most land in the soil. We have thus an almost undescribed factor in malaria production, and one constantly in operation. Some of the Malaria thus produced is doubtless exhaled, as air is driven out over by the rising subsoil water or by ascent of heated currents. Some of the person however remains and is sucked into the wells; thus source of infection is most important; for malaria is doubtless drawn in as well as inhaled. Subsoil water is affected also by the reasons, heat, rainfall, and these factors influence bear
in producing malaria. Sometimes we have great rifts and channels formed in the ground, by which rich moist new earth is exposed to air and rain, and thus malaria is produced.

It is impossible to overestimate the important part that subsoil water plays in the generation of malarial poison. It may be taken as a rigid and unfailing rule that in proportion as the subsoil water is nearer to the surface or is increased the unhealthiness of a place: the nearer the subsoil water, the more malarious the locality.

The barracks in Belize in British Honduras were built on the delta of the river—the subsoil was waterlogged and malarial diseases were very ripe—but perhaps the most remarkable instance is that furnished by the city of Allahabad in India. This city is built upon a loop of land between the rivers Ganges and Jumna. The old barracks were built 50 feet above the river, and the subsoil water was 40 feet from the surface at this place.
Some years ago for strategic reasons new barracks were built near the railway station. They are roomier, lighter, and immensely better than the old ones, have every modern improvement and the soldiers sleep in the second story, instead of on the ground floor as in the old, but the subsoil water in the new barracks is but 12 feet from the surface, as a result despite all their advantages soldiers in the new barracks suffer enormously more from malarial diseases, than ever they did in the old, according to the report of Hamilton, who was in charge of them. Amritsar was at one time looked on as a health resort. The subsoil water was in 1859, 40 feet below surface. Irrigation canals have since been made. The land has been systematically overflooded. There is no subsoil drainage. The water level now (1892) stands at from 8-10 feet below surface, and the place is one of the most unhealthy in the whole Punjab.
We may have severe forms of malaria, where there is nothing but rushes, neither air nor subsoil water; such cases were no personal experience. The most famous case on record is the granite hill behind Victoria in Hong Kong. Any disturbance of this soil is followed by deadly fever.

The rock is pure granite, but Dr. Maclean notes that it is disintegrated and loaded with fungus while another observer, Dr. Black, states that it is "so porous that it is something like a mineral bag". The moisture requisite, in the absence of rain and subsoil water, must have been supplied by the heavy dew.

But in all instances of malarial diseases in places where it cannot appear to be easily produced, we must not forget the possibility of infection from a distance. I think most probable, many places are infected from malarial places farther from them. Malaria appears to be heavier than any given winds powerful enough to propel it, but not strong enough to disperse it, there is no valid reason why it should not.
be carried very considerable distances.
In all anomalous cases regard should be had to prevailing winds as the probable explanation of the problem. Thus places which ought to be a priori unhealthy are found to be healthy, for the prevailing winds blow malaria away from them, and these converse also hold good. Aden is a bare rock, and it is supposed to have rain once in 10 years; nevertheless at certain seasons when the land winds blow, malarial fevers prevail extensively, and the infestive area is in all likelihood a place called Zaidah situated inland, where the conditions for malarial production are very favourable. A striking instance is presented by the Kacapa Valley, in the Punjab. At certain periods of the year it is a vast rice swamp, and may be, like all ricefields, safely traversed while flooded with water, and covered, but as soon as the grain is ripe and cut, and instead of a swamp the ground begins to dry, most terrible outbreaks of malarial fevers occur. The snowy range
of the Summit, as rises up from the valley to a height of 17,000. At the bottom of the mountain, mangoes ripen and the climate is tropical, at the top we have eternal snow, with all gradations of climate in between. Now with the outbreak of fevers in the valley, malaria also makes its appearance on the hill side up to 6 or 7,000 feet, and it is to be noted that not the houses and villages on bluffs and knolls suffer, but there alone the watercourses and gullies that score the sides of the mountain, the malarial poison is blown up there, and is kept compact for many miles. Between the high banks of the watercourses there are two currents, one descending me of malarial and an ascending me of malaria. Above 7,000 there are no villages, so that learning day by day the poison goes farther, but is steadily decreases in its intensity as far as one can observe it, with every 1,000 feet ascent. The villages on the other side of the snowy pass get no malaria.
at all. A similar thing occurs as regards rainfall. On the Numpa Valley slope, to which the clouds come with the monsoon, the fall averages 146 inches per annum, but the mountains so efficiently stop the clouds that the partie side is practically rainless. In selecting sanitary water holes, or building houses, regard should be had to rifts gullies and water courses, and to the not improbable danger of infection from lands below. This density of malaria is also noteworthy in another way. In flat countries any little valley or bottom or hollow is a most dangerous place between sunset and sometime after sunrise. As the hot air ascends and heat radiates from the ground, cold air rushes down to supplant the place of the hot. It trickles down the sides into the hollows and bottoms, so that practically these become lakes or ponds of cold air. In Scotland it is often noted that the valley is colder than the hill above it. In India it is also
noticeable. In walking or driving through one of these dips in the land, one passes out of warm, moist air, into an intensely chill, me — even in the hot weather, the feeling of cold is quite remarkable. These hollows are always the coolest places. In one instance an officer pitched his tent under a projecting bank, about 15 feet below the surface of the surrounding country, to be warm and be sheltered from the winds. He suffered intensely from cold the whole night — the night following he pitched on the top of the bank, and was warm and comfortable.

In these cool, air-breaths malaria also collects, to illustrate the danger of these hollows, I can cite my own case. In the course of an early morning march, I had to descend a little hill, cross a small valley and ascend another hill on the other side. As I went down hill the sun was warm, but it had not yet penetrated the valley, which lay in the shade. It was, me, about a hundred yards across. As I descended into it, the intense chilliness struck sharply through me. I crossed rapidly, but before I had ascended 300 yards of the opposite hill I was in the mire of the cold stage of an intermittent fever which troubled me for a week. Half an hour later the valley was flooded with bright sunshine, and it could then have been
Waiver used safely. This fact concerning the weight of malaria has also its practical application in the measures to be taken for escaping it. A very simple but effective precaution is to sleep above the ground. The peasants of the Roman Campagna sleep in old Etruscan limbs perched up above the plain, the American Indians sleep in trees. The workmen of the Panama Canal, along their hammocks at night in the highest trees with the best results, the people of malarious tracts in breece and in the Pontine marshes, sleep on raised platforms. Sleeping on a level instead of a ground floor confers merited immunity. Huxley records that cases of Malarial fever in Kingston Barracks, Jamaica were 3 on the ground floor to 1 in the second. Frequent relate concerning Antigua, that while soldiers in guard duty at the docks below were almost infallibly struck with mortal disease in the course of a few hours, those in barracks 300 feet above enjoyed almost complete immunity, and those in barracks 500 feet above the docks had not a case of fever amongst them.
In two very unhealthy situations there
seen very substantial benefit result-
by changing the bedrooms from the ground
to the second floor of the house.

The danger of sleeping, in or near the ground
is that the production of malaria is acti
active during the earlier part of the night
as if it is during any portion of the day. With
this difference that when malaria is

evolved during the day, it does not concen
but is dissipated and carried into the

higher regions with the heated air current.

It is different at night. After sunset the
heated earth takes longer to cool than
the air: indeed the earth can hardly
be said to cool at all, except in the
early morning. I have found it unpleasant-
ly warm to the naked foot at 10 P.M.

after a June day. The heated earth
continued to evolve malaria, and this
now accumulates on the surface of
the ground. We therefore find it con-
centrated and highly dangerous. This
also explains why sunset, night and
just before sunrise are considered to be
the most dangerous times in the East. As
soon as the sun sets, a peculiar chilliness
is at once evident— at most seasons.
Radiation of heat begins to take place
as soon as the heat of the air
diminishes, the malaria evolved in the day, and which had been kept in the higher regions during the hot hours, in a state of dispersion, descends to a lower strata with the cold air currents and condensing vapour, so that we have both the malaria evolved after sunset present, and that also which had been given out during the day concentrated—hence the danger, and the rigid horror that the people of India have to expose themselves either to night dew, or early morning mists, and the danger at these periods of the day is enhanced if the air be still and humid.

From another point also this weight of malaria and its method of propagation by air currents is important. It can therefore be deflected from its course by walls or houses. Thus an intervening building may protect another, and it may be intercepted by the walls round towns, by the suburbs of cities, or by other obstructions of the like nature. This view has an important bearing in respect of sanitary...
measures. An Indian town appears to be built in defiance of all sanitary laws. A high wall surrounds it. The streets are extremely narrow and crooked, the roofs of houses in opposite sides of the patte, were almost level to each other, and the tout ensemble is most painful to us with our knowledge of air and light and the requirements of perfect health. Of late years there has been a perfect mania for widening and improving streets, for introducing costly schemes of drainage and water supply, and for approximating Indian towns to the Western ideal. My observations lead me to think the result is not good unless these measures be here considered, and the improvements be very carefully done. In the East everything, Eastern is not necessarily bad, nor is a thing good in the West necessarily suitable to the East. I believe that thousands of years of experience have taught the people of India what is best for them in matters affecting their food, and clothing, housing, exposure, sleep, and the matters of daily life, and rashly to disregard.
the practical outcome of generations of experience and to supplant them by those of your experience, acquired under totally different conditions of life, national social and climate is not for the benefit of the people. We showed study where unto they have attained and help them to rectify mistakes and supply that which is lacking else as an old Indian gentleman tersely expressed it: "you will with the heat, water also throw away in the cloud." Now straight and wide streets and free air currents are doubtless good, yet we can also stop the evolution of malaria round about a city by removing protecting walls and deflecting angles we do but lay the city more open to the enemy. The narrow streets excluded the sun, which in our broad improved street beats fiercely on the ground, searing pitilessly, and causing the most horrible emanations from our open drains and sewers, with no flushing, and but slight fall. The straight streets present no obstacle to the dissemination of the malaria poison. Drainage again is comparatively easy in our sea port-land with its slopes and valleys and abundant water supply.
It is not so simple a matter in the flat Punjab plains, with hardly any fall, with a limited water supply, a burning sun, a limited intelligence, an intense conservation in these matters, the outcome of an utterly different set of social customs, traditions, and beliefs, to those that obtain amongst us. Then again, white arid country like ours can afford to buy its food abroad and to let millions of pounds sterling run to waste annually, by letting its drainage and waste run into the sea. India cannot afford to do so. Some cities are 5000 miles from the sea and in as much as the country is poor the problem is how best to return to the soil that which has been taken out of it, that its fertility be not impaired. A portion of the city of Amritsar has been rebuilt. The new streets are stately and wide. There is light and air and cubic space inside houses according to the western ideal, and yet the worst cases of malarial fever in my experience have been in this part of the town, and proportionately sickness is quite as rife in the new city as in the older part of the town. Do we undervalue the blessings of modern sanitation, sanitary science having a great future in India, but it must move cautiously and adopt things wide streets, wide streets were of good when malaria production ceased. I think there is
something of the same sort concerning the new Rome built by Nero after the great fire that destroyed that city. He observes (Annals, Lib. xv. 43) concerning the new city and its broad streets "these changes which were liked for their utility also added beauty to the new city. Some however thought that its old arrangements had been more conducive to health, as much as the narrow streets with the elevation of the roofs were not equally penetrated by the sun's heat while now the open space unsheltered by any shade was searched by a fiercer glow."

the effects of screening by walls from malaria were exemplified in a great outbreak in Jubbulpore in Central India in 1866. Within 500 yards of a swamp were the Royal Artillery Barracks, between the Artillery and the swamp were the Barracks of the 23rd Regiment (Welsh Fusiliers) and these buildings ran in the same direction and on the same line as the Artillery barracks so that these were completely screened...
from the swamp. Very fever broke out amongst the Welsh Fusiliers, 300 men were attacked out of a total strength of 500, but there was not a single case of fever in the adjacent Artillery lines. After the fever commenced the Artillerymen were put on daily doses of Quinine as a prophylactic, and this doubtless contributed to the result recorded, but the Quinine was begun after the malarial outbreak had established itself in the 28th regiment: and therefore the exemption of the Artillery from attack was not due in the first instance to Quinine. The protection lay in the fact that the Welsh barracks screened them from the Malaria, had it not been so it is reasonable to suppose that the same causes which produced the fever amongst the Fusiliers would have had the same effect on the adjacent Artillery battalion in the adjoining building. Another case in point is that of Mean Dr. this is one of the greatest military cantonments in the Punjab. It is very regular, and carefully laid out, in wide straight roads.
with any building. It has every modern improvement, yet it is notorious as being the most unhealthy part north of the Indian Cantonments. Malarial fever causes much sickness and mortality.

Four miles away lies the crowded city of Lahore, the native portion is old, and it is atypical Eastern town with its crooked narrow streets, angles and walls. Yet despite a crowded population, poorly housed and badly fed, and with none of the advantages of the British soldier in the Cantonment of Mean Bur, and exposed to the same sources of malarial infection as the Cantonment (the malarial degree for Lahore is on the Ravi river with much marshy land near) malarial is comparatively not nearly such a scourge to the city as it is to the Cantonment. The difference cannot be accounted for by race, for I have found that the poorly fed and badly clothed native suffers much more from malarial than the European with better surroundings. The result is due in part I think to the fact that the open streets are much more malarial except...
Another curious fact concerning malaria has come under my notice, and that is that sometimes instead of diffusing itself, it for weeks and months concentrates itself in a particular locality. A remarkable instance occurred in Amritsar in 1887, when there was a malarial pestilence such as is seldom seen even in India. Amritsar, in the Central Punjab, is 1500 above sea level, and is distant about the same number of miles from the sea as Jhelum. The place being approximately, apart from the mile it is built-in a sort of shallow dip or basin about three miles in circumference. The land being flat, a part of the great plain from Beharwar to Calcutta about 2000 miles in extent. It lies between two rivers the Ravee and the Nedia, close by are two very large irrigation canals, and many million tine acres, are annually turned on to the soil. There is no subsoil drainage, the subsoil water has risen from 40 feet in 1854 to 10 feet in 1891, it is still rising. Places that were gardens when I first went there are now marshes.
deep rich clay. There is a most luxuriant vegetation, there are large gardens in great numbers, regularly flooded twice a week by the canals, filled with decaying vegetable matter and the debris, and encrusted with numberless reptiles and insects. The city (the largest in the Punjab) is girdled by morasses and marshes. There are many stagnant pools in all directions the centre is a mass of putrefying water thick with green scum. They are surrounded by circles of yellowish mud, with the outermost ring crested broken and curled up in proportion as it has dried; dead bodies of animals and unfrequently add to the horrible smell that comes from these pools. Then as it is a holy city, there are numbers of great tanks built by the priests for the performance of religious duties, they reproduce the conditions of the stagnant pools and receive in addition an enormous amount of organic pollution from the washing and the washing continually carried on in them.
the sanitary arrangements are not of the best, the water supply is from wells and there is a teeming population, subject to great addition at stated periods from the influx of merchants from all parts of Northern India and Central Asia into this great commercial capital, and also from pilgrims who come at certain times in vast numbers to the holy city. The conditions are thus eminently favourable for malaria, and it is never absent, but in 1887 it became a pestilence. In June of that year an abnormal rainfall (rather more than twice the average) took place. The average for 15 years had been 24.9 inches. In 1887 it amounted to 52.2 inches in the city and 68.5 in the district. Immense lakes were formed in all directions; the subsurface water rose flush with the ground, so that if a stick was put into the ground the water bubbled up like a small geyser. As long as the land was flooded, all went well, but as the waters began to dry, malaria
disease appeared in a well marked sequence. Intermittents as the dryness began, remittents, when it was more advanced, and in September when the whole land was bare, most malignant fever broke out which lasted through many weeks. The fever was characterised by very severe rigors, high temperature, coma and death in a few hours after seizure.

Nine tenths of the shops were closed, railways, post office and telegraphs, were worked under the greatest difficulties, grass grew in the streets, the place looked a city of the dead. The mortality in two months was about 12,000.

From the 19th to the 30th of Sept., 2265 persons died; these figures are much below the reality, because of the reluctance of the natives to give information concerning death.

At one time the death rate was calculated to be 600 in the 1000, instead of 40 or 50 per mille as is usually is.

Thousands of peopls were carried out every day. Thousands of people fled into the country and died there, many thousands more died in the months after the epidemic was over. frem secondary disorders
not a single European escaped an attack.

The curious thing was that during this devastation, a light grey haze hung over the city, and there was a distinct malarial line sharply drawn as it were; you felt as if an entered the city in quite a different air, and healthy European adults who had just come from the hills were at once pierced with vomiting, pain in the limbs, and had to be taken home. This strange localisation of the poison was very striking. Day after day, places outside the city suffered less; these entire districts some miles away had not more than their usual amount of malarial disease at their time of the year. The same fact was noticed in 1890 in another part of the Punjab, a large district instead of city. In this year a malarial pestilence broke out in a district. It began in September and lasted through October. The mortality was very high—according to officials returns only one person in every 1000 escaped an attack. Yet the
pesteilence confined itself very remarkably
to that one district: A very remarkable
instance is recorded by Dr. Devitt. He
took a new house in Burlington in a locality
where the soil had been.aground and deel-
disturbed to make new streets. Fires were
burnt all through the house, but on the
first night he was seized with fever which
lasted 9 weeks. It was characterised by
short cold and long hot stage, and by a
large number of paroxysms a day. "The
singular circumstance was the strict limita-
tions of the malarial influence to the house
and so many yards round it. So well
defined was the limit of the operation
that I could at any time stop a paroxysm
by going a certain distance from the
house and invariably did feel its
influence in returning within the
haunted area as a paroxysm super-
vened the instant I entered the house
which appeared to be the very focus
of the malarial atmosphere round."2

The outbreaks of malarial pestilence
in Annoitern recur in a curious cycle
of 7 years—why I am unable to say.
In 1888 another period of pestilence
seemed to start 1887, but much
less violent broke out. A whole generation of children were swept away by it, so that streets which used to be full of them had hardly one left. Great public works are now in progress at Amerina and we trust the melancholy record of the two years of epidemic will not again be repeated.

The malarial person is usually breathed into the system, but it is in my opinion quite as commonly drunk in also. Water is contaminated in two ways, either by the power that it has of absorbing malarial which passes over its surface, or in the case of wells through the outlet water as I have noted elsewhere. And the reason why some Indian cities have not benefited from water supplies introduced is that the water comes from an infected source: this is also one of the causes of malarial outbreaks on board ship in mid ocean. Stagnant flowing through the terra are often very dangerous because of the malarial in them. In 1854 a party of workmen sent to repair a bridge over the Chukoo drank of this stream, and out of 30
typhus fever, and several died. A deep well has now been sunk near the river, and the station has become as healthy as any other. Again in the same region colonies established at a village called Burhiva, were annihilated by malaria time after time. A well 40 feet deep was sunk some years ago, and drinking water fetch from it solely, and since then the village has become one of the healthiest in that tract. The forest department have now sunk a large number of wells, with the result, that instead of having to invoke their employees once every fortnight, they are enabled to retain a permanent staff. The streams that are known to be deadly all receiv dense forest and are overhanging shrubs and bushes, those bordered by sand or shingle seem to be much less infected.

Another source of infection may probably be milk—apart from the accident of having been watered after it has been drawn from the animal. It is a most point in India, whether the great prevalence of enteric fever may not be due to the fact that cows are fed on garbage of all kinds. They become infected with the term...
and there is consequent infection of the milk. The same reasoning would apply in the case of Malarea. The buffalo, whose milk is largely used— is an animal that delights to wallow in the mud of marshes, and it spends the hot, wetter days and nights immersed with only the nostrils protruding, in the nearest marsh, swamp or pond. Both it and the cow are watered at the filthy pools I have described. Malarea must enter plentifully into these animals. They are said to have attacks of fever, but often I cannot speak from personal knowledge. I have only myself seen one dog which suffered unequivocally from tertian ague— if the milk can be infected by the systemic infection of the animal, it may be a vehicle of malarial transmission— as it is of tuberele.

The mosquito has been convinced a large share in the propagation of disease in the East. Those who have not suffered can have no conception of the myriads of these
Insell, nor of the intense terror they cause. Their poison is therefore far more virulent than that of the Cobra. They predispose to malignant fevers by the intense irritation caused by their bites, the weakness, insomnia and nervous exhaustion that they cause and the serious prostration and lowering of health which sometimes results from the injuries they inflict. In addition it is possible they have a more direct share in the propagation of malaria. Some insects carry the pollen of one flower to that of another plant, so mosquitoes may transplant the malarial germ to a suitable victim, by direct inoculating their victims with it. The eggs of this insect are laid in water and the larvae hatched in the mud of swamps, pools, wells, and stagnant waters — in all waters that are not running. They must therefore be saturated with the germ of malaria and when this is definitely discovered it will probably be found the mosquito has its share in its life history, and fulfills a part
in its transmigration, factually inoculating with the germs derived from its birthplace, and then embarking from the bodies of persons suffering from malaria in whom it has preyed. The mosquito has a well ascertained share in the development of the Filaria Sanguinis Hominis: the matter was first investigated by Dr. Manson of Amur, and thereafter by Cunningham, who found that no less than 14 per cent of the mosquitoes caught at random and then examined contained filarial embryos. If the germ of malaria prove to be a Haemal ozoon, mosquitoes and other such Culicidae insects will be found to have had a share in inoculating their victims:

1. from the original source of the person;
2. from person to person, as when having preyed upon a person suffering from malaria they settle immediately after on one who is not so affected;
3. in the contamination of articles of food and water in which they breed and die.
Though malarial diseases are present all the year round yet the seasons have a marked influence. February is the Indian spring. The trees put forth their leaves; the days are cool and the nights pleasantly warm. The country is one vast compass so that one can hundred miles through waving corn. The air is delicious—all things are bright and beautiful. This is the healthiest time of the year; malarial diseases are at a minimum. By the end of March, the days are much hotter, mosquitoes now abound, the nights are warm, the harvest is ripe for cutting. In April a further aggravation of heat occurs. May and June are months of intense heat and suffering. Vegetation has disappeared except where it is kept alive by artificial irrigation—the whole land is now one vast tract of bare ground, baked hard by a proehling sun, shining day by day in a cloudless sky. The sun is unbearable by 8 am and to the long weary day succeeds the intensely hot shifting nights. Mosquito pests abound—at night the
has breeze blows, like the blast from
a furnace - the whole land reeks with
heat. Everything that has life seeks
shelter and shade - the birds go about with their bills wide open
gasping for breath. Clouds of dust
blow about all day long, and every-
now and then there is a violent
dust-storm. The noonday sun is blown
out, an uneasy darkness overpreads
the sky, there is a furious, warm breeze,
with it an avalanche of dust. This
burst in a place, lasts a varying time,
and then passes on. During this
intensely hot period, also, as regards
malaria, disease is at a minimum.

Then in July, the monsoon breaks
a cloud the size of a man's hand
is seen on the far horizon, an
incredibly short space of time the
heavens which have been a cloud-
less blue for months, are overcast.
Lightning plays all around, and
from every quarter are heard the
mutterings of the gathering storm.
It soon begins to rain as it may does
rain in tropical lands - for 18 or 20
hours. Illu -graphic language.
Fabre wrot, "the dense vapour atmosphere
clouded with the exhalations of plants,
insects, and reptiles, and often soil and
its vegetable productions, after remaining
for a time still and suffocating, ever-
veloping those who were destined to breathe
it and infecting their circulating
fluids, suddenly becomes kindled into
the most vivid commotion, sweeping be-
fore it whatever opposes its progress,
and blazing out into an ocean of
flame which seems momentarily ex-
tinguished by the torrents of rain which
rush furiously to the earth, and is
immediately lighted up to its greatest
brilliance and widest extent; so
then the atmosphere presents the most
intensive and the most sublime con-
flict between fire and water which
the imagination can paint; whilst
the irresistible force of the wind
seems to sweep both combatants
from the field." As fast the rain dispa-
res, so soon as it touches the hot air, then
lathe on pools, and vast shallow
lakes, rivers come down in
flood inundating enormous tracts
of country, a luxuriant vegetation
springs up in all hammers: the temperature
falls 10 or 12 degrees in an hour, the
drought and, and the whole land
looks joyous. Now insects increase
in fold. When the rain ceases, the
sun shines with old fierceness and
now the whole country become
the great vapour battle, and as it continues,
see the next downpour. These alternate drenchings and
Continues during August and early September. During this period malarial diseases are steadily on the increase. By late September, the rains are over. The sickles begin to turn the brown earth over rapidly. The days are hot, the nights are chilly, and now malaria is at its height. This is the most unhealthy time of the year. The sickness continues through the early days of October. In November, it begins to cease, then the cold weather sets in, and no one who has not experienced it can possibly realise the intense cold—raw and penetrating—of December and January. Even we natives of a northern land feel it acutely. The poor, clad, in fed nature of India it is a rigorous and unhealthy time, but malarial diseases wane steadily until the middle of January—then the country has dried from the deluge that comes down on it in the Christmas rains—and there is a sudden rise in the number of malarial cases, which again falls to a minimum in February. So that, the two most unhealthy months of the year are September and January, in each of which the land is drying or has dried after the heavy rains.
One attack of malarial fever seems to predispose to another, and when once in the system I do not believe the poison is ever eradicated. It lies dormant, but is readily excited into action by any passing cause. A specific malarial manifestation may be the result of poison acquired years ago. Thus we frequently have cases of people who while abroad have enjoyed perfect health, yet when they come home, the change of climate so disturbs the balance of their system that they suffer from severe attacks of malarial fever, which they never had while abroad. Then acquired the poison then, but their state of health was good, and not favourable for the manifestation of the poison; as soon as circumstances changed the virus asserted itself. Similarly, when the balance of health is disturbed by some passing affection, malarial poisoning, either makes that disease aggravated or complicates it, or succeeds to it, and may prove far more formidable than the original disease was. This peculiarity of malaria has to be borne in mind in treating anyone who has been exposed to malaria, from whatever disease they may be suffering. The malarial poison may manifest
use of a physiological process such as parturition. There is a peculiar malarial fever, which is apt to develop on the fifth day after delivery, in women who have lived abroad. It closely resembles septicaemia in its symptoms and the diagnosis is not always easy.

The first year at home is dam inclined to think of a critical period, for those who have been long abroad, even as the first year abroad is a trying one for us when we first go out. In nine years of Indian life, I have suffered from malarial fever almost 8 times. In the one year of furlough at home I have had about 30 attacks—much milder than they would have been in India, but distinct attacks nevertheless. Three friends who came home much about the same time as I did have not been so fortunate; some of the severest attacks that they have ever had have been initiated in the first year of furlough. In addition to the change of climate, there is change of life—and probably the lack of the mental stimulus that the work of daily life brings.
India, (of which they are deprived during furlough, and for which many Australians inseparable from change of country are substituted,) as well as the very great increase in purely physical exertion which home life entails, are potent factors in favouring malarial outbreaks as any change of climate conditions.

As an instance of how Malaria may lie dormant until caused into activity by a passing disorder, I may give the following case. The patient had resided in India for 25 years, (with four short furloughs to home) and during this time, though very hard worked, he had enjoyed excellent health, and had not suffered from malarial disease. He came home on furlough, and while in France, was exposed to a chill which resulted in an ordinary attack of Typho-pneumonia, which affected the base of the left lung, and ran an atypical course, the attack being moderate in severity. During convalescence he progressed to a certain point, then his temperature showed a rise every evening, from the normal to between 100°-101°.
very seldom reaching the latter figure, being more usually about 100.2. This rise was regular in its occurrence, always about 8 P.M. It began at about 5 P.M., and the temperature fell rapidly to normal after 10 P.M.; and the patient remained well as far as the temperature was concerned, until the next evening. When the rise began to manifest itself, his convalescence was arrested, he began rapidly to lose flesh, became cachectic, and grew steadily weaker, until in six weeks time he presented all the appearances of profound malarial marasmus: the skin was lichenoid, he had greatly emaciated. The usual evening rise persisted despite all treatment. There was no organic lesion anywhere, to account for this condition. The liver and spleen were normal; the condition was one of steady malarial poisoning, which was so intractable that the gravest fears were entertained concerning the patient's recovery. Chance to the South of England, seemed to check further wasting - the condition no longer progressed steadily and rapidly, unfavourably as it had been doing, but there was
no improvement, and at the end of four months, the patient was as emaciated and weak, as he had been in the first stages of the disease. At this juncture it became necessary, for him to return to India, he had hardly strength to get on board, and his condition during the voyage caused anxiety; after he reached India, to the astonishment of everyone, a rapid improvement set in, he regained, weight and strength, and colour, and though he has never been the same man that he was before this attack, he has lived another 15 years in India and gone through an enormous amount of very hard and responsible work.

The various malarial diseases are the outcome in all lands of one identical poison, and the effects produced vary in proportion to the quantity of the poison which obtains entrance to the system, its condition as regards concentration, the season, temperature and humidity, and not least, upon the individual. That the poison is identical in all lands and in
all varieties of malarial diseases is evident from the broad lines of resemblance, which malarial manifestations bear to each other in all quarters of the globe:—the periodicity of the specific course of the symptoms, the specific lesions produced by the poison of malaria, in the liver, spleen and blood, and the value of the specific treatment by quinine. These features however much they are modified by country, climate or season—yet remain essentially the same; as regards idiosyncrasy or individual peculiarities in those affected it too has its share; it is difficult otherwise to see why the same poison should in one case produce fever—quodidián, tertian or quartan,—and in another neuralgia, hemianopia or dysentery. Another proof of the one poison though the manifestations are varied, is to be found in the way in which malarial diseases merge into one another. Thus when a malarial outbreak occurs, we have, in proportion as the land dries, intermitents, then remittents; and finally, the more pernicious forms of fever.
Commencement of the Intermittents: It is stated that the tertian is the common type, as the character of the epidemic gets severer, quodlaneous occurs, and as it begins to die away, the quodlanian reverts again to the tertian or quartan type. Remittent fever, often passes into intermittent as the patient tends towards recovery, and similarly, an intermittent may pass into a remittent fever, and this in turn into the pernicious form. In certain epidemics, in which the intensity of the poison very rapidly destroys life.

Though fevers are the chief manifestations of malarial poison, they are not the only diseases produced by it. It has a direct causal relation to dropsy, and to abscess of the liver, in addition to these, it may and does give rise continually to the most varied diseases of the various systems of the body. As the direct result of the action of this poison we have: neuralgia, insomnia, melancholy, bronchitis, pneumonia asthma, and a variety of respiratory affections. We have a large number of diseases of the digestive tract, and...
allied organs. Skin eruptions, for we have, affections of the spleen, hebetude, and profound anaemia. Quite a large number of people in malarial tracts do not get any fever, but they fall into the most extreme anaemia accompanied usually (not always) with splenic enlargement. These are diseases of special senses too to which this person gives rise, such as loss of vision, otitis, and other aural diseases.

The number of diseases of which malaria is the parent are infinite. There is one manifestation which I have noted in 18 instances, that I do not find recorded— and that is a sensory paralytic affection of parts of the body supplied by various nerves. This is not a common condition, and appears to be due to a peripheral neuritis, as the areas of affected are usually small, and other areas supplied by the same nerve are unaffected. The affection may occur in the course of a malarial fever, more usually however it ensues from
as the result of prolonged exposure to malarial influences, or after repeated attacks of intermittent fevers. It develops gradually, and finally there is profound loss of all sensation, the motor function of the part and the trophie remain unaffected. In a few of the cases there was at one time or another perverted sensibility, also tingling, numbness, formication, and in five cases severe ephemeral pains. I have noticed this condition in the inside of the forearm, the back of the hand, the plantar surface of the foot, on the dorsolateral aspect of the leg, the inner side of the thigh, the skin about the knee and shoulder joints. It has always been unilateral in the cases recovered at intervals of 10 days to a month.

Even when there is no actual disease present, the malarial poison is injurious to the life of Europeans. The fevers and other diseases to which it gives rise are bad, but the true scourge of malarial countries.
to the chronic malarial infection of the system that goes on day by day. It is this that causes deterioration of the race, and saps the strength and destroys the life of the individual individual. It resists remedies in a remarkable degree, and even when the victim has been removed to better surroundings or has returned to his own land, it is the cause of permanent ill health and much suffering. The infection is progressive and renders acclimatization to malaria impossible. Certain races enjoy undoubted immunity from malaria. Thus the negro is said to be less susceptible than any other race of mankind. In the case of the negroes of the coast of Guinea, this tolerance appears to be more perfect than in any other race. Their country is but a few feet above sea level, it is constantly inundated and abounds in lagoons, marshes and rice swamps. It is most insanitary to Europeans, and is unfavourable even to ordinary domestic animals, the horse, the bullock or sheep are
rarely seen. Yet in this unpromising land the negro flourishes in greatest perfection. The inhabitants are well grown, symmetrical, very little subject to disease, and as a rule live to a good old age. Again it has been noted that in the rice-growing countries of America while the white population suffers from malaria, the black is exempt. In India according to Sir John Herschel, the Tharros, who inhabit the terra appear to enjoy a comparative immunity from malaria—certainly no other race does. Individuals doubtless vary in their susceptibility to malarial influence, and in past ages malaria may itself have been the great-acclimatizer by sweeping away all who could not withstand its ravages, while from those who could spring, in time, a race that was impervious to malaria. This process may have been possible in the past, nowadays there are no traces of the action going on amongst any of the Indian peoples, nor as far as I know amongst any race anywhere. Amusement Civilised peoples
not only in the selection of individuals and species impossible, but in addition, the poisonous medical science is to keep alive the weaklings of the race by appropriate measures. The malaria poison is so peculiar, imitative to the white races of mankind, that it is not possible to establish a tolerance of it.

In Georgia (U.S.A.) Annæley records that white women seldom attain the age of 40, and white men seldom that of 50, unless they have attained adulthood before they retire, in which case their prospects of life is good. According to the same authority, at Petersburg in Virginia no white has ever reached the age of 23. There was one who attained the age of 21½, and he was very worn down and decrep. In India where there is ample opportunity for servitude, as a matter of fact it is evident that with each successive year, and with each period of service, the European becomes more and more unfit to bear the climate, and to resist its microbes. There is no such thing I believe in existence.
as a third, or second generation even, of Europeans in India, born and brought up in the plains. It would be impossible torear children there: even when brought up in the hills they almost tend to die out in the 3rd generation. Europeans children in West Africa seldom reach the age of 10 years. In India with the climate of the hills in summer and that of the plains in winter—(the two best climates in the world)—the life of the European child is kept with many perils. If we consider the high position of life occupied by the parent and the care and provision for children that are possible, infant mortality in India is proportionately extremely large. The children despite everything do not thrive after a certain age—they are stunted in growth and, (apart from mental and moral development, which is not possible for them in India) have no strength of constitution or stamina. There is a peculiar form of cachexia, due to malaria—in children, which is noticed sometimes in mere infants. They are wasted
they are always ailing, they do not thrive,
but physically a blight seems upon them,
while in mind they are rather precocious.
Unless removed such children soon die off.
Even after they reach home, they
require careful attention and treatment
before they begin to thrive. The cachexia
may exist with or without fever.

In one case under my care, a little
baby of 3 years presented a typical case
instance of *Plasmodium Infantis*
Malariae. Bright and precocious in mind, he was stunted and blighted
in body, extremely thin and weak
with turgid skin and marked
anaemia. In his brief life he had
suffered from about 100 attacks
of severe intermittent fever. After
he reached home, despite every care
and the best surroundings, even
in Scotland, he continued to suffer
and in the first 9 months had
six attacks of intermittent fever,
each of which was severe, and
prostrated him for days. Latterly
the attacks have ceased (the last
was at the end of January, 1892) and
the little girl has begun to thrive. Another hot weather in India would probably have killed him: and for this one had who has been brought home, many another dies in India. The treatment necessary in such cases is removal from India, and therefore long continued small doses of quinine (if there be no fever, larger if fever occurs) and Cowper's oil with malt extract: as well as the usual hygienic measures, of fresh air, good food &c. This case shows the profound systemic infection that may occur even in very early life.

The effects of Indian climate are equally evident on the youth, who is unfortunate enough to go there with his constitution not fully developed. He suffers greatly from Malaria, and either succumbs, tovert, or has the invalided home, shattered health. Malaria under my own observation affects, aged 17 went from Scotland to India. In the first year, he nearly lost his life twice from severe malarial fever, and suffered much from...
Long continued severe intermittent fever, so that he returned home. He went out again to the same place and a harder life, when he was 22, with his constitution fully developed and has hardly suffered from malaria at all. We thus see the deadly effects of the malarial poison on the young and uninformed Constitution, while those who go after they have attained maturity, do not the less have their constitutions utterly undermined by chronic malarial infection, so that with each year life in India becomes harder for them. Their bodily fibres are lost, they become much more susceptible to heat and to cold and less able to stand the inroads of disease. Acculturation is possible in the plains of India. In the hills, and in the portions beyond the limits of malaria, the European stands in a much better footing—though even there the tendency of the stock is to degenerate and to die out, or else to approximate to the aboriginal.
For maintenance of health and stamina frequent visits home are necessary—
at the conclusion of the first five or seven years of foreign residence—
and at the conclusion of every subsequent five years—but these terms will
be subject to great variation, with the special circumstances of each case.
As an ordinary rule they represent fairly the period after which it is necessary for the European
in good health, to take furlough if he is to maintain his constitution unimpaired. Prolonged resi-
dence is possible, but is not advisable; there must be a longer period spent
and change much cases Restore
the balance of the constitution. and
often the prolonged residence
has reduced the vital and recuper-
tive powers to so low an ebb, that
the individual is never completely
restored. It is to this fact that I
attribute the larger number of
failures of health in the period
of foreign service, after the first
furlough, where the said furlough
has been delayed beyond seven, and in some cases 10 years.

Anything that disturbs or lowers the balance of general health predisposes to an attack of malaria: thus the exhaustion produced by heat, and especially, if it be caused by exposure to or exertion in heat, is often the cause of establishing a fresh attack of fever, or inducing a primary attack, according as the individual has suffered previously or not. Other diseases, exhausting evolutions, debauchery, all have a share in inducing malarial disease. Indolence has a very marked effect in this connection: excessive indulgence produces satiety and debility, which tends to indolence; this indolence, in its turn, has its effect on the moral as well as the physical nature and is a fruitful predisposing cause of disease. It is an axiom in India that the only way to be healthy in India during the hot weather is to be busy. A very frequent cause is a chill — for though chills do not produce fever, they certainly
The common cause of chills are punkhahs. These are huge fans suspended from the ceiling and pulled night and day. They do not lower the temperature but keep the body cool, by keeping the air in motion. The least exertion with hot weather cause violent perspiration, especially if one is away from the influence of the punkhah; and when one is again within its range, rapid abstraction of heat is followed by chills. At night chill is still more common. The nights are sultry and most stifling, even with the punkhah and quite intolerable without. It frequently happens that the punkhah puller falls asleep, as soon as the fan stops, the bodies of those sleeping under it become bathed in perspiration in a few minutes the punkhah puller awakes, or is awakened, and pulls violently. The result is a very thorough chill. If the punkhah is bad, other heat-alleviating appliances which act by directly lowering the temperature of a room are infinitely
Chill amongst these is the
Thermomètre and Tachis; in
both of these, air is cooled by being
passed over or through water and
is then conducted into a room. The
effect is very marked. A room with
a temperature of 100° falls to 75° and
is easily maintained at that, but
the cooled air is also laden with
moisture, and is fruitful of disaster,
chills, sickness, the dry air
currents induced by the pummeh
are much the more preferable and
healthful. The irrational life too often
as is also a powerful factor in
the production of malaria and
disease. After a troubled hot weather, many
people rise at 5 A.M., to take exercise
in the cool part of the day, between 5 and 6 A.M.: after a cup of tea
and a little toast, they go to work
until 10 or 11 A.M., when breakfast
is taken. This is in the déjeuner a la
gourmande style: there are usually
many dishes, highly seasoned, and
as the day wears on, the effect
of these and the heat is to cause
time. This is aggravated not relieved by "pegs" - a peg being a variable amount of Brandy or Whisky in water. Lunch (Tiffin) at about 2 p.m. is another breakfast; the heavy meal is not conducive to refreshing slumber, and as the afternoon rests is as troubled, as is the long night after a heavy dinner at 8 p.m. All people do not live in this way, of late years there is steady improvement, and a much more rational type of life is now in vogue, but there is yet need of improvement. Alas, the food and drink and social custom abroad we are too much wedded to the traditions of home, and not unnaturally - but too often find that what is not actually harmful, was at all times innocuous in our cold northern home land, is not only unsuited to our new surroundings, but is positively harmful. To most men in India the life is one of intensely hard work, under unhappy circumstances, and the true secret of life is, by every means to economise brain and nerve power, and by suitable changes in diet and habits to adapt life to the new surroundings.
The preventive treatment of malarial disease resolves itself into two heads, general, and that specially relating to the individual. General measures must have reference to the production of malaria, the special, to fortifying the individual against it.

The general principles in organizing measures to prevent the production of malaria, are based upon an study of the conditions necessary to its birth. Thus a certain condition of temperature, a certain amount of moisture, a certain amount of air, and a peculiar condition of soil are necessary. These we have considered elsewhere. It is now necessary only to note that if one or other of the necessary conditions be lacking, the production of malaria becomes impossible.

This production may cease naturally. The temperature may be too low for its production, (i.e. less than 20°C) or it may be too dry, thus prolonged...
heat acts favourably by diminishing moisture in the air and soil, or soil may be covered, and thus access of air rendered impossible.

Thermic conditions are beyond our control, nevertheless it is important to remember them, for it is possible by due attention to them to dwell safely, or pass unharmed through tracks of country which are ordinarily pestilential. It may make all the difference in the world to an army, or an espedition, what time or season is chosen for traversing malarial wastes, and according as a wise choice is made or otherwise, lives may be saved or hazarded.

The condition of moisture is one much more under our control. We can withdraw moisture from the soil, and thus prevent the production of malaria.

Drainage schemes is most important in this respect: be a proper system of canals and ditches it
is possible to render unhealthy places, healthy; but in all drainage schemes we must not think of the superficial water only, but must provide for the even more fruitful factor in malaria production—the subsoil water. A waterlogged soil must be drained yet deeper waters, and in all systems of irrigation in tropical lands due provision should be made for the escape of the water that has fertilized the soil, lest it remain and become a producer of disease. Where it is not possible to drain, we may achieve the desired end by careful, calculated, the capabilities of the soil, (based on its nature and composition) retain water, and by adopting a minimum system of drainage irrigation; we may regulate the amount of water supplied to it, that the water shall be used for its legitimate
purpose of irrigation, and evaporation shall so balance the supply that the water will not add to the subsoil water, and so raise the subsoil water level. In many parts of India, a restriction of irrigation is urgently needed in the absence of subsoil drainage, for while our elaborate system of canals has undoubtedly turned many thousands of miles of desert land into fruitful ground, it has equally indubitably been and has been well increasing be a source of sickness and death to vast multitudes of people.

Where drainage works may not be possible or would be too costly, we may achieve the same effect by judicious training of rivers, by means of embankments, and we should thus be enabled to protect great areas from inundation when
rivers are in flood, or from access of water even when they are not.
A study of the slope, or physical features of a piece of ground, and a little embanking, may do in a simpler way, one that drain-sage would do.

If none of these methods are applicable, we may withdraw another of the factors needed for malaria production by preventing access of air to the sail. We have noted that rice fields, one of the worst haunts of malaria are perfect, safe, while covered by the water needed for the growth of the young crop, and that the dangerous time is when the harvest has been garnered and the fields have dried. Similarly, malarial diseases are most virulent, not when rain is falling or the land is flooded, but when the land begins to dry after rain, and that the extent and severity of these disease is in direct
nals to the stage that the drying process has reached. The reason of these facts is, that air is unable to reach the soil, and thus malarial production ceases. We can imitate the natural process, and attain the same object, by flooding. These dangerous lands. They will be harmless as long as they are fully covered with water. I have in India seen large tracts of low lying swamp, grounds, near cities, valueless for crops, grazing or building lands, and a fruitful source of malarial disease, which were then but flooded, might be objected against, artistically, and a source of pleasure; they might be made into ornamental waters, be used for bathing and boating, and if stocked with fish might be an unfailing supply of a much used and highly valuable article of diet. With a little damming, the water level in them could be sufficiently
raised, and as is now done with many tanks in India, be a little arrangement to ensure a constant inflow of water, and an outflow. The same level could be always maintained—and thus what is now an eye sore and a cause of much suffering, might at little expense be converted into an object of great benefit to the community.

If it is not possible to load material spoil, they may be covered deep with earth, but this plan, though it has been extensively tried in at least one great Indian city (that of Amritsar), is not to be recommended: apart from the fact that the expense is very great, the digging and upturning of large masses of soil, is in itself a source of danger to the community, and as the new earth receives rainfall, and surface water rises into it, it may in
it is now become a focus of infection.

lands reclaimed by covering with

soil, should never be allowed to
lie fallow. In America they are
been utilised largely for market

gardens. Thus is a welcome addition

of food supply to the teeming popu-

lation of the city, and the profits
derived go far towards defraying
the cost of the original work.

- but the difficulty is that in

- tropical lands it is impossible

to grow crops without constant

rotation, and thus the new

rice is being steadily infiltrated

and the subsoil water continues

rise, and in time the rice

will be found that a great

mistake has been made, and

that the form of cultivation

adopted has rendered negating

the advantages of covering the

malarial spots with soil.

Clearance and cultivation

are important measures and
of very great value in the permanent reclamation of land. It has elsewhere been pointed out, that while ultimately these measures must prove beneficial, yet when begun, and for some time to come, the denudation of the soil, and its upturning may be followed by most fatal results! and that the true secret of achieving the desired result safely, is to clear ground very slowly, never more than can be immediately occupied, never to leave the ground bare, but to adopt that system known as "High Forest with field crops," and gradually to thin the forest and extend the crop.

A measure of special importance in the planting of trees. The great value of trees, in promoting an equable temperature, in protecting the soil from sun and air and rain
has been fully dwelt on when the subject of forests was considered. In their relation to malaria production.

Beets of trees judiciously planted are of the greatest good. Trees absorb carbonic acid, the air in their vicinity is rich in ozone — they, are thus valuable factors in the purification of the air of a locality.

In malarial districts, they have a special value — not only do they shade and screen the soil, accord-
ing to some they directly absorb malaria — however, that may be. I myself do not believe that they do; undoubtedly intercept it, and thus mechanically act effectively as anti-malarial agents. In planting such belts of trees, regard should be had to malaria producing localities, and the direction of prevailing winds in regard to such localities. If trees are not planted with a full
knowledge of these particulars, they may be injurious, by intercepting malaria on the wrong side - by keeping it near dwellings and cities that is instead of intercepting between them and malaria. Spruceable trees there is no lack in the East. The tall, stately, forest trees, with dense foliage are invariably the best. Trees of what is termed - usually known in forestry as the light-demanding species are unsuitable. They have thin crowns, which have a great tendency to open out. The light penetrates very readily through the crowns to the soil and only a fractional part of the rain is intercepted. Typical trees of this kind are the various species of Dalbergia, Adiaca, the various Palms also, and many other fasten most valuable Eastern forest trees. The trees chosen should be of what is known as the shade enduring species with dense crowns, which effectively screen from winds, and accompanying malaria, which intercept malaria measure the rainfall, and which effectively screen the earth from the sun.
In this Shade enduring category, there are a very large number of majestic trees, valuable alike for beauty, shade, for timber, and for fruit and other economic products. I may instance the Ficus Indica ("Banyan") the Ficus Religiosa ("Peepul") and amongst fruit trees I may mention the noble Mango tree, and others of the Anacardiaceae. 2 trees of this nature had been planted instead of vegetables, on the land reclaimed round Amritsar, the purpose of the works would have been permanently attained.

In this connection it is necessary to refer to the Eucalyptus (globulus; serratifolia; and other varieties) This tree has been supposed to exercise a specific beneficent effect in malarious lands, by a specific influence which it exercises on the soil, and also by the exhalations which emanate from it.

Eucalyptus has been tried and found wanting. It has no more influence per se in malaria production than another plant, for which large
Antimalarial powers were claimed at one time - the common Sunflower (Helianthus).

In Australia, the natural habitat of the eucalyptus malarial prevails extensive - though, at all events, in the centre of the island and the northern portion, as has been established by Professor Leveredge of Sydney (Hancock Vol II. 1884, p. 797) in the Roman Campagna Professor Tommaso Crudelle shows that at the Fontane where the eucalyptus was extensive - by grown, there was universally bad outbreak of malarial fever in 1882, while the surrounding villages were free from disease (Hancock Vol II. 1884, p. 797). The fact appears to be that in Europe, or at all events these parts of Europe in which the tree has been grown it has been found that the cultivation is not easy. It will not grow in a watery soil, the roots rot and the tree perishes: an elaborate system of drainage is therefore necessary, and from
the way in which the roots spread and large trenches have to be dug. This excellent drainage system, has an undoubted influence in a malarious locality; it would have just as good an effect were it carried out without any Eucalyptus at all. In India the tree has been largely grown. It takes kindly to the country, and is very quick growing; it is an ornamental tree, handsome in appearance, its timber is hard and valuable. But as regards malaria it is of no avail in stopping the production, or in countering its effects when produced. To one it has always seemed a particularly useless tree from the point of view of any production of malaria. It is essentially a "light demander," its thin crown is absolutely no protection whatever to the soil, from sun or wind or rain. Then its stem shoots up straight.
fifteen or twenty feet before it spreads out
into the then interrupted crown. This
affords absolutely no protection from
side winds, abating sun rays or
from driving rain. The tree gives shelter
fertility, to man nor beast nor even
and is as useless in these respects as
the Poplar.

There is one tree of very special
value, which has hitherto not
received notice, to the best of my know
ledge least the forest to draw attention
to its unique capabilities in the
reclamation of malarious lands.
prefer to the Plantain tree, the
Banana as it is called in the
New World. Musa Paradisiaca (Plantain) M.
Sapientum (Banana) M. Cavendishii. Nat. Ord. Musaceae
This is a tree of marvelous
suitability in every way for the
purpose of which we are dealing.
It is indigenous to all tropical
countries, it is most rapid in its
growth a few months bring it to
perfection. Its cool, deep, fresh
green leaves are a most refreshing,
sage-in the hot weather, it is a most graceful tree, and with its flower and fruit and leaf, forms one of the most beautiful of objects in a tropical land. The fruit and fibre of the tree are of very high economic value. It forms dense clumps, grows on almost any soil, needs neither clearing, weeding, manuring, or attention of any sort. Once planted it continues to propagate itself without any looking after; it is subject to neither blight nor disease. Its special value in malacious land arises from the immense amount of water which it absorbs. The tree can be planted in the most waterlogged soil; and for growth it requires neither drainage nor irrigation - by simply extracting the water from soil, it supplies itself and effectively drains any wet land, from which it absorbs enormous quantities of water. When the tree dies, as much as most trees' bulk is nothing but water, it rapidly dries in the powerful sun, and
any debris gives to the improvement of the soil without the concomitant evils and noisome odours that accompany the decay of other forms of vegetable matter. In virtue of these considerations it is pre-eminently the tree for the reclamation of malaria-ridden land. However, to make a further series of observations and experiment more in detail, before I can formulate definite propositions and give statistics concerning it.

Drainage, sanitation, water supply, all have their bearing on the diminution of malarial disease, but concerning these factors I have written elsewhere. In this thesis, individual measures must be regulated by a consideration of each case. Of matters of personal hygiene in addition to a proper diet, avoidance of exposure to heat and cold, especially when fatigued or without food, and the avoidance of malarial infection by a consideration of the seasons and the factors leading to its production, one of the most important is suitable clothing.
Chills is the greatest enemy of health in hot countries, and therefore it is important always to wear flannel or suitable woollen clothes next the skin, and big suitable covering at night. The danger of malarial infection may also be guarded by a consideration of prevalent winds, and making campments to the leeward of malarial localities, or by being sheltered by an intervening belt of trees or coops of water. Double walled tents confer great immunity, as also does mosquito netting, and the habit, universal amongst the natives of India, but not possible for us, of sleeping with the face and head quite covered by the best clothes. In addition it is a most important measure for preservation of health to boil all water used for drinking purposes, and also milk. Coffee used habitually has a decided prophylactic effect, and so I am inclined to think has tobacco.
The smoker creates an artificial atmosphere around himself, it is warm, obnoxious, damp, and causes from unwholesome smells, and in addition the practice of smoking when moderately indulged in, poisons and tranquillizes and so produces a state of mind in which the person is less predisposed to contract disease; further by its soothing effect tobacco helps to conserve nerve energy, and distinct, discourages the attacks of mosquitoes.

More direct methods of prophylaxis are to be found in the administration of various drugs, whereas we try to ward off the attacks of malaria, and hence according to the views upmine the production of malaria cannot be satisfactory, controlled by us, and the hope of ridding the bate with malaria lies in rendering the system of those exposed to it impregnable to its attacks. This is sought to be done by the systematic use of antiperiodics. Quinine may be regularly taken with advantage at all times in tropical lands and is ought to be taken when
malaria is ripe. The substance which Crucllet prefers is Arsenic. Receiv in 1882, administered it to 45 persons. These doses were from 1.105 milligrammes. Of these numbers 338 persons are reported to have been cured or prevented from contracting fever (malaria). In 74 cases the results were doubtful, and in 43 it was negative. It is claimed, therefore, these investigators that if the drug is not always preservative against malarial infection it renders the organism less and less susceptible to the malarial ferment. (Proc. med. Journ. Aug 30 1884. p. 407)

My own experience of Arsenic has not led me to value it as an antiperiodic. I have found it to be uncertain in its action, apt to cause also gastric disturbance in the weak individual and death, and because of its active character its administration has proved to me to be a matter of anxiety. It is not possible with any satisfaction to
put Arsenic into the hands of people, whose ideas of medicine are of the lowest description, and who look upon Western medicines and methods with a mixture of awe, distrust, and contempt.

It is the commonest thing in the world for a patient to take the medicine given for 24 hours, in one dose, but he should forget to take it when the proper time came. They have many irrational notions which make it unsafe to trust them with powerful drugs, both on their own account and of those around them. As an Antiparasite,

I find small doses of Arsenic are of no avail. The drug must be given in large doses such as four minims of medicine. Three times a day, together, and increased as patients come from long distances. For 4 days, medicine has to be furnished at one time, with such a drug as Arsenic because of the crude notions and limited intelligence of the people. This cannot be easily done, and
This is also a fatal objection to its use as a prophylactic amongst uncivilized races of mankind, or amongst people not conversant with modern medicine and our Western remedies. It is better under such circumstances to choose one or other of the other substances used as anti-pyretics. The practice of Arsenic eating exists in India, though it is not very common. I have heard of numbers of cases, but have myself only seen one individual, a man of 45 who took 4 grains daily of Arsenious Oed. I have not had sufficient opportunity to observe whether these Arsenic eaters are exempt from the attacks of malarial diseases. Of assimilation I have already written, if it was ever possible, it is no possible now for Europeans. As regards the peoples of India, it has not been possible for them during the last 3 or 4000 years that they have inhabited the country — with the exception of the negro, all other races of mankind.
whose lot is cast in malarious lands appear to acquire no immunity, despite the centuries that have gone by since these lands were inhabited by them. The Indian is as susceptible to malarial influence as the European. The Chinaman suffers equally with the strangers who sojourn in the land, and amongst these races medical science has been so imperfect that malaria has had full play, and the principle of selection and survival of the fittest, ever, chance of producing a race impervious to malaria. The hope of all races of man save the negro, in the conflict with malaria, seems to lie in the eradication of the pestilence, rather than in being able to acquire any tolerance of it, and while the slow process of eradication goes on help may certainly be given to men, by fortifying their systems against malarial influence by the use of anti-malarial remedies. Arsenic I should not recommend, because I have found it uncertain and it is dangerous in the hands.
of ignorant people. Quinine has not this objection.

The various malarial fevers require no description; in my experience it is frequently difficult to diagnose a Remittent from a case of Enteric fever. The Remittent usually commences abruptly, while Typhoid is insidious. The temperature in Remittent fever reaches its highest point in a few hours, while in Typhoid it does so after some days. The remissions of Typhoid are in the morning, while of Malarial Remittent are not confined to any period of the day. It is not possible to confuse a typical case of either disease with the other, but Typhoid fever, as the most irregular of fevers in its manifestations, and Malarial fevers are also rarely typical — in anomalous cases, a diagnosis can only be arrived at after careful watching, and some days have gone by, and there is no history or record of temperature it is impossible to make an absolute
diagnosis, except perhaps from the results of treatment. In all cases of doubt where specific malarial treatment shows no results, it is the safer course to treat the case as one of enteric fever.

Vomiting is a frequent and distressing complication in the treatment of severe malarial fevers. It proceeds from the congestion of the gastric mucous membrane, and has also doubts, a central origin, and is one of the effects of the poison on the central nerve centres. It is apt to be obstinate, it robs the patient and interferes alike with the administration of food and medicine, and it thus not infrequently adds greatly to the gravity of a patient's condition.

In two cases which came under my care it was the form of malarial manifestation. I was called to attend a child of 3, who while in apparent good health, was seized with violent vomiting. There was nothing in the history or appearance
The patient to account for the symptoms. A teaspoonful of water, the administration of such drugs as Acea Pedro year Dil. of Bismuth, caused vomiting, and protracted retching. In 24 hours the child was unable to retain even a sip of water. The morning temperature was 100° and that in the evening 100°.4. Next day the symptoms continued unabated. The temperature was normal in the morning, but at 11 A.M. began to rise and in the evening registered 100°.6. On the 3rd and 4th and fifth days the temperature showed a like record, and despite all treatment the child had not improved. We had abandoned all treatment and feeding by the mouth, and had tried a number of drugs per rectum, and had fed the patient by nutrient enemata. Opium, Hyd. Eryth. Aed., Bismuth, Manganese, Chloroform, had all been tried, without any effect. The course of the temperature suggested to us that this might be an anomalous case of malarial
pausing; on the 6th day, four grain enemata of strychnine were given every six hours, and the patient was also allowed to suck little pieces of ice which had been procured with difficulty from a distance. The next day the sickness ceased, and the temperature remained normal. There were slight returns of vomiting during the next day, but on the 10th day the vomiting ceased permanently, and therefore convalescence was uninterrupted. The second case was similar but only lasted 3 days.

In addition to the usual treatment of vomiting, in very many cases, immediate relief is obtained by blestening behind the ears. This was first tried some years ago by a Belfast surgeon. He has continuously adopted the practice with almost uniform success, though sometimes it fails. The resulting good is due to reflex stimulation of the vague. When the vomiting is a really serious symptom, it is best to abandon
all medication and feeding in the mouth. They attempt only result in distress to the patient. Medication should be hypodermic, and feeding should be per rectum. For thewhelming pains in the limbs, the severe headache and backache, nothing gives so much relief as a species of massage—a kind of kneading and rubbing in which the people of India are great adepts.

As regards the treatment of malignant fevers, the introduction of remedies of the class of Antipyrin—Antifebrin, Phenacetin, &c., has greatly modified some points of practice. It is now possible to control high temperature much more satisfactorily than we were able to do; we can shorten long hours of suffering, and not infrequently can ell them. What would in all probability have been a severe Remittent fever

In numerous instances in my practice the use of these remedies has enabled the patient to rise up and about
at the end of three or four hours instead of being prostrated by the tertian quinidum or quartain attack for 18 hours, and in cases of severe fever, commencing inpatients, these remedies have saved a protracted illness. This is illustrated by the following case. I was sent for to see a child aged five months who was suffering from fever. He had been noticed to shiver and sweat that morning, and then he grew hot - the temperature was where drawn him 101.4. The fever continued during the day. The evening temperature was 102.6. The treatment consisted in one grain of quinine every three hours and in a little simple fever mixture ever now and then. During the night the fever continued; in the morning there was a remission. The temperature was 100.6. Despite the quinine, shortly after 11 a.m. it began to rise steadily, and died 20 hours by hour. I concluded the case was one of Remittent Feve
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**Records of Temperature, Pulse, Respiration and Stools, from Day of Antipyrin**

Arch. Young, Surgical Instrument Maker, Edinburgh.
A severe type, that never before given
Antipyrin - it was a drug then but
newly introduced into Indian practice-
but resolved to try it in this case.
The action was very marked, and
as will be seen by the accompanying
chart, it reduced the temperature
steadily and permanently; it was
very interesting to see the temperature come
down hour by hour, under the influence
of hourly, half-grain doses of Antipyrin.
These drugs require to be used
cautiously, because of their powerful
depressant action, but I cannot
recall a single instance of evil
results from their use, and very
many, such as that recorded above
in which great good was done.

I do not purpose to enter into the
treatment of malarial fevers, but
merely to record some points of
practice which I have noted
concerning these diseases;
of all the remedial agents at our disposal
for the treatment of malarial disease
Change of air is one of the most powerful
flaws. I cannot say, but this is certain that it is sufficient to put
a stop to the progress of most virulent
fevers (malarial) without any other
treatment whatever, and that it
will act beneficially when all else
fails. I know cases in which it has
saved life, when the patients appeared
to be in a perfectly hopeless condition.
The change may be from one room
to another in the same house, it may
be to another house, in the same
place — to another town, from the
plains to the hills, and vice versa
or it may be a change to Europe.
The effects are simply marvellous,
even when the change is not to a
purer air, but to a malarious locality.
This is a very puzzling thing, but I
have frequently noticed it. It constantly
happens that a case of malarial
disease contracted in America
is cured by a change 10 miles
away — into a purer air, but—
curiously enough a fever contracted at
the place 10 miles away in the country,
which resists all remedies, will at
once begin to improve when brought
to such a centre of Malaria as Amritpur.
The composition of the atmosphere is equa-
ly uniform all the world over, whereas
the potency of a change lies, I am unable
to determine—but the fact that it works
a marvellous cure oftentimes, I have
frequently seen. The following cases
may serve as illustrations:-
1. Effect of Change of Room. — A lady
under my care had suffered from
Pyogenic Malaria. Her condition
had been hopeless, and her recovery was
very remarkable. In the later stages of
her convalescence, there was a regular
slight rise of temperature every evening
and the temperature was never quite
normal in the morning. I had her
removed into an adjoining room, which
opened out of the room she had been in
and the results were soon apparent.
The temperature became normal and
Records of Temperature, Pulse, Respiration and Stools, from Day of

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Remittent Fever. Effects of Removal.
her progress was rapid and uninterrupted in Indian houses, there are no drains or sewers, that might have hindered her progress in the one room, and not in the other.

2. Effect of removal on cases of Remittent Fever. The patient was suffering from Remittent Fever, which resisted treatment, and was evidently of a severe type as will be seen from the temperature chart. If he remained in Cawnpore the prognosis appeared to be grave. I therefore sent him away to a hill station, on the journey many difficulties were encountered nevertheless despite the rough road, his temperature fell, there was one attempt at remission during the fever, otherwise his convalescence was uninterrupted.

But perhaps the most remarkable case is the following. Miss, aged 28, contracted Interme

Fever, which ran an ordinary course, towards the conclusion
of the typhoid which had been of moderate severity and uncomplicated, the patient developed a Remittent fever, of peculiarly intermittent nature. It was characterized by a high temperature, long continued, with slight remissions, the patient's condition was grave. As much as all treatment was useless, while in controlling the fever, I advised her removal. This was a difficult thing to accomplish. She was in a remote part of the country, far from railways. The nearest European residence to which she could be removed was distant 17 miles. The journey would have to be made over rough country, the patient being carried by men, as she lay in her bed. Hindrances had to be crossed in new space; these difficulties her friends declined to submit her to the risk of removal. In another four days the patient's condition was desperate. Her temperature had continued steady between 103° and 105°. The pulse was very feeble, 180-130 per minute. The disease was untouched by any remedy.
and her condition was such that a fatal issue seemed imminent. Antipyrin reduced the temperature of fever in large doses (20 grains) but only for half an hour or so, it rapidly rose to its former height or even exceeded it. The temperature and pulse were recorded every hour. The lowest point was at 5 AM, and rose began about 10 AM. The maximum was reached about 3 PM, and maintained until about midnight or 2 AM. The remissions were exceedingly slight, except on the 4th and multiples of 9 days—when they were decided, and the range of temperature also was lower as a whole during these days. The range as a rule was through two degrees.

As she could only live a few more hours, her friends at last resolved to let her be moved, as the one remaining chance of life. We started at 10 AM, it being the cold weather. The temperature was then 103.4 and the pulse 135 (partly due to excitement).
She had not been carried a quarter of an hour when she collapsed, and appeared to be moribund. The journey was continued, when 10 miles were done, though it was late for the diurnal rise to be at its height, we found the temperature had not risen. We reached our journey's end at 6 P.M. having been 8 hours on the way, a most trying journey even for one in good health.

The evening temperature had despite the excitement, polling, and trials of the journey, fallen to 100. The pulse was 95. Next morning the temperature was subnormal, and convalescence thereafter proceeded without a single head symptom.

Several others such cases have occurred in my practice, in which remarkable results have followed removal of almost hopeless cases, in some instances to a more malacous lethargy than that in which the fever was originally contracted.

Dr. Donaldson (British Medical Journal April 3, 1875) records a remarkable case. In this instance the
Colonel Euphrates Habrana had been
the victim of Remittent Fever, when
taken on board ship, he was in
articulo mortis, so that they held a
looking glass to his face three times
still respiring, yet as the ship put out
to sea, he revived and eventually recup-
ered. It is to be noted as a significant
thing that changes of locality only
drove out in Acute Cases of Malarial
disease, in the cases of Chronic
malarial poisoning, change to be use-
ful must be out of the country alto-
gether. It is impossible to benefit
Cases of the Enigma
of Malaria by anything
short of this. Usually, residence for a
time at home suffices, but in some
cases it is not so. Thus a lady, at
one time under my care became the
subject of Chronic Malarial poisoning.
She lost flesh, became Anaemic, there
was slight enlargement of the spleen
and the liver. She suffered from slight
rises of temperature, sometimes, but
more rarely, from actual high fever.
and after four months, in which all that
could be done was unavailing—she was
invalided home. During the voyage she
rapidly improved. But in England, her
eyeptoms returned, and she suffered
as regularly, though not as severely as
she had done in India, and it was not
of much moment in what part of the country
she happened to be—her feverishness did
not leave her, nor did her general condition
improve. Eventually, she was sent to
Tasmania; on the voyage her health
improved considerably, and in the sea
that she spent in Tasmania, she had
not a single attack of fever, or of
malaria. She returned to India in
restored health, but had not been
six weeks in the country when her
old symptoms returned, and at the
end of 18 months her condition of
health was as unsatisfactory as it
had been. Having learned by ex-
perience, in this instance she
went straight to Tasmania, and
she has been there now nearly.
two years and a half, during which time she has been untroubled by Malaria.
Quinine is administered in Malarial outbreaks, less often between.
There are two ways in which this is done:
We may give it in small doses, such as five grains frequently repeated, or larger doses such as 10 or 15 grains.
In all cases the good effects are not manifest until the system is thoroughly under its influence, and we get the first symptoms of mild Cachexia.
and it is well to continue the drug in slightly diminishing doses for a week or ten days after all symptoms of malaria have disappeared. It is best given either in rice paper or black coffee (in which case it merely slightly enhances the bitter flavor of coffee without sugar) or dissolved in Hydrobromic Acid.
Tannate of Quinine is a salt that appears to cause less constitutional disturbance than other forms. For hypodermic use, the neutral Sulphate is best, but whether it is best. The
body, state of law during an attack of malaria, or from some peculiar, in the quinine itself. In spite of every precaution, abscesses are very apt to result, at the point of puncture, and in one case, though the syringe had been carefully prepared, and every precaution taken, an erysipelas-like blister appeared four hours after the injection, but the disease was easily controlled. Quinine is also given per anum. In such cases it should be dissolved and given in some bland medium. Abscess purce makes a great difference in the action of the drug. Frequently, when even in large doses, it appears to have no effect on the disease, after free purgation. In smaller quantities, it is rapidly effective; 2 grains with opium may suffice. In effect, grains of quinine may be multiplied and thus intensifies the action of quinine in a peculiar degree. It has frequently been given to excite vomiting and thus prepare the system for quinine, but quinine is not nearly so good as free purgation. Vomiting is alone...
much more disagreeable and exhausting for the patient, and when once in a malarial case the delirium has been erected, it is difficult to check it so that not often the vomiting goes on, and becomes a very serious feature in the management of the case.

Speeuaeua has a specific effect on another manifestation of malaria—diabetes. It and in combination with quinine it sometimes gives remarkable results in malarial fever. Perhaps one of the most striking is the following: (for notes of which I am indebted to Dr. Tuttleman in whose practice it occurred,) the patient, a gentleman aged 57 (?), was seized with malarial fever of a severe quotidiean type. Quinine, in full doses, did not appear to influence the course of the fever. On the 7th day, instead of the usual 10 grains dose of quinine in the morning, Dr. Tuttleman gave the patient 4 grains of sulphate of quinine in combination with 1/2 a grain of Pulv. Speeae. The temperature
rose but did not reach its normal height. Between 103° and 105° quinine only, about 10.2°.

During the day, quinine only was given. Next morning, 1 grain was again administered together with 1/2 a grain of Speeacuanha, and the usual diurnal rise was postponed by about two hours and was lower than the day before. During the day, quinine alone was administered, the temperature rose only slightly. Next day, after the usual dose of quinine and Speeacuanha, and therefore became subnormal, and constipation was established. The Speeacuanha in this case had a very marked effect.

It has a tendency to cause nausea, even in small doses. The Speeacuanha is a fine medicine, which was introduced into Indian practice as a substitute for Speeacuanha in the dispensary, by Dr. Harold Brown of the Hospital. It has been used in the treatment of enteric disease, and it has to use in cases of fever also. The medicine is extracted from the
Specimens: The drug, then no longer nauseating or causes evilness, and its specific properties are left un-
changed. The substance was intro-
duced into practice shortly before I
left India. I have therefore only a
very limited experience of its properties.
In the few cases of Dysentery in
which I employed it, its action
was perfect, successful. I have
had no experience of its effect in
Malarial Fever.

In no malarial fever are we per-
ceived if the temperature falls to normal
Whenever it does so, there is sure to
be a rise again. Convalescence is only
certain when the temperature becomes
a little sub-normal. In these cases we
know that the fever has passed.

There is one other form in which
Quinine serves which is extreme
value — and that is in the form of
what is known as Warburg's Dience-

This remedy was introduced into practice
by Dr. Charles Warburg, who ha.
published its combinations. It consists of a tincture (made with Proof Spirit) of Quinine in combination with several aromatics and with Saloline Alca (1 m 40) Opium (1 m 4000) Rhubarb (1 m 100), Camphor (1 m 500). The proportion of Quinine is 1 m 60. The tincture is very greatly increased. It is not too much to say that Warburg's tincture has saved many lives which would have been lost without it. Its specific value (though it is of the greatest use in all forms of malarial diseases) is in those cases of Remittent or Pernicious fevers in which Quinine as ordinarily given is quite inerf. These cases are fairly numerous, and in them Warburg's tincture is most satisfactory in its action. In some cases it fails, but in the vast majority of instances it very speedily puts an end to the fever. There have been a very large experience of this drug, in severe
continued Malarial fevers, and looked upon it as the most valuable drug we have in these cases. Specimens of the Tincture vary according to the maker, some samples are not as effective as others, and if the drug has been kept long in storage it is apt to deteriorate. Some of the cases in which it has failed to do good in my experience, have been cases in which I was not satisfied with the quality of the medicine.

The mode of administration is trouble some, but much depends on it. The Tincture must be given pure without any admixture of any other substance whatever; it must be given in an empty stomach and not even a cup of water must be given after it. The full dose is four drams. In three hours time, if the temperature still shows fever, (or in two hours, if the case be urgent) a second dose is to be given; no food must be given until two hours after the second dose.
It is sometimes necessary to give a third dose of half an ounce two hours after the second dose, in which case feeding must be deferred for another two hours. This third dose is very rarely required—probably in not more than 20 per cent of the cases treated. The second dose is needed in the vast majority of the cases. Because of the trouble that it gives the patient, this medicine is not the one which I employ, except in urgent cases, where quinine fails. The cases treated here are therefore those that are exceptionally severe, and when this is borne in mind the almost uniform success that attends its administration is as remarkable as it is gratifying. I usually give it in practice as follows, the patient is fed as thoroughly as is possible, thereafter nothing else is given. Two hours after the feeding, the first
close of the Warburg's Tincture is given and
thereafter further doses if required, as
has been already detailed. The medicine
acts as a sudorific, and the perspiration
which is usually copious is carefully
promoted. Nothing, whatever is given
by the mouth, the patient's strength
is maintained by nutrient enemata.

The great drawback to the employ-
ment of this remedy, that it interferes
with the proper feeding of the patient
is thus obviated. Patients complain
greatly of the taste of the medicine
which is most unpleasant and per-
sistent. This can be minimised by
a little management. In giving the
tincture it is best to open the mouth
wide, and to pour the liquor as
far back as possible; a few
moments later the patient may be allowed
to rinse the mouth with a little
accelerated water.

The following case will illustrate
the value of this remedy.

Mrs —, age 28, was confined on the
25th December. It was her second child. The labour was speedy and normal, and the patient progressed most favourably, until the 30th of December, five days after the confinement. In the morning of that day, she complained of languor, and no care for her breakfast. The temperature was normal (8° AM) but at 11 AM, she had a rigor, and the temperature rose to 103.4. It remained high until 10 PM, when it began to decline. In the morning, it was 100°. She complained of chilliness, and pains in her limbs, and the temperature again rose during the day. As usual, it fell off the day before, to about 70°.

During the day, she was troubled by frequent perspirations, and the chilliness occurred periodically. After 10 PM, the temperature again fell, and next day, the usual rise took place, accompanied by chills and perspirations. I diagnosed the case as one of Puerperal Malarial
fever, because of the regularity of the rise and fall of the temperature, the fact that the disease began on the 5th day, and because from the first very careful Antiseptic precautions had been taken, which rendered the occurrence of Septicaemia extremely improbable. This peculiar form of Malarial fever is not at all uncommon. The patient was treated with large doses of Quinine. Cinchonism was thereby established, but the course of the fever was not affected. It was evidently one of those cases in which Quinine fails to do good. The fever was of a severe type it tended to recur earlier in the morning, to decline late in the night, and to recur, a higher peak on the thermometer each successive day.

On the fourth day, I gave the patient half an ounce of Warburg's solution, one hour before the usual diurnal rise
there was no recurrence of fever. Convalescence was established, and recovery thereafter was steady and most satisfactory. It is to be noted that where quinine has failed and Warburg's quinine has to be employed after the course of the fever has been ended by the Warburg quinine, quinine which was before ineffective, is amply sufficient for the further treatment of the case.

Opium while valuable as an adjuvant in treatment, in that it overcomes pain, procures slumber, and makes the patient feel comfortable—is in no sense an anti-pyretic in my experience. But Opium Eaters are as liable to malarial diseases as other people, who are not addicted to its use.

Quinine has in my hands given
very disappointing results. The reason I suppose is that Malarial fevers depend upon a speepee cause, for which Aconite is in no sense as speepee, and over which it exercises no control. In Intermittent fevers, substances of the Antipyrin type, readily produce perspiration and relieve the symptoms and therefore Aconite is not needed. In Remittent fever, however, it is to be done by merely treating symptoms. Specific remedies must be given to act on the speepee cause of the febrile manifestation, and Aconite is therefore not a suitable agent.

Amongst native practitioners, Chirecta enjoys a high repute as a febrifuge. Leam inclined to think that it is in no sense an anti- periodic, except as far as it acts indirectly by building up the system, as any other tonic might.

Another favourite remedy with these practitioners is Alcies—the perceived root of some species of Aconite. It is uncertain with effects—This may be because it is very difficult to procure unadulterated drug from native
The last substance to which I would draw attention is one which I have had very large experience in the treatment of malarial diseases. It is Pectate of Ammonia, a salt possessed of very valuable therapeutic properties in this class of cases, though it has not received the attention which it deserves. The character of its properties and therapeutic uses of this substance were carefully investigated by Dr. Duparc de Beaumont, who communicated the result of his investigations to the Therapeutical Society of Paris in 1872. The salt is a combination of Ammonium and Picrosulphane, or as it has been called Carbazolite or Trinitrophenol. It is brilliant yellow in colour and intensely bitter to the taste. This quality of bitterness is a curious characteristic of all antimonials, except Arsenic. In physiological action Pectate of Ammonia very closely resembles Quinine. It eases the blood pressure markedly, and the sudden lowering may cause convulsions and death. It in moderate doses, has a decidedly

meet 12th Oct. 1872
relative influence on the brain and spinal cord. In larger doses in one case which came under my observation, it caused much giddiness and nausea, accompanied by heaviness, some headache, and it is said to have even caused delirium. It is a very active substance; it is necessary to commence with the lower doses and to increase the quantity gradually and cautiously. As far as my experience goes it does not appear to be cumulative in its effects; it is eliminated by the kidneys. Previously, to Dr. Dupardin Beaumont's investigations the belladonna had been used by Braconnot, Arpelard, Bell, Eulter and others in the treatment of intermittent fever. Dr. Beaumont employed it in these cases. The results confirmed the conclusions of the observers already named, and showed that in various forms of malaria and malarial diseases, and one which, in some cases where quinine fails, well give brilliant results.
Dr. Bevan's cases were 1. Quotidian fever. Cured in four days. 1 to 2 centigr. given per day. In full. 2. Also Quotidian fever in which Quinine had failed to give any good result though given fairly. Perera's ammonium was given during five days, after which time the patient was cured. 3. Tertian fever. The drug effected a cure after 9 days use. 4. Quotidian, cured in 8 days. 5. Malarial facial neuralgia, Speedily cured. 6. Tertian fever. Quinine had been used for 17 days with no result. (Perera's ammonium cured the patient in two days.)

With the exception of the 2 cases in which Quinine is stated to have been given, these results are very distinctly inferior to those which Quinine would almost certainly have given in these cases. It would have cured much more speedily. The reason which my experience suggests for the length of time the Perera's ammonium took to show a good result, is the smallness of the doses used by Dr. Bevan.
After D. Beaumont published his investigations, the subject seems to have passed out of mind. There is no literature concerning it, nor were the Picro- 

Ammonia ever used. I was the 

first to employ it in India, and as 

far as I can learn, anywhere else. 

Published the results that I had obtained 

with it in the treatment of malarial 

diseases, and since then it has 

been largely used in India and also 

to some extent in China and other 

parts of the world. Its employment 
as an antiperiodic in India is 

steadily on the increase, and it 

would have been much more universal than it is, yet had not been 

for the very steady fall in price of 

the older and better known drug, 

Quinine. Still Picro- Ammonia 

is coming steadily into favour; it is 

now easily obtainable in the Indian 

market, instead of being an almost 

unheard of drug, as it was when I 

first employed it. My attention was 
directed by accident in the 

summer of 1862 to the following way

of using it.
I was at the hill sanatorium of Dalhouse in the Punjab, and there I had under my care a patient who had suffered very severely for seven months from malarial fever of the Quotidian type. In all these months she had not had relief for a single fever period.

Imin, Aresenic and other antiperiodicides had been used but failed to give the slightest relief. After ten days treatment the fever still occurred daily with its accustomed severity. At this juncture when I was at a loss what to try next, the local chemist told me of a remedy for fever which he had received some years previously but had never tried. This proved to be Pterate of Ammonia. I gave it to my patient with very gratifying results. The fever did not occur next day nor did it do so at any time during the three subsequent months in which she remained under my observation. I have since then constantly used the pterate of Ammonia in the treatment of malarial diseases and as Amritsar is notorious in the Punjab for its unhealthiness and severe malarial epidemics, I have had the most ample opportunity of giving
This substance. During a period of nine years I have treated hundreds of thousands of cases of malarial disease with verdite of ammoniac, and in most instances with the happiest results. So uniformly successful has it been that in my very extensive practice I have almost entirely abandoned the use of quinine, and other Cinchona alkaloids for the treatment of intermittent fever, and have substituted verdite of ammoniac for them. In 1887 I published the results of a record of 5000 cases of malarial fever treated with this agent, and of this number I find that in 9 cases only did it fail to cure, and in these quinine succeeded -ed at once. I usually give it in doses of from one eighth of a grain to a grain and a half, four or even five times a day. A fair average dose is half a grain three times in the day, and in every case it is better to begin with small doses, and to increase the amount gradually, as required. It is best given in pill. The effects are soon visible. In the great majority of cases treated the half grain doses during the interval prevented
the recurrence of the next attack of the fever, while in about 20 per cent of
the patients two or three attacks followed before the fever ceased. In one case of
Quartan Ague despite full doses of the
cart the fever recurred for six periods
in gradually diminishing intensity, and
then finally yielded to the treatment
the Picrot of Ammonia was equally
successful in all the forms of
malarial intermittent fevers, but it is
a curious fact that the cases in
which it failed to cure were all of
the tertian type—and under any
form of treatment this is in my ex-
perience the most troublesome vari-
y of the fever, as well as the most
invertebrate. At the time when I pub-
lished the results of the 5000 cases I
had employed Picrot of Ammonia
in the treatment of twenty-five cases of
malarial neuralgia of various nerves
in the cases of malarial headache
and in one of malarial Colic. In
all these cases it was most effect-
ively and speedily in its results.
Since 1887 I have treated very many similar cases, with a like happy result. It is noteworthy as a point of treatment, that though the manifestation of the malarial person should take the milder form of Neuralgia or Hemorhania rather than the more severe form of fever, yet treatment good can only be obtained from large doses of the Antiperiodicum used in the one case as in the other. A malarial Neuralgia, say of the supraorbital region, lasting during two hours of the day, and perhaps not very violent even at its worst, will for its cure require as large doses of Quinine or Perale of Ammonia as will a Quarten fever which prostrates the patient for 8 or 10 hours at each attack. Some of the most intractable cases, which need much patience alike from patient and physician, are not in the class of malarial fever, but in a common manifestation of the malarial person—a headache, which begins about 8 or 9 A.M. reaches its acme about
midday, and then gradually dies down, ceasing at sunset, to recur again the next day or at a later interval according as to whether the malarial type is quotidiana, tertiana, decimata, or something else. This type of cases requires full doses of the antiperiodic, frequently repeated, and withdrawal in the case cases there is a constant tendency to relapse; and progress is often very slow.

In cases of remittent malarial fevers I have been unable to obtain the slightest good results from Perice of Ammonia. I employed it in some cases of such fever of a severe type without any good effect. Neither have found it of any use in the enlarged spleen of malaria. This is a very common condition either after attacks of fever, or sometimes as the result of chronic malarial poisoning without any fever at all, and sometimes the enlargement of the spleen is almost incredible. The largest that I have seen was in a boy of about 14, small and
greatly emaciated. He had suffered effects from attacks of intermittent fever during many months, but since the spleen enlargement (as frequently happens) the fever had ceased. In this case the spleen reached to the iliac crest on the left side, filling the left hypochondriac, lumbar, and inguinal regions, the hypogastric and part of the umbilical and epigastric also, somewhat as noted on the diagram*.

In these cases of enlarged spleen, Quinine is of doubtful value in my experience. Pierrei of Ammonia is of none at all. The best method of treatment is by the use of Ergotamine, either hypodermically, or by mouth. The drug has to be given for a long period, in moderate doses, and it may be advantageously combined with Iron and Quinine. I have seen no untoward results ensuing from its use, though I have continued to use for months in some cases. It usually reduces an enlarged spleen satisfactorily and safely.

Pierrei of Ammonia is of especial value in a class of cases with...
which we meet, not infrequently, and
that is where quinine, not only, com-
pletely fails to control the outbreak
of the malarial poison, but in addition
does positively to be harmful. Some-
times possible, this is due to an idiocyn
crecy in the part of the patient, more
often the quinine cannot be tolerated
it causes much depression, disturba-
nces of the alimentary system, and in
some instances that have come
under my notice—profound nausea,
insomnia, and intense nervous
irritability. When at the cost of
much suffering the patient has
taken and retained it, it utterly
fails to affect the malaria from
which the patient is suffering—
and this however given. In this
class of cases the Trenchard of
Ammonia acts speedily and pleasur-
ably as have observed in several
instances. In one case a lady, who
suffered from Malarial fever (quotidian)
and who was markedly cachectic
and presented all the symptoms of
intolerance to quinine (which had been largely and unavertedly used) in a very aggravated degree. There seemed to be no alternative but to involve her home; however, the Pillar of Ammon was so effective in relieving her that she was enabled to remain another 18 months in India. In another case, while there was no intolerance of quinine, this drug failed to benefit the patient.

Mr. A. M. - A. aged 54, Mohammedan, agent general, of means, came under my care after having been ill three weeks. He had been under treatment during this time both in America and another city. The patient complained of a general feeling of ill health, weariness every afternoon at four o'clock, he felt slight chill, and then pain of a gnawing character developed in the lower third of the spine, being most intense all a point one inch above the inner malleolus, on the anterior aspect of the bone. At about
10 P.M. The pain ceased, slight perspiration appeared, and he was comparatively well, until the usual period set in. The patient looked old and careworn. He was jaundiced slightly and had emaciated very rapidly—having lost according to his friends about 10 lbs in weight in three weeks. Careful and repeated examination failed to show anything abnormal in any of the systems: the lungs and kidneys were sound, there was no evidence whatever of pain, bone mischief. The thermometer showed a daily rise during the attack of titreal pain, and guaded by the periodicity of the rise, and the absence of any disease in any of the great systems, I diagnosed his condition as one of Malarial fever of somewhat anomalous character. The temperature never exceeded 101° and only reached this point on two occasions—the pulse showed a slight quickening during the febrile attack. I ascertained that
These conditions had remained since
the commencement of the illness. I put
the patient upon large doses of Quinine
10 grains, 3 times a day, freely opened the
bowels, and kept him at rest—the
result was nil. After four days of this
treatment I tried Quinine in smaller
doses, four grains every 3 hours, and
this too after two days trial was found
to be useless. The temperature still
rose regularly, and the pain in the bones
occurred every afternoon as usual.
Therefore I tried Arsenic with no
better success, then for two days
tried nine doses of Warburg's Tincture
with the result that the temperature
registered 101° on the eleventh
day. I gave him Peralde of Ammonia
in half grain doses every four hours.
That day the temperature rose as
usual, but the pain in the bones
was very, decidedly less. The next
day the temperature remained
normal, nor did the pain recur.
That third day it was a little abnormal.
Therefore the patient rapidly
convalesced without any relapse.
He soon regained his weight and was completely established in health. Six months after while away in another city, he again fell ill with an attack somewhat similar in nature to that from which he had suffered. He was treated by means of quinine for a week, but steadily grew worse. He then came to Amoora and under Perafe of Ammonia recovered in 2 days. Dancing convalescence the patient was put upon a course of antimalarial pill.

My experience leads me to the conclusion that most varieties of intermittent fever and in malarial neuralgias, in Perafe of Ammonia we have a valuable antiperiodique and a efficient and perfect substitute for quinine. It has the following advantages over quinine: (1) It is much less expensive. This is a very important matter where cases of malarial disease have to be reckoned with by the thousands annually, and that amongst an extremely poverty-stricken people (2) It is needed in much
It does not (in the doses in which it is usually given) produce the unpleasant effects that quinine does, in even the smaller doses that it is necessary to give for the cure of malarial diseases. The headache, tinnitus, deafness, disorder of digestion, nausea, depression that are very apt to follow even moderate doses of quinine, and certain, since in the larger, are avoided by using Persul of Ammonia. This is a great boon to the patient. I have found that where quinine has to be given Hydrobromide Ales much mitigates its unpleasant effects. (4) Persul of Ammonia has a distinct advantage over quinine, in cases of malarial disease which may occur during the late months of pregnancy. My experience does not warrant me in believing that pregnant women enjoy immunity from attacks of malaria. Though this opinion is widely prevalent, quinine especially in large doses in which it has been given in India, has every
powerful effect on the uterus—so much so that it is well known in America. It is largely used instead of ergotoxin. There is possible danger therefore in the employment of quinine in cases where pregnancy is advanced, and Perusal of Ammonia has in these cases, the advantages of quinine, and none of the disadvantage.

5. In cases where quinine cannot be tolerated, this drug is found to be useful.

6. In a class of cases in which quinine fails to benefit, this salt acts very speedily and certainly.

Thereby certify that this thesis has been entirely composed by me, and the work has also been done by me entirely.

Marthin Clark
M.B. C.M.

April 29, 90