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 rife 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 Lincolnshire 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 in time 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 prophylactic, and I am assured by a friend who has knowledge of the facts that to this day on any market day in Lincoln numbers of people purchase the opium; so numerous are the customers that the local druggists 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 such 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 latitudes,

as in the northern part of Europe, in swamps and marshy 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 scourge of India and of China, of Burmah of 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. Boudin the northern limit of malaria is the isothermal line of 5°C. (41. Farn)[a] He states that malarial fevers have been rife at Gefle in Sweden, 60°40" N. latitude, and he has heard of them even farther north than that.[b] The Southern limit is still uncertain, and has been variously given at from 25° to 30° S. latitude[c]

Not only 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 homeland[d]; it is "the chief source of sickness and mortality over a large portion of the earth"[e]. "Official records" says 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,"[f] while Dr Cornish Sanitary Commissioner of Madras Presidency, observes concerning malaria that "fevers are

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year with another destroy twice as many people in India as Small pox, Cholera and all other Epidemics put together. To put it in another way If we reckon the deaths annually, all the world over, according to Sir Joseph Fayrer, Malaria has killed no less than one half of those who die. Well may Dr Macculloch term it "the great enemy, the very Destroying Angel to whom the task of keeping man within bounds has been specially assigned".[a] In any returns, the actual deaths from malaria directly, represent but a small portion of the mischief it does. When we think of the secondary affections which arise from it, the constitutions it ruins so that men do not live half their days, or else go through life with suffering, and seriously diminished working power; of the blight that it is to the spread of the white race, and the formidable barrier it presents to the missionary, philanthropist, colonizer, civiliser and trader, we realise in some measure what a terrible blight Malaria is. To the practitioner in the East it is of vital moment both from its direct effects and also

[a] Malaria p. 419.

because it complicates almost every disease he has to treat. My own experience has extended to nine years of Indian practice. During this time I have been in charge of the Amritsar 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 I have 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 secondarily from malaria.

What is malaria - is therefore a most important question, and as Macculloch tersely observes "perhaps the best as the truest account of the nature of malaria would be an acknowledgement of utter ignorance". Despite the many researches made our knowledge cannot yet be considered adequate, nor can we be said as yet definitely to

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have found the poison of malaria.

We have advanced from the theories of an earlier day which sought the explanation of the phenomenon of "marsh miasm", either directly in marshes and their vegetation, or in excessive production of Marsh Gas; or phosphuretted Hydrogen, or other gas; 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 Bourdel showed by experiments made first on a sheep and then on himself and then on others, with dew obtained from marshy pools, water from marshes containing mero zoa, merospores, filaments & bacilli obtained from air over marshy places, that these substances did not cause intermittent fevers. The micro organisms varied in genera and species with place time of day and season.[a]

None of these things are malaria

[a] Progres
Med
Dec. 18. 1880

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 inasmuch as these conditions and influences have never been as yet precisely indicated the theory cannot well be discussed.

Another theory that of Dr Oldham, is, that there is no such specific person as malaria, but that the fevers termed "malarial" are, to epitomise this theory, due to cold or chill after exposure to great heat, especially after exhaust-ing labour. A vast array of facts is arrayed against this theory; e.g. large masses of people in many countries are subject to chills, who nevertheless are not subject to malaria, in some lands. Eg. Britain, malaria has almost disappeared, though at one time very rife, 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, ~~malaria~~ may serve as examples of the objections to Oldham's hypothesis, 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 get 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 cases of intermittent fever in the valleys of the Ohio and Mississippi, of a special palmella associated with cells and sporullae of Mer fungi, which he thought was the cause of malarial disease[a] and by experiments made he stated he had succeeded in communicating malarial fever to individuals with these algae

[a] Am. Journal Science January 1866

It thus came to be thought though these results were not accepted, that some form of lowly organism might be the efficient cause of Malaria.

In 1879. Klebs, Tommasi-Crudelli, Celli and others as the result of their observations in the Roman Campagna announced the discovery of "a microscopic fungus consisting of numerous moveable shining spores, of a longish oval shape about nine micro-millimetres in diameter." They named the Bacillus Malariae

It exists in the soil, water, air of malarious 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 spore-bearing bacilli, and the spores are found in the blood spleen and marrow of the bones of those dying from malarial fevers. but these observers investigated further.

They were able experimentally to inoculate rabbits from Soil washings

Times
Jan 17/80

and bacillus cultivations[a]. In 27 cases Crudelli reports that he has found the bacillus in the blood during the stage of invasion of intermittent fever, at the height of the hot stage spherules only can be found, and these subsequently give rise to a fresh crop of bacilli.[b]

[a] the bacillus does not exist in all marshes.

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1. p. 139

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 not necessary, for according to Crudelli 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 necessarily connected either with putrefaction, marshes, ponds or rich soils. A number of observers in Italy – Lanzi Marchiafava, Lubroni and Celsch and Kiemer in Algeria have confirmed the statements of Klebs and Crudelli, but they 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, still the evidence is not conclusive, that these cause the specific symptoms of malarial fevers. The evidence of Klebs and

Crudeli 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 inasmuch as similar changes occur in the spleen of 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 inasmuch as this is frequently found in the spleen of Septicaemic rabbits" – but Dr Sternberg adds that there is nothing in his experiments to show that the so called malaria bacillus or some allied organism is not the cause of intermittent fever, while the hypothesis that it is, explains many of the facts of malarial disease

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In 1881 Laveran published his researches and thereby originated what may be termed the Protozoa, or parasitical theory of malaria. He claimed to have discovered 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 that diameter. A second series of bodies were also found. These were pigmented (as also are those described above) finely granular or transparent and unshape spheroidal or irregular. Their diameter is $\frac{1}{100}$ of a micromillimetre; they are non nucleated and motionless. They appear to be the ultimate stage of the filamented bodies. There was yet another series of bodies, conical motionless, 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 disorganise the blood corpuscles. the parasite is seen to attach itself to a red corpuscle. In the blood were yet

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various changes the chief of which are (1) Red corpuscles with pegment granules and one or more vacuoles (2) pegmented leucocytes (3) free masses of pegment derived probably from the destruction of the organisms. a

Laveran found the conditions described in 180 out of 192 cases of malaria in North Africa Quinine even in small quantity 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 obstructing the capillaries.

According to this view the phenomena of malarial fevers would result from the disorganisation of the blood, and from the effects of that disorganisation 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, Skin lesions, pegmentations and that grave dyscrasia melanaemia

in which free masses of pigment are found in the blood. ~~Concederma~~ When the life history of these animalcules (of which we at present know absolutely nothing) has been elucidated we may get light on the broad facts of malaria production generally, and the mode of by which the parasite gains access to the blood. Laveran's researches have not yet been accepted; ~~Cunningham~~ Lewis 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 Heler (M.D. F.R.C.S.E.) pathologist at the Hyderabad Medical School. The observations are most elaborate and thorough and of the greatest interest and importance. Dr Heler records them in a monograph of 27 pages Entitled "Microscopical Observations on the Haematozoon of Malaria". The work was published in March of this year in India, and is not as yet obtainable in this country. Dr Heler has

isolated Laveran's malarial parasite and after carefully scrutinising and testing the researches of this investiga-tor he adopts the classification of Mitrophanow and calls it the Haemotomonas Malariae, while the following definition is given of it. (1) Body plastic ovoid or globose: no differentiation of protoplasm, which contains pigment grains; flagellae variable from one to four, highly polymorphic occurring in amoeboid form. (2) Crescents and the encysted form; (3) Sporocysts, cellular free pigmented bodies, and "to these I would add" says Dr Ikeler (4) "Spores; (5) Stellate and cruciform bodies and (6) flagellulae."

Dr Ikeler dwells on the diagnostic value of his observations in differentiating the various types of malarial fevers. He places great stress on this. The presence of the parasite merely indicates a proneness to malarial disease. When the germ has been introduced into the system, certain

other conditions are essential for its further development. Dr Heller 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 of a pure remittent the malarial parasite is to be found, while in that of enteric it is not, and this if so 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 Heller confirms the assertion made by others, Laveran Celli & Marchiafava, that the parasite is found as a constant inhabitant of patients suffering from malarial poisoning in malaria, neuralgias, dysentery haematuria, lymphatic affections, when these are of malarial origin. Referring to the action of Quinia Dr Heller says "quinine effects the disappearance or disintegration of both

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the free amoeboid bodies and the pig-
ment granules, that is the spores: this
I have repeatedly proved by irrigation
experiments" a. It would be hard
to over rate the importance of these obser
-vations, if they receive further confirma
-tion. Though we have not yet arrived
at definite Knowledge of Malaria, and
the cause must still be deemed un
-certain, we seem to be within measur
-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 those elements which exist in
soil and nourish animal and vegetable
life, if the said elements be allowed
to lie fallow or are not fully expended
in the growth of healthy vegetation;
that under such circumstances mal
-aria is produced if certain conditions
of temperature, moisture and air
be favourable: Though the precise nature
of the poison is still undetermined 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. It also flourishes in bottoms, valleys and confined places, as a plain hemmed in by hills, or hemmed in on the side of 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 of necessity 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, throughout 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 fall is little, the land is flat. They percolate the soil with their water, which percolates to considerable distances, they inundate vast tracts of country when in flood. During summer they dry up so that the largest 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 30 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 of a mile wide in the hot season, becomes

18 miles wide at Dera Ghazi Khan, and takes 12 hours, and not unfrequently from 18 to 24 to cross from bank to bank: In the last great flood in 1889, 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 rife. During the rains, every gully becomes a stream, every stream a river, and the large rivers look like seas. and it is not while the rains are that they unhealthy time is, but when the inundated lands begin to dry.

The permeation of adjoining lands by the waters of a river, apart from inundations 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,

low and large and constantly flooded — no better than marshes at their mouths. Tidal currents silt up the river 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 frail 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 carcases consigned to it, we shall see that apart from its malaria producing power an Indian river is a serious danger to public health, for it constitutes alike the drain and the water supply probably of 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 under growth. The soil is rich and not under cultivation, we have a dense mass of vegetation, a moist stagnant atmosphere, and a soil which after heavy rain has much water in it, 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 hill side becomes as it were a morass, which as it dries, becomes a source of malaria. Apart from rain, there are very heavy dews, which keep up the process. Those who have not been

been in India can have no conception of the extraordinarily heavy dews. They wet the ground as rain would do, and when one is camping in the district they 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 mosses (Hypnum) under conifers absorb up to five times their own weight of water. Sphagnum (peat mosses) 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 the Terai, a strip of country at the foot of the Himalayas, in breadth it is about 80 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 subsoil 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 projected and villages have been planted, the fight with malaria has been steadily carried on with a fearful sacrifice as a result of human life." Here 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 constantly being planted 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 to succeed sometimes

to fly back panic stricken after an unhealthy season leaving half their number under the sod".

What happens on a large scale in the Terai happens all over India on a smaller scale as the result of malaria production in jungles.

The influence of forest is somewhat different. If we take as an example what foresters term a "High forest" (that is one in which the trees have sprung from seedlings, and are much about the same age) we find at the earlier and middle period of its 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 air 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 equable. The forest is cooler by day and warmer by night than the surrounding country; it is also 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 3d 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 that of the high station (No 3) .41 less than outside. In winter the range of the low station was 2.54 less, and .61 less than the range outside. The crown station was lower than outside in summer by 1°.48 and warmer in winter .05.

The minimum difference of the diurnal variation was at night in the low

forest station when it was 1°.87 less than outside in summer.—the range being from 3°.15, in summer to .95 in winter. At 8 am the low 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 of rainfall which is connected with forests) 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 and oblique sunlight, and is also protected from air currents Malaria production cannot be as a rule very vigorous, and unlike the jungle, the poison when developed is not distributed broad cast over the land but is intercepted by the forest trees, which the jungle lacks. The forest may under some circumstances be dangerous, perhaps even deadly to those passing through it, but it will not at this stage of its growth vitiate the health of tracts 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. Grasses begin to disappear and grass takes their places. Sun and air now begin to play on the humus and soil, which receives almost all

the rainfall, the condition begins now to approximate more to that of the ordinary jungle, and the forest may then become as sure 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, there are special wet clove woods which are very pernicious in their effects but the cause of the trouble is probably 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 malaria 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, is yet of import in the vitiation of the air, the lowering of vitality and the predisposition to disease. I refer to the superabounding, teeming animal life, more especially insect life. To say that insects swarm is but feeble to express it. I 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, or termite, 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 Crane fly or daddy long legs, (Tipula oleracea) and after her hymeneal flight, she drops the wings, and having been impregnated retires into the earth to fulfil 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 eaten by birds, which were busy devouring them on all sides, yet in the morning in one room in my house, the gossamer like wings 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; swarms of land frogs, reptiles &c. &c. Of the causes of the death and decay and excuviae 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 poisoning public health, and so as it were paving the way for the ravages of malaria

It is an axiom in the Punjab, at all events almost, 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 any who may have to do with it, and will certainly give rise in them to serious outbreaks of malarial disease.

Clearance of soil, 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, to some extent 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

them 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 decays 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." [a] As regards cultivation and upturning of soil there is also need of caution, for experience has shown that the danger of malarial production is very great and serious. Masses of earth are exposed to the sun

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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 malarial disease 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. Labuan 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 earthwork, was characterised by severe malarial fevers. Such records that after forests had been cut down malaria prevailed very extensively in Pennsylvania and was at first aggravated by cultivation — here we have forests cut down, and soil 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 of opinion that clearing and cutting should be very gradually done: ground never bared but sown before

while the trees are still standing;
the cutting is done, a system of what
is technically known as "Forestry
with field crops" should be followed,
and as regards buildings, excavations,
and all operations which require
breaking up soil, it is most impor-
-tant that they should be carried
on when there is no chance of rain;
and inasmuch as the seasons are
very regular in tropical lands
a fit time may be easily chosen.

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 Bhawulpore, in the
Peshawur valley, in many a
place, without either marsh or
jungle, and more so in some
without any vegetation whatever.
We owe it to Dr Cruelli's researches
that the idea of marsh production
of malaria has, as the sole conclusion
been dismissed from our minds'

and others clue placed in our hands. While the old belief in marsh poison demonated, it was impossible to explain rationally the outbreaks of fever in the arid lands of the Punjab, and North India, in the dry sand of Estremadura where the British army was decimated by malaria during the Peninsular War, and in other similar instances. We now know that a very 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 vegetative ~~force~~ energy. Many a hundred mile 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 land barren desert again. In an earlier part of this thesis 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 vegetative

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 Amritsar the subsoil water is at 10 feet below ground. Irrigation is by wells (pakka) 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 hours the well again rose to its old level of 10 feet. During these hours we had a depth of soil of 4 feet, below ground which was practically drying after having been moistened, and if we think of this round the wells of the district, it gives us many square miles of malaria producing

land. Recent researches of French and German foresters, show that the soil is continually absorbing and exhaling air; this 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, especially if this be at all porous, and in a porous soil air will make probability be forced in until checked at the subsoil water level. We thus have a 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 what land in the soil. We have thus an hitherto undescribed factor in Malaria production, and one constantly in operation. Some of the Malaria thus produced is doubtless exhaled, as air is driven out of soil by the rising subsoil water or by ascent of heated currents. Some of the poison however remains and is washed into the wells; this source of infection is most important; for malaria is doubtless drunk in as well as inhaled. Subsoil water is affected also by the seasons, heat, rainfall, and these factors therefore all bear

in production of malaria ~~also~~. Sometimes too we have great rifts and chasms formed in the ground, by which rich moist new earth is exposed to air and sun, 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 so is increased the unhealthiness of a place: the nearer the subsoil water the more ~~bad~~ malarious the locality. The barracks in Belize in British Honduras were built on the Delta of the river – the subsoil was water logged and malarial diseases were very rife – 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

British Med. Journal June 30. 1875

Some years ago for strategic reasons new barracks were built near the railway station. They are roomier lofties and immensely better than the old ones. have every modern improvement and the soldiers sleep on 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 Dr Hamilton, who was in charge of them[a]. Amritsar was at one time looked on as a healthy resort the subsoil water was in 1859, 40 feet below surface. Since 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.

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We may have severe forms of malaria present. where there is nothing but rock, neither soil nor subsoil water; such cases I have 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 fungi[a], while another observer Dr Black, states that it is "so porous that it is something like a mineral bog" The moisture requisite, in the absence of rain and subsoil water, must I should think be supplied by the heavy dew. But in all instances of malarial diseases in places where it cannot apparently be easily produced, we must not forget the possibility of infection from a distance. I think most probably many places are infected from malarial places far distant from them. Malaria appears to the heavier than air, & given winds powerful enough to propel it, but not strong enough to dispel it, there is no valid reason why it should not

[a] Med. Journal 1875-79.

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 the converse also holds 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 infective area is in all likelihood a place called Zaidah situated inland, where the conditions for malaria production are very favourable. A striking instance is presented by the Kangra Valley in the Punjab. At certain periods of the year it is a vast rice swamp, and may be, like all rice fields rapidly 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 Himalayas rises up from this valley to a height of 17,000. At the bottom of the mountains 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 7000 feet. and it is to be noted that not the houses and villages on bluffs and knolls suffer, but those along the water courses and gullies that score the sides of the mountains The malarial poison is blown up there, and is kept compact for many miles. Between the high banks of the water courses there are two currents a descending one of ~~malaria~~ water and an ascending one of malaria. Above 7000 there are no villages, so that seaward day of the poison goes further, but it steadily decreases in its intensity as far as one can observe it, with every 1000 feet of 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 Kangra Valley slope, to which the clouds come with the monsoon, the fall averages 144 inches per annum, but the mountains so effectually stop the clouds that the further side is practically rainless. In selecting sanitaria in the hills, 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 supply 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 below is colder than the hill side 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 intense — by chilly me — even in the hot weather the feeling of cold is quite remarkable. These hollows are always the coldest places. In one instance an officer pitched his tent under a projecting bank, about 15 feet below the ~~surface~~ 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 cold air basins 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 only 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 miseries 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

traversed with safety. 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 tombs perched up above the plain,[a] the American Indians sleep in trees,[a] the workmen of the Panama Canal, slung their hammocks at night in the highest trees, with the best results,[a] the people of malarious tracts in Greece and in the Pontine marshes sleep on raised platforms.[a] Sleeping on a second instead of a ground floor confers marked immunity. Hunter records that cases of malarial fevers in Kingston Barracks, Jamaica were 3 on the ground floor to 1 on the second.[b] Ferguson relates concerning Antigua, that while soldiers on guard duty at the docks below were almost infallibly struck with mortal disease in the course of a night or 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.[b]

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In two very unhealthy situations I have seen very substantial benefit result by changing the bedrooms from the ground to the second floor of the house

The danger of sleeping on or near the ground is that the production of Malaria is as active during the earlier part of the night as it is during any portion of the day; with this difference that when malaria is evolved during the day, it does not concentrate but is dissipated and carried into the higher regions with the heated air currents. It is different at night. After sundown the heated earth takes longer to cool than the air: in fact the earth can hardly be said to cool at all, except in the early morning. I have found it unpleasantly warm to the naked foot at 10 PM after a June day. The heated earth continues to evolve malaria, and this now accumulates on the surface of the ground; we therefore find it concentrated 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 rarefication, 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 exposing themselves either to night dews, 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 propulsion by air currents is important. It can I believe 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 a city or by other obstructions of the like nature. This view has an important bearing in India on Cantonments

measures ~~in India~~. 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 pathway almost lean to each other; and the total 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 well considered, and the improvements be very carefully done. In the East every thing 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 in many instances 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 our experience, acquired under totally different conditions of life, national social and climatic is not for the benefit of the people. We should study whereunto 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 bath water also throw away the child". Now straight and wide streets and free air currents are doubtless good, if we can also stop the evolution of malaria round about a city otherwise 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, scorching 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 malarial poison. Drainage again is comparatively easy in our sea girt island 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 conservatism in these matters, the outcome of an utterly different set of social customs traditions and beliefs, to those that obtain amongst us. Then again while a rich 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 of its cities are 2000 miles from the sea and inasmuch 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 in the houses according to the western ideal, and yet the worst cases of malarial fevers 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 not undervalue the blessings of modern sanitation. Sanitary science has a great future in India, but it must move cautiously and adapt itself. Wide streets were a good when malaria production ceases. Faecal matter

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 inasmuch 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 scorched by a fiercer glow" [a]

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XV. 43

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 23d Regiment (Welsh Fusiliers) and these buildings ran in the same direction and to the same extent as the Artillery barracks So that these, the latter were completely screened

from the swamp. Very fatal 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 thus doubtless contributed to the result recorded; but the quinine was begun after the malarial outbreak had established itself in the 23d 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 this 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 buildings. Another case in point is that of Mian Mir, this is one of the greatest military cantonments in the Punjab. It is very regularly and carefully laid out, in wide straight roads

with any building. It has every modern improvement, yet it is notorious as being one of the most unhealthy of all Northern 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 a typical 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 Mir, and exposed to the same sources of Malarial infection as the Cantonment, (only in a larger degree for Lahore is on the Ravi river with much marshy land near) malaria 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 malaria, than the European with better surroundings. The result is due in part I think to the fact that the open streets are much more malaria swept

them the crowded narrow town.

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 occured in Amritsar in 1881, when there was a malarial pestilence such as is seldom seen even in India. Amritsar in the Central Punjab is 1,500 above sea level, and is distant about the same number of miles from the sea the fall being approximately a foot to the mile. It is built in a sort of shallow dip or basin about 3 miles in circumference = the land being flat, a part of the great plain from Peshawur to Calcutta about 2000 miles in extent. It lies between two rivers the Ravee and the Beas, close by are two very large irrigation Canals, and many million tons of water are annually turned on to the Soil. There is no subsoil drainage, the subsoil water has risen from 40 feet in 1859 to 10 feet in 1891 - it is still rising. Places that were gardens when I first went there are now marshes. The soil is a

deep rich clay. There is a most luxuriant vegetation, there are huge gardens in great numbers, regularly flooded twice a week by the canals, filled with decaying vegetable matter and the debris, and ecurviae of 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 half dried mud, with the outermost ring crisped broken and curled up in proportion as it has dried; dead bodies of animals not 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 pious 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 bathing 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 additions 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 1881 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 1881 it amounted to 52.2 in the city and 68.5 in the district. Immense lakes were formed in all directions; the subsoil 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 malarial

diseases appeared in a well marked sequence. Intermittents as the drying began, remittents, when it was more advanced, and in September when the whole land was bare, a most malignant type of (malarial) 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, railway 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 19 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 it usually is. Two hundred corpses 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, from 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 you entered the city in quite a different air, and healthy European adults who had just come from the hills as they crossed this malarial line were at once seized with vomiting, pains 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, those in the district some miles away had not more than their usual amount of malarial disease at that time of the year. The same fact was noticed in 1890 in another part of the Punjab, a large district instead of a city. In this year a malarial pestilence like that which had occured in Amritsar broke out in Gujerat District. It began in September and lasted through October. The mortality was very high - according to official returns only one person in every 1000 escaped an attack: yet the

pestilence confined itself very remarkably to that one district: A very remarkable instance is recorded by Dr Dworky. He took a new house in Carlisle in a locality where the soil had been a good deal disturbed to make new streets. Fires were burnt all through the house, but on the first night - he was siezed 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 limitations of the malarial influence to the house and so many yards round it. So well defined was the limit of its operation that I could at any time stop a paroxysm by going a certain distance from the house and invariably did I feel its influence on returning within the vaunted area as a paroxysm supervened the instant I entered the house which appeared to be the very focus of the malarial atmosphere round."[a]

The outbreaks of malarial pestilence in America recur in a curious cycle of 7 years - why I am unable to say. In 1888 another period of pestilence similar to that of 1881, but much

[a] Irish Journal p 39 75.

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 Amritsar and we trust the melancholy record of the two years of epidemic will not again be repeated

The malarial poison 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 malaria which passes over its surface, or in the case of wells through the subsoil 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. Streams flowing through the Terai are often very dangerous because of the malaria in them. In 1884 a party of workmen sent to repair a bridge over the Chuka drank of this stream, and out of 30

only 3 escaped 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 regions colonies established at a village called Burhwa, were annihilated by malaria time after time. A well 40 feet deep was sunk some years ago, and drinking water taken 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 invalid their employes once every fortnight, they are enabled to retain a permanent staff. The streams that are known to be deadly all rise in dense forest and are overhung by 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 moot 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 germs

and there is consequent infection of the milk. The same reasoning would apply in the case of Malaria. The buffalo, whose milk is largely used – is an animal that delights to wallow in the mud of marshes, and it spends the hot weather 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. Malaria must enter plentifully into these animals. They are said to have attacks of fever – but of this I cannot speak from personal knowledge – I have only myself seen one day 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 tubercle.

The Mosquito has I am 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

insects, nor of the intense torments they cause. Their poison is said to be weight for weight more virulent than that of the Cobra. They predispose to malarial fevers by the intense irritation caused by their bites, the restlessness, 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 As some insects carry the pollen of one flower to those of another plant. so mosquitos may transplant the malarial germ to a suitable medium, by directly inoculating their victims with it. The eggs of this insect are laid in water and the larva 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 fulfils a part

in its transmission, both by inoculating with the germs derived from its birth place, and those imbibed from the blood of persons suffering from malaria on 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 Amoy[a], and thereafter by Cunningham & Lewis who found that no less than 14 per cent of the insects caught at random and then examined contained filarious embryos[b]. If the germ of malaria prove to be a Haemal zoon, mosquitos and other such insectorial insects will be found to have have a share in inoculating their victims (1) from the original source of the poison (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 of water in which they breed and die.

[a] ...ina ...stoms ...port No XIV 1878

[b] ...ological ...l Patho- ...real ...searches ...ons - p 620

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 cornfield, - so that one can go hundreds of 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, mosquitos 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 perching sun, shining day by day in a cloudless sky. The sun is unbearable by 8 a.m. and to the long weary day succeeds the intensely hot stifling nights; insect pests abound - at night the

hot breeze blows, like the blast from a furnace - the whole land reeks with heat. Every thing that has life seeks shelter and shade - The very 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 blotted out, an inky darkness overspreads the sky, there is a furious hot wind, bearing with it an avalanche of dust; this bursts on 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, in an incredibly short space of time the heavens which have been a cloudless blue for months, are overcast. lightning plays all round, and from every quarter are heard the mutterings of the gathering storm. It soon begins to rain as it only does rain in tropical lands, - for 18 or 20 hours. What graphic language

Gabriel Wells "the dense hazy atmosphere loaded with the exhalations of putrid insects and reptiles and of the soil and its vegetable productions, after remaining for a time stagnant and suffocating, enervating those who were destined to breathe it and infecting their circulating fluids, suddenly becomes kindled into the most vivid commotion, sweeping before it whatever opposes its progress, and blazing out into an Ocean of flame which seems momentarily extinguished by the torrents of rain which rush furiously to the earth, and is immediately lighted up to its greatest brilliancy and widest extent: so that the atmosphere presents the most extensive and the most sublime conflict between fire and water which the imagination can paint whilst the irresistable force of the wind seems to sweep both combatants from the field". At first the rain disappears as soon as it touches the hot soil, then later on pools, and vast shallow lakes form - rivers come down in flood inundating enormous tracts of country, a luxuriant vegetation springs up in all haunts: the temperature falls 10 or 12 degrees in an hour, the dust is laid, and the whole land looks joyous. Now insects increase ten fold. When the rain ceases, the sun shines with old fierceness and now the whole country becomes one great vapour bath, and so it continues till the next down pour. These alternate dreadnings and

continue during August and early September. During this period malarial diseases are steadily on the increase In late September the rains are over the moist heat begins to die off — under the hot sun the process of drying sets on quickly, the days are hot but 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, but the poor ill fed natives 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 face to a minimum in February So that the two most unhealthy months of the year, as regards malaria 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 activity 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. They acquired the poison there, 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 masks that disease, aggravates 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

itself after 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 I am inclined to think a critical period, for those who 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, about 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 in their 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 ~~to~~ there had at work in

India. (of which they are deprived during furlough. and for which many distractions inseparable from change of country are substituted.) as well as the very great increase in purely physical exertion which Home life entails, are as potent as factors in favouring malarial outbreaks as any change of climatic conditions.

As an instance of how Malaria may lie dormant until roused 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 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 Lobar (Croupous) Pneumonia, which affected the base of the left lung, and ran a typical 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° F.

very seldom reaching the latter figure, being more usually about 100·2. This rise was regular in its occurrence, highest 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 appearance of profound malarial marasmus: the skin was tinged, he had greatly emaciated, the usual evening rise persisted despite all treatment. There was no organic lesion anywhere, to account for his 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. Change 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 go on board ship, and his condition during the voyage caused anxiety; after he reached India, to the astonishment of every one, 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; 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 peculiarity in those affected it too has its share; it is difficult otherwise to see why the same person should in one case produce fever- quotidian, tertian or quartan,- and in another neuralgia, hemicrania 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 outburst occurs, we have, in proportion as the land dries, intermittents, then remittents; and finally the more pernicious forms of fever. At the

commencement of the intermittents it is stated that the tertian is the common type, as the character of the epidemic gets severer quotidians obtain, and as it begins to die away the quotidian 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 — met with in certain epidemics, in which the intensity of the poison very rapidly destroys life.

Geographical distribution Some tropical diseases Elkin p 15

Though fevers are the chief manifestation of malarial poison, they are not the only diseases produced by it. It has a direct causal relation to Dysentery 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 neuralgias, insomnia, melancholia, Bronchitis, Pneumonia Asthma and a variety of respiratory affections. We have a large number of diseases of the the Digestive tract, and

allied organs; skin eruptions, too we have, affections of the Spleen, hemoglobinaemia, and profound anaemia
Quite a large number of people in malarious tracts do not get any fever, but they fall into the most extreme anaemia accompanied usually (not always) with splenic enlargement. There are diseases of special senses too to which this poison gives rise; such as loss of vision, otitis, and other aural diseases[9]
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 paralysis of portions 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 affected are usually small, and other areas supplied by the same nerve are unaffected.
The nerves are such as the Ulnar, Median, &c.
The affection may occur in the course of a malarial fever, more usually however it ensues from or

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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 functions of the part and the trophic remain unaffected. In a few of the cases there was at one time or another perverted sensation 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 dorsal aspect of the or on the outer aspect of the leg, the inner side of the thigh, the skin about the knee and shoulder joints. It has always been unilateral but the cases recovered in at intervals of 10 days to a month.

Even when there is no actual disease present the malarial poison is inimical to the life especially of Europeans. The fevers and other diseases to which it gives rise are bad, but the true scourge of malarial countries

is the chronic malarial infection of the system that goes on day by day. It is thus that causes deterioration of the race, and saps the strength and destroys the life of the individual individ-ual. 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 soon renders acclimitisation 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 Gran Coast of Guinea this toleration 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 inimical to Europeans, and is unfavourable even to ordinary domestic animals, the horse the dog, 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.[b] In India according to Surg. Fayrer the Tharoos, who inhabit the Terai appear to enjoy a comparative immunity from malaria[a] — 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 acclimatiser by sweeping away all who could not withstand its ravages, while from those who could, sprang 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. Amongst civilised peoples

[b] Diseases of India p. 88

[a] Climate & Fevers of India p. 27

not only is the selection of individuals and species impossible, but in addition the provence of medical science is to keep alive the weaklings of the race by appropriate measures. The malarial poison is so peculiarly inimical to the white races of mankind, that it is not possible to establish a tolerance of it. In Georgia (U.S.A) Annesley records that white women seldom attain the age of 60 and white men seldom that of 50, unless they have attained adultage before they settle, in which case the prospect of life is good.[a] According to the same author, at Petersburgh in Virginia no white has ever reached the age of 23. There was one who attained the age of 21[b], and he was very worn down and decreped. In India where there is ample opportunity for observance, 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 inroads. There is no such thing I believe as resistance

[a] Annesley Diseases of India p. 88

[b] Ibid,

as a third, or second generation even, of Europeans in India, born and brought up in the plains. It would be impossible to rear children there: even when brought up in the hills their stock tends to die out in the 3d generation. European children in West Africa seldom reach the age of 10 years. In India even 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 beset with many perils. If we consider the high position of life occupied by the parents 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~~ 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 boy of 3 years: presented a typical instance of this Malarial Infantile Marasmus. Bright and precocious in mind, he was stunted and blighted in body, extremely thin and weak with tinged 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 3 days. Latterly the attacks have ceased (the last was at the end of January. 1892) and

the little lad has begun to thrive. Another hot weather in India would probably have killed him: and for this one lad who has been brought Home, many another dies in India. The treatment necessary in such cases is removal from India, and thereafter long continued small doses of Quinine (if there be no fever, larger if fever occurs) and Cod liver 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 in the youth who is unfortunate enough to go there with his constitution not fully developed He suffers greatly from Malaria, and either succumbs [illegible], or has to be invalided home, shattered in health. In a case under my own observation a youth 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 unformed constitutions, while those who go after they have attained maturity, do not the less have their constitutions steadily undermined by chronic malarial infection, so that with each year life in India becomes harder for them. Their bodily fibres lose tone, they become much more susceptible to heat and to cold and less able to stand the inroads of disease. Acclimatisation is not 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 maintainence 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. ~~In~~ ~~to~~ As an ordinary rule they represent pairly the periods after which it is necessary for the European to good health, to take furlough if he is to maintain his constitution unimpaired. Prolonged residence beyond 7 years is possible, but is not advisable There must be a longer period of rest and change in much cases to restore the balance of the constitution, and often the prolonged residence has reduced the vital and recupera - 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 of inducing a primary attack, according as the individual has suffered previously or not: other diseases, exhausting evacuations, 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; thus inactivity of mind 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

induce it. A very common cause of chills are punkahs. 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 in the hot weather cause violent perspira-tion, especially if one is away from the influence of the punkah: and when one is again within its range, rapid abstraction of heat is followed by chill. At night chill is still more common. The nights are sultry and most stifling, even with the punkah, and quite intolerable without. It frequently happens that the punkah 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 punkah puller awakes, or is awakened, and pulls violently - the result is a very thorough chill. If the punkah is bad, other heat alleviating appliances which act by directly lowering the temperature of a room are infinitely

were. Chief amongst these are Thermantidotes and Tatties: 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 disastrous chills. Of the two, the dry air currents induced by the punkah are much the more preferable and healthy. The irrational life too often led by Europeans in the East is also a powerful factor in the production of malarial disease. After a troubled hot weather night many people rise at 5 am, to take exercise in the only cool part of the day, between 5 and 6 Am: after a cup of tea and a little toast they go to work until 10 or 11 Am, when breakfast is taken. This is in the dejeuner a la fourchette style: there are usually many dishes, highly seasoned, and as the day wears on, the effect of these and the heat is to cause

thirst; this is aggravated not relieved by "pegs" - a peg being a variable amount of Brandy or Whisky in Soda Water. Lunch (Tiffin) at about 2 P.M. is another breakfast; the heavy meal is not conducive to refreshing slumber, and so the afternoon siesta 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. Alike in food and drink and social custom abroad we are too much wedded to the traditions of home, and not unnaturally — but we too often find that that which is not actually beneficial, was at all events innocuous in our cold northern home land, is not only unsuited to our new surroundings, but is positively hurtful. To most men in India the life is one of intensely hard work, under unhelpful 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 preventitive 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 organising measures to prevent the production of malaria, are based upon a study of the conditions necessary to give it 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 in detail 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) 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 unhurt through tracts of country which are ordinarily pestilential. It may make all the difference in the world to an army, or an expedition 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 of lands is most important in this respect: by 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 of its 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 carefully calculating the capabilities of the soil, (based on its nature and composition) to retain water, and by adopting a minimum system of ~~drainage~~ irrigation; we may so 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 thousand miles of desert land into fruitful ground, it has equally indubitably been and ~~has been~~ will increasingly be a source of sickness and death to vast multitudes of peoples.

Where drainage works may not be possible or may be too costly we may achieve the same object by judicious training of rivers, by means of embankments, and we should thus be enabled to protect great tracts of land from inundations 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, all that drainage 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 soil. We have noted that rice fields, one of the worst haunts of malaria are perfectly 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 diseases is in direct

ratio 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 malaria production ceases. We can imitate this natural process, and attain the same object, by flooding all 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 swampy grounds, near cities, valueless ~~as~~ either for crops grazings or building lands, and a fruitful source of malarial disease, which were they but flooded, might be objects of beauty 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 source of 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, by a little arrangement to ensure a constant inflow of water, and an overflow, 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 flood malarial spots, 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 subsoil water rises into it, it may in

in turn become a focus of infection. Lands reclaimed by covering with soil, should never be allowed to lie fallow, In Amritsar they are being utilised largely for market gardens. This is a welcome addition of food supply to the teeming population of the city, and the profits derived go far towards defraying the cost of the original works — but the difficulty is that in tropical lands it is impossible to grow crops without constant irrigation, and thus the new soil is being steadily infiltrated and the subsoil water continues to rise, and in time I believe it will be found that a great mistake has been made, and that the form of cultivation adopted has rendered nugatory 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 object 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 hygienic importance is 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 malarial production.

Belts 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 malarial - however that may be, (myself do not believe that they do) they undoubtedly intercept it, and thus mechanically act effectively as antimalarial 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 act injuriously by intercepting malaria on the wrong side – by keeping it near dwellings and cities that is instead of interposing between them and malaria. Of suitable trees there is no lack in the East. The tall stately forest trees, with dense foliage are undoubtably the best. Trees of what is technically 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, Acacia the various Palms also, and many others of the most valuable Eastern forest trees The trees chosen should be of what is known as the "Shade enduring" species with dense crowns, which effectually screen from winds, and accompanying malaria, which intercept malaria measure the rainfall, and which ~~effectually screen~~ completely protect the earth from the sun

In this Shade enduring category, there are a very large number of majestic trees, valuable alike for beauty and 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. If 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 specially beneficial effect in malarious lands. by a specific influence which it exer-cises 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 on 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 malaria prevails exc-tensively, at all events in the centre of the island and the northern portions, as has been established by Professor Liversedge of Sydney (Lancet Vol II. 1884. p. 797) In the Roman campagna Professor Tommasi-Crudelli shows that at the Fontane where the Eucalyptus was extensive-ly grown, there was a singularly bad outbreak of Malarial fever in 1882, while the surrounding villages were free from disease. (Lan-cet Vol II. 1884. p. 797). The fact appears to be that in Europe, or at all events those parts of Europe in which the tree has been grown it has been found that the culti-vation 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 large trenches have to be dug. This excellent drainage system, has an undoubted influence on 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 a very quick grower, 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 counteracting its effects when produced. To me it has always seemed a particularly useless tree from the point of view of non 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, planting sun rays or from driving rain. The tree gives shelter neither to man nor beast nor seed: 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 knowledge I am the first to draw attention to its unique capabilities in the reclamation of malarious lands. I refer 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 marvellous 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 brings it to perfection. Its cool, deep, fresh green leaves are a most refreshing

sight 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 malarious land arises from the immense amount of water which it absorbs. The tree can be planted in the most water logged 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, inasmuch as most of its bulk is nothing but water, it rapidly dries in the powerful sun, and

dry debris goes 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 malarious land. I have yet 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 that go to its production, ~~one~~ one of the most important is suitable clothing

Chill 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 to use suitable covering at night. The danger of malarial infection may also be warded by a consideration of prevalent winds, and making encampments to the leeward of malarial localities, or by being sheltered by an intervening belt of trees or expanse 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 bed 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 decidedly prophylactic effect, and so I am inclined to think has tobacco

The smoker creates an artificial atmosphere around himself, it is warm, obviates damp, and saves from unwholesome smells, and in addition the practice of smoking when moderately indulged in, soothes and tranquillises 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 it distinctly discourages the attacks of mosquitoes.

More direct methods of prophylaxis are to be found in the administration of various drugs, whereby we try to ward off the attacks of malaria, and since according to the views of some the production of malaria cannot be satisfactorily controlled by us, and the hope of victory in the battle with malaria lies in rendering the system of those exposed to it unpregnable 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 it ought to be taken when

malaria is rife. The substance which Crudeli prefers is Arsenic. Recchi in 1882. administered it to 455 persons the doses were from 1 to 8 milligrammes. Of this number 338 persons are reported to have been cured or prevented from contracting fever (malarial) In 74 cases the results were doubtful and in 43 negative. It is clear from these investigations that if the drug is not always preservative against malarial infection it renders the organism less and less susceptible to the malarial ferment. (Brit. 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 anaemic and ill fed - and because of its active character its administration has proved 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 hazziest 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, lest he should forget to take it when the proper time came. They have many erratic notions which make it unsafe to trust them with powerful drugs both on their own account and of those around them. As an Antiperiodic I find small doses of Arsenic are of no avail, the drug must be given in large doses, such as four minims of Liq. Arsenic. 3 times a day to begin with; and inasmuch as patients come from long distances 3 or 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 safely done, and

this is also a fatal objection to its use as a prophylactic amongst uncivilised 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 antiperiodics. 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 Acid. I have not had sufficient opportunity to observe whether these Arsenic eaters are exempt from the attacks of Malarial diseases. Of acclimitasation I have already written, if it was ever possible, it is not possible now for Europeans. As regards the peoples of India, (a portion of the same Aryan stock as ourselves) 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

where 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 Hindu 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 imper-
fect that Malaria has had full
sway. and the principle of selection
and survival of the fittest, every 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 person; 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 influences
by the use of anti malarial remedies.
Arsenic I should not recommend,
because I have found it uncertain
and its 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 those 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, is 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 when 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 doubtless a central origin, and is one of the effects of the poison on the central nerve centres. It is apt to be obstinate. It exhausts the patient and interferes alike with the administration of food and medicine, and thus not infrequently adds greatly to the gravity of a patient's condition.

In two cases which came under my care it was the only form of malarial manifestation. I was called to attend a child of 2, who while in apparent good health, was seized with violent vomiting. There was nothing in the history or appearance

of the patient to account for the symptom
A teaspoonful of ale, the administration
of such drugs as Acid Hydrocyan. Dil.
or Bismuth, caused vomiting, and pro
tracted retching. In 24 hours the child
was unable to retain even a sip of ale.
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 3d and 4th
and fifth days, the temperature showed
a like record, and despite all treat
-ment 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; Hydro
cyanic Acid, Bismuth, Magnesia,
Chloroform, had all been tried, but without
any effect. The course of the temperature
suggested to us that this might be
an anomalous case of Malarial

purgeing; on the 6th day four grain enemata of Quinine 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 thereafter 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 blistering beyond the ears. This was first tried some years ago by a Belfast surgeon. I have continuously adopted the practice with almost uniform success, though sometimes it fail. The resulting good is due to reflex stimulation of the Vagus. When the vomiting is a really serious symptom, it is best to abandon

all medication and feeding by the mouth. They attempts only result in distress to the patient. Medication should be hypodermic, and feeding should be per rectum. For the racking 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 Malarial 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 cut short, what would in all probability have been, a severe Remittent fever. In numberless instances in my practice the use of these remedies, has enabled the patient to be up and about

at the end of three or four hours instead of being prostrated by the tertian quotidian or quartan attack for 18 hours. and in cases of severe fever, commencing in patients, these remedies have caused a protracted illness. This is illustrated by the following case. I was sent for to see a child aged one year and nine months who was suffering from fever. He had been noticed to shiver and groan, that morning and then he grew hot — the temperature was when I saw 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 every 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 am. it began to rise steadily, and did so hour by hour. I concluded the case was one of Remittent Fever

A

Remittent Fever
Effect of antipyrin

Records of Temperature, Pulse, Respiration and Stools, from Day of 18

In the Case of Aged Occupation

Day of Malaise	1	1	2	2	2	2	2	2	2	2	3	3	4	4	5	5	6	6	7	7
Day of Disease	M	E	M	12 AM	1·30 P.m	3 P.m	4 P.m	5 P.m	6 P.m	7 P.m	M	E	M	E	M	E	M	E	M	E
CENT. FAR																				
41° 106°																				
105°																				
40° 104°																				
103°			A M																	
39° 102°			9				ANTIPYRIN Gr 15	do												
101°																				
38° 100°																				
99°																				
37° 98°																				
97°																				
36° 96°																				
Pulse																				
Resp^n																				
Stools																				

ARCH^D YOUNG, SURGICAL INSTRUMENT MAKER. EDINBURGH.

of a severe type; I had never before given Antipyrin to an infant - it was a drug then but newly introduced into Indian practice, but I resolved to try it in this case. The action was very marked, and as will be seen by the accompanying chart A, it reduced the temperature steadily and permanently; it was very interesting to see the temperature coming 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. How it acts 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 fail. 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 Amritsar is cured by a change 10 miles away - into a purer air, but

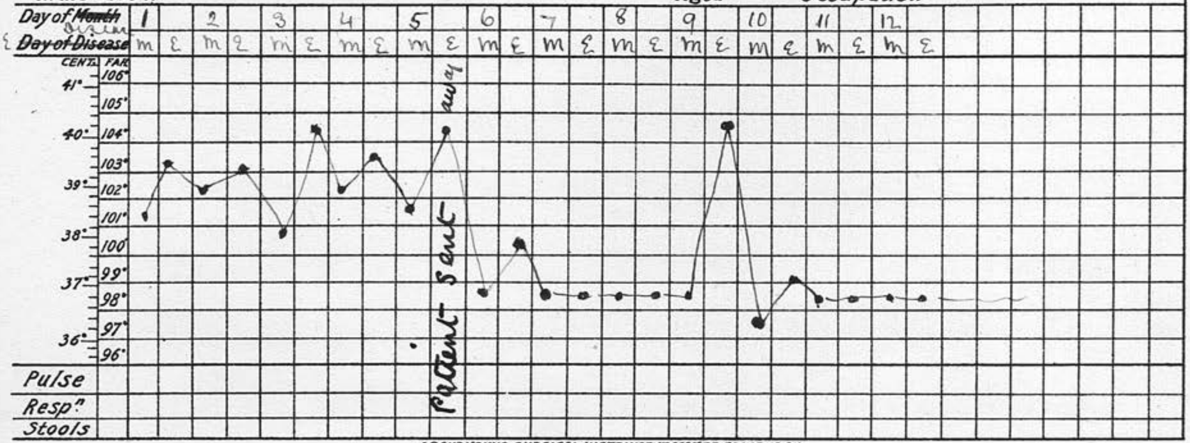
curiously enough a fever contracted at the place 10 miles away in the country, which resists all remedies, will at once begin to improve when brought to such a centre of Malaria as Amritsar. The composition of the atmosphere is singularly uniform all the world over, wherein the potency of a change lies. 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 Puerperal ~~Septicaemia~~ Pyaemia. 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

B Remittent Fever. Effect of Removal

Records of Temperature, Pulse, Respiration and Stools, from Day of 18

In the Case of Aged Occupation



ARCH^D YOUNG, SURGICAL INSTRUMENT MAKER. EDINBURGH.

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 in 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 B. If he remained in Amritsar the prognosis appeared to be grave. I therefore sent him away to a hill station, on the journey many difficulties were encountered never-theless despite the rough road, his temperature fell, there was one attempt at recrudescence of the fever, otherwise his convalescence was uninterrupted:

But perhaps the most remarkable case is the following. Miss —. aged 28. contracted Enteric 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 a peculiarly intractable nature. It was characterised by a high temperature, long continued, with slight remissions. The patient's condition was grave. Inasmuch as all treatment was utterly futile 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 a rough country, the patient being carried by men, as she lay in her bed, two rivers had to be crossed In view of all 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 steadily between 103° and 105°. The pulse was very feeble, 120-130 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 even 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 2 hours. The lowest point was at 8 PM, a rise 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 7th and multiples of 7 days — when then were decided, and the range of temperature also was lower as a whole during those 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 a mile when she collapsed, and appeared to be moribund: The journey was continued, and she rallied when 10 miles were done, though it was time 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 of travelling and trials of the journey, fallen to 100.° the pulse was 95. Next morning the temperature was ~~not~~ subnormal, and convalescence thereafter proceeded without a single bad symptom.

Several other such cases have occurred in my practice, in which remarkable results have followed removal of almost hopeless cases, in some instances to a more malarious locality, 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

Colonial Surgeon at Labuan 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 to see if life still ~~remained~~ respired, yet as the ship put out to sea, he revived and eventually recover-ed. It is to be noted as a significant thing that changes of locality were desired 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 ~~the~~ cases of the cachexia ~~Marasmus~~ of malaria by any thing 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 almost daily and 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 symptoms 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, in the voyage her health improved considerably, and in the year that she spent in Tasmania, she had not a single attack of fever, or of malaise. 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 experience - in this instance she went straight to Tasmania, and she has been there now nearly ~~18 months~~

two years and a half, during which time she has been untroubled by Malaria

Quinine to be efficacious in Malarial outbreaks, has to be largely given. There are two ways in which this is done. We may give it in small doses, such as five grains frequently repeated, or less often and in 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 Cinchonism. And it is well to continue the drug in steadily 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 flavour 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 that the

bodily state is low during an attack of malaria, or from some peculiarity 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 erysipelatous blush 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. Arrack punch makes a great difference in the action of this drug. frequently when even in large doses, it appears to have no effect in the disease, after free purgation, in smaller quantities, it is rapidly effective: 2 grains with a purge given equal in effect to 8 grains without. Spirit of camphor 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 vomiting is not nearly so good as free purgation. Vomiting is also

much more disagreeable and exhausting for the patient, and when once in a malarial case the action has been excited, it is difficult to check it so that not unfrequently the vomiting ensues, and becomes a very serious feature in the management of the case.

Ipecacuanha has a specific effect on another manifestation of Malaria – Dysentery; 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 Hutcheson under whose practice it occurred) The patient a gentleman aet. 57 (?) was siezed with malarial fever of a severe Quotidian type. Quinine, in full doses, did not appear to influence the course of the fever. On the 4th day, instead of the usual 10 gram dose of Quinine in the morning, Dr Hutcheson gave the patient 4 grams of Sulphate of Quinine in combination with 1/2 a gram of Pulv. Ipecac. The temperature

rose but did not reach its usual height. (between 103° and 105°) being only about 102°
During the day Quinine only was given. Next morning 4 grains were again administered together with ½ a grain of Ipecacuanha, and the usual diurnal rise was postponed by about two hours, and was lower than the day before. (between 101° & 102°) During the day Quinine alone was administered The temperature rose only slightly next day, (100° & 101°) after the usual dose of Quinine and Ipecacuanha, and thereafter became subnormal, and convalescence was established. The Ipecacuanha in this case had a very marked effect. It has a tendency to cause nausea, even in small doses: the Ipecacuanha yields Emetine, which was introduced into Indian practice as a substitute for Ipecacuanha in Dysentery, by Dr Harold Browne is likely to prove a great boon in the treatment of Hepatic disease, and it has its use in cases of fever also. The Emetine is extracted from the

Ipecacuanha: the drug then no longer nauseates or causes sickness, and its specific properties are left unchanged. The substance was introduced 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 perfectly successful. I have had no experience of its effects in Malarial fevers.

In no malarial fever are we satisfied 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 subnormal, in these cases we know that the fever has passed.

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

This remedy was introduced into practice by Dr Charles Warburg, who has pub-

published as composition. It consists of a tincture (made with Proof Spirit) of Quinine in combination with several aromatics and with Socotrine Aloes (1 in 40) Opium (1 in 4000) Rhubarb (1 in 25) Camphor (1 in 500). The proportion of Quinine is 1 in 50.7 In this tincture the activity of the Quinine 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 special 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 inert. 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. I have had a very large experience of this drug, in severe

continued Malarial fevers; and I look 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 stock 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 troublesome, but much depends on it. The Tincture must be given pure without any admixture of any other substance whatever; it must be given on an empty stomach and not even a sip 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 (3iv). 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 one which I employ, except in urgent cases, where Quinine fails. The cases treated by it 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

dose of the Warburgs' Tincture required 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 required by the mouth, the patient's strength is maintained by nutrient enemata

The great drawback to the employment 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 persistent. This can be minimised by a little management. In giving the tincture it is best to open the mouth wide, and to pour the liquid in as far back as possible; in few moments the patient may be allowed to rinse the mouth with a little acidulated water.

The following case will illustrate the value of this remedy.

Mrs — . age. 28 — was confined on the

25th of 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. On the morning of that day she complained of lassitude, and not 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 P.M. 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 it had done the day before, to about 104°.

During the day, she was troubled by frequent perspirations, and the chilliness recurred periodically. After 10 P.M. the temperature again fell, and next day the usual rise took place, up to 104° = 104.6° or so 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 thoroughly 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 later at night, and to register a higher point on the thermometer each successive day.

On the fourth day, I gave the patient half an ounce of Warburgs tincture, one hour before the usual diurnal rise

the rise took place, but the maximum reached was only 102°; after three hours interval a second dose of the Tincture was given and the temperature fell rapidly to subnormal; being subnormal that evening. 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 Warburgs Tincture has to be employed after the course of the fever has been ended by the Warburgs Tincture, Quinine which was before ineffectual, is amply sufficient for the further treatment of the case.

Opium while valuable as an adjunct in treatment, in that it soothes pain procures slumber, and makes the patient feel comfortable— is in no sense an antiperiodic in my experience of it. Opium eaters are as liable to Malarial diseases as other people, who are not addicted to its use.

Acute, has in my hands given

very disappointing results. The reason I suppose is that Malarial fevers depend upon a specific cause, for which Aconite is in no sense a specific, 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, no good is to be done by merely treating symptoms Specific remedies must be given to act on the specific cause of the febrile manifestation, and Aconite is therefore not a suitable agent.

Amongst native practitioners Chiretta enjoys a high repute as a febrifuge. I am 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 Atees – the powdered root of some species of Aconite. It is uncertain in its effects – this may be because it is very difficult to procure unadulterated drugs from natives

The last substance to which I wish to draw attention is one of which I have had very large experience in the treatment of Malarial diseases. It is Picrate of Ammonia, a salt possessed of very valuable therapeutical properties in this class of cases, though it has not received the attention which it deserves. The chemical properties and therapeutical uses of this substance were carefully investigated by Dr Duyardin Beaumetz who communicated the result of his investigations to the Therapeutical Society of Paris in 1872[a]. The salt is a combination of Ammonia and Picric or as it has been called Carbazotic or Trinitrophenic) Acid. It is brilliant yellow in colour and intensely bitter to the taste - this quality of bitterness is a curious characteristic of all anti periodics, except Arsenic. In Physiological action Picrate of Ammonia very closely resembles Quinine. Like it lowers the blood pressure markedly and the sudden lowering may cause convulsions and death from paralysis of the heart. It in moderate doses, has undoubtedly

read 12th Oct. 1872

sedative influence on the brain and spinal cord. In larger doses in one case which came under my observation it caused much giddiness & 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 Guyardin Beaumetz's investigations the salt had been used by Braconnot, Aspland, Bell, Calvert and others in the treatment of Intermittent fever. Dr Beaumetz employed it in 200 cases, the results confirmed the conclusions of the Observers I have named, and showed that in Periodic Ammonia we have a valuable and efficient substitute for Quinine in the vast majority of Cases of Malarial diseases, and one which, in some cases where Quinine fails, will give brilliant results.

Dr Beumetz cases were 1. Quotidian Ague cured in four days - 1 to 2 centigr. given per diem. in pill. 2. Also Quotidian fever in which Quinine had failed to give any good result though given fairly. Perals of ammonia 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 14 days with no result - 6 centigr. (1 gram) of the Salt (Perals of Ammonia) Cured the patient in two days.

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With the exception of the 2 cases in which Quinine is stated to have been of no avail, these results are very distinctly inferior to those which Quinine would in all probability have given in these cases. It would have cured much more speedily. The reason which my experience suggests for the length of time the Perals of Ammonia took to show a good result, is the smallness of the doses used by Dr Beumetz.

after D Beaumetz had published his investigations, the subject seems to have passed out of mind. There is no literature concerning it, nor was the Perchlorate of Ammonia ever used. I was the first to employ it in India, and as far as I can learn, anywhere else. I published the results 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 Perchlorate of 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 to it accidentally in the Summer of 1882 in the following way

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I was at the hill sanitareum of Dalhousie 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. Quinine, Arsenic and other antiperiodics had been and were freely used but failed to give the slightest relief. After ten days treatment the fever still recurred 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 I found to be Pierate of Ammonia. I gave it to my patient with very gratifying results. The fever did not recur 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 pierate 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 must have treated hundreds of thousands of cases of malarial disease with the Perrate of Ammonia and in most instances with the happiest results So uniformly successful has it been that in my very extensive practice I have I have almost entirely abandoned the use of Quinine, and other Cinchona alkaloids for the treatment of intermittent fever, and have substituted Perrate of Ammonia 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 found that in 9 cases only did it fail to cure, and in these Quinine succeeded at once. I usually give it in doses of from one eighth of a grain to a gram and a half, four or even five times a day. A fair average dose is half a gram three times in the day; and in every case it is better to begin with small doses, and to increase the amount gradually if required. It is best given in pill. The effects are soon visible. In the great majority of cases treated half gram doses during the interval prevented

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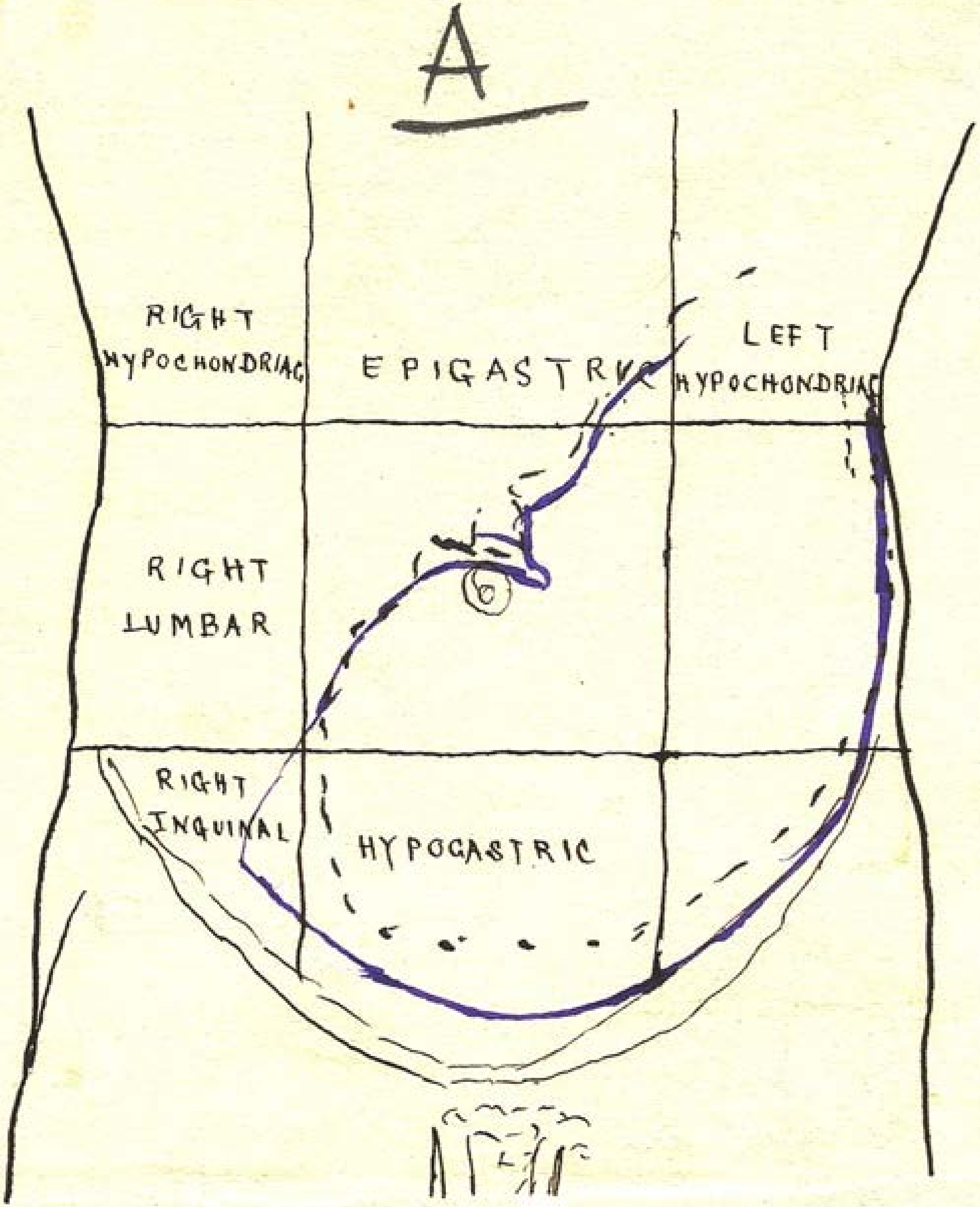
the recurrence of the next attack of the fever, while in about 20 per cent of the patients two or three attacks followed before the fever ceased. In one case of Quartan Ague despite full doses of the salt the fever recurred for six periods in gradually diminishing intensity and then finally yielded to the treatment. The Perate 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 experience the most troublesome variety of the fever, as well as the most inveterate. At the time when I published the results of the 5000 cases I had employed Perate of Ammonia in the treatment of twenty five cases of malarial neuralgia of various nerves, in six cases of malarial headache and in one of malarial Colic. In all these cases it was most satisfactory and speedy in its results

Since 1887 I have treated very many similar cases, with a like happy result. It is noteworthy as a point in treatment, that though the manifestation of the malarial poison should take the milder form of Neuralgia or Hemicrania rather than the more severe form of fever, yet in treatment good can only be obtained from as large doses of the Antiperiodic used in the one case as in the other — A malarial neuralgia, say of the supra orbital 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 Quinia or Perchl of Ammonia as will a Quartan fever which prostrates the patient for 8 or 10 hours at each attack. Some of the most intractable cases, ~~and~~ 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 poison — 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 next day or at a later interval according as to whether the malarial type is Quotidian Tertian, Quartan, or something else. This type of cases requires full doses of the Anteperiodic, frequently repeated, and withal in these cases there is a constant tendency to relapses, and progress is often very slow.

In cases of Remittent Malarial fevers I have been unable to obtain the slightest good results from Perchloride of Ammonia. I employed it in six cases of such fever of a severe type without any good effect. Neither have I 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


A
RIGHT
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LEFT
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greatly emaciated. He had suffered greatly from attacks of intermittent fever during many months, but since the Splenic 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 A

In these cases of enlarged Spleen Quinine is of doubtful value in my experience - Perchl of Ammonia of none at all. The best method of treatment is by the use of Ergotine 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 ensue from its use, though I have continued its use for months in some cases. It usually reduces an enlarged Spleen satisfactorily and safely

Perchl of Ammonia is of especial value in a class of cases with

which one meets not infrequently, and that is where Quinine, not only completely fails to ~~be~~ control the outbreaks of the malarial poison, but in addition seems positively to be harmful. Sometimes possibly this is due to an idiosyncracy on the part of the patient, more often the Quinine cannot be tolerated it causes much depression, disturbance 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 Perrate of Ammonia acts speedily and pleasantly as I 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 unavoidably used) in a very aggravated degree. There seemed to be no alternative but to invalid her Home: however Pierate of Ammonia 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

Mirza M— H— aet 54, Muhummedan; a gentleman of means, came under my care after having been ill three weeks. He had been under treatment during this time both in Amritsar and another city. The patient complained of a general feeling of illness, weariness every afternoon at four o'clock he felt slightly chilly, and then pain of a gnawing character developed in the lower third of the tibiae, being most intense at 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 next day. The patient looked old and care worn, 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 any bone mischief. The thermometer showed a daily rise during the attack of tibial pain, and guided by the periodicity of the rise, and the absence of any disease many of the great systems, I diagnosed his condition as one of Malarial fever of a somewhat anomalous character. The temperature was usually 99–101 never exceeded 101° and only reached this point on two occasions – curiously enough after Warburg's Tincture had been given the pulse showed a slight quickening during the febrile attack: I ascertained that

these conditions had obtained since the commencement of the illness. I put the patient upon large doses of Quinine 10 grams, 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 ~~some~~ two days trial was found to be useless. The temperature still rose regularly, (99° - 101°) and the pain in the bones recurred every afternoon as usual. I thereafter tried Arsenic with no better success, then for two days I tried full doses of Warburg's Tincture with the result that on both days the temperature registered 101°. (the only time during the illness) On the eleventh day I gave him Perralé of Ammonia in half gram doses every four hours. That day the temperature rose as usual, (100° - 4) but the pain in the bones was very decidedly less. The next day the temperature remained normal, nor did the pain recur. Note that day it felt a little subnormal. Thereafter 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 Amritsar and under Perolé of Ammonia recovered in 2 days. During convalescence the patient was put upon a course of Antimalarial pill

My experience leads me to the conclusion that in all varieties of intermittent fever and in malarial neuralgias, in Perolé of Ammonia we have a valuable antiperiodic 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) The dose needed is much

smaller. 3. It does not (in the doses in which it is usually given) produces 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 certainly ensue on the larger, are avoided by using Perralé of Ammonia. There is a great boon to the patient. I have found that where quinine has to be given Hydrobromic Acid much mitigates its unpleasant effects. (4) Perralé 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 the large doses in which it has to be given in India - has a very

powerful effect on the uterus — so much so that it is well known in America it is largely used instead of Ergot. There is a possible danger therefore in the employ-ment of Quinia in cases where pregnan-cy is advanced, and Perrate 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 well borne and is useful (6) In ~~the~~ a class of cases in which Quinine fails to benefit, this salt acts very speedily and certainly.

I hereby certify that this Thesis has been entirely composed by me, and the work has also been done by me entirely.

J Martin Clark
MRCPE.

April 24. 90