Malaria.
To Nature and Origin.

Malaria, in his lectures on tropical diseases opens his subject with a description of malaria and it seems to me that in assigning it this place he purposely desires to give an emphasis to the very important position he considers it to hold. Not only does this apply to the disease included under the term "malaria," but to the modification in the symptoms and progress of many other diseases, and also to its effects on the apparently healthy insusceptible residents in those countries where it is endemic. I have frequently heard experienced men say that in malarial countries malaria...
Manifestations are not only unceasing, but often will stimulate other diseases. This too is my own experience in a great extent; and I have found further that the profound influence exercised by Malaria in such regions on other diseases is as true an observation as it is an old one.

Malaria has been estimated to cause half the mortality of the human race, and in tropical countries it takes even higher rank than this in the atrocity. It is because in India seemingly intimately connected with the etiology of Cholera, bowel complaints, and hepatic diseases of the tropics. The following figures are given by Tappier and are intended by him to illustrate the importance of the study of the Fever of India. They are taken from the Registrar General's return for the year 1870, and give the number of deaths in India from four diseases which are the chief causes of mortality there.
Cholera 240,552
Smallpox 194,708
Bowel complaints 250,178
Fever 3,562,035

To take the figures for the year 1889 when Cholera appeared all over the country in unusually severe epidemic form. The deaths were from—

Cholera 425,923
Smallpox 130,624
Bowel complaints 273,427
Fever 3,524,168

Under the term "Fever" are included all the different kinds, but of this large total diarrheal fevers it is found contributed probably as much as 60 per cent. From the same Return for 1889 of the Registrar General (or Sanitary Commissioner) the following figures are taken which will bear this out also. In Bengal fevers accounted for 68 per cent of the total mortality from all causes, in Assam 44 per cent, in the N.W. Province 52 per cent, in the Cutch 47 per cent.
In the Punjab - 44 per cent.
In the Central Provinces - 52 per cent.
In Berar - 42 per cent.
In Lower Burma - 48 per cent.
In the Madras Presidency - 34 per cent.
In the Bombay Presidency - 66 per cent.

The European army in India has carefully compiled statistics are kept year by year and having into consideration the fact that a soldier suffering from any indisposition has slight which prevents him from taking part actively in military duty is at once taken into hospital. The rate of admission to hospital thus enables one to form a very accurate estimate of the proportionate amount of sickness caused by dysentery. Here one finds that for many years malaria fever has headed the list usually by a preponderating number, and in some years more than 40 per cent of the total admissions were due to this cause. On the other hand from an
examination of the statistics of our
many tropical and subtropical
campaigns. Demean seems to think
that too great importance has been
attached to malarial fever for in
his opinion they do not form a
great proportion of the diseases of
campaigning, but he admits that
they "must play an important role
and will also be more ripe in a
war than in a cantonment."

In geographical distribution
of malaria is very wide and to
enumerate in detail the many
countries in which it occurs would be to
a great extent superfluous, but
at the same time it is interesting
to note a few points in this con-
nection as it indicates in a de-
gree some of the circumstances
under which malaria occurs and
the natural surroundings which
true to its production. In England
it was at one time very common
notably in the fen country and in
tu Essex marshes, at the present day, it is rare even in those particular places. In Scotland it is unknown. In the greater portion of Ireland it is free from it, but outbreaks of Italian fever have been known to occur in districts which had previously been free and from which they had afterwards disappeared. Norway and Iceland seem to be free, and Switzerland also except along the shores of her great lakes, but in Sweden in some districts it is present. In the north and west of France and in Spain more especially in the uplands of Estremadura and Castile it is found and now at times causes the fever to assume a very malignant form. Of all the countries of Europe, Italy has the most evil reputation especially on the western side, but it is curious that along the eastern coast Italian fever does not seem to be so prevalent, and also are con-
mudly of a sudden type. In the continent of Africa Eucalyptus is not an uncommon region in the very greatest intensity especially along the western coast and up the valleys of the great rivers. In the Southern States of South America, in Central America especially on the west coast and in South America Eucalyptus is widely prevalent and frequently most malignant. A notable exception to this boreal occurs in Mexico where the lake Texcoco and its neighbourhood seem to be quite free from Eucalyptus. Even the greater portion of Asia it is present not only along the seacoasts and in the large alluvial plains of the great rivers but in the uplands of the interior. In Australia a small form only occurs notwithstanding the presence of enormous nearest districts situated in sub-tropical regions. It is unknown in New Zealand, in
Van Rieman's case and in the Sandwich Islands. The geographical distribution of Inalaria is thus seen to be very extensive, but evidently it does not seem to be dependant on latitude. There is a point however in common to the different regions and that, the disease later on is found to lie in the thermal conditions and more particularly the thermal conditions prevailing in the summer season.

It has been decreed that Inalaria is a specific poison and its endemity has been accepted, but by the great majority of observers it has always been considered to be a specific and endemic poison dependant on and developed in certain local conditions and hence the cause of the group of Inalarial diseases. The nature of the soil of those localities where these diseases occur has thus naturally attracted attention but to what
differences in the varieties of soil presented by the countries enumerated alone preclude one from attaching too great and particular an importance to the composition of the soil. Parsley says that he thinks no particular chemical condition of the soil seems to be specially favorable to the production of Quelaria and that the chemical constituents seem to be of little or no consequence, and I think it needs a very short acquaintance with Quelariano localities to induce one to agree readily with this opinion. It has been considered that a loam soil with a comparatively impermeable subsoil may present conditions favorable to the production of Quelaria, though this is no doubt the case so far as goes the conditions are by no means limited to this. Parsley enumerates various soils that have been noticed to be productive of Quelaria, and in connection with two he also states that soil under the influence of
that is said to have an alkaline-
action involving the prevalence of cold
unbecome acid in reaction. The effect
of this particular in the production of
malaria is doubtful but when it is
borne in mind that peaty soils are
acid-humous and that they have
an acid reaction this circumstance
is adduced as favourable to the
theory that alkalinity of the soil is
favourable to malarial production.
By others however this same immu-
nity of peaty soils is considered to
be due rather to the antiseptic qual-
ities of peat which it derives from
its tarry and other constituents.

Malaria is found most com-
monly in swampy regions and it
is from the observation that the ex-
halations from swamps give rise
to malarial diseases that we derive
the term itself. It is well known
that swamps which are in process
of being dried up are more espec-
ially when this is accompanied by
that are in a most favourable condition for the production of malaria. This is seen every year in tropical countries as the rainy season is passing off or when a break occurs during that season when a hot rain breaks out and pours down on the damp earth drawing up a steaming vapour which loads the air. On the other hand, submersion of a marsh tends to diminish if not altogether obstruct the production of malaria. Marshes of brackish water sometimes over which the tide flows are found to be very malarious. Peaty marshes as mentioned before are found to be invicious as in Scotland and Ireland. Marshes on a substrat of lime stone, chalk, clay, or mud have been found to be of most malarious character and it is from this that the conclusion, already mentioned, has been arrived at that an impermeable subsoil is a requisite. When marshes are drained and cultivation
is introduced. Inalaria disappears on only one occurrence in a mild form.
Inalaria is not however necessarily the product of Inarilus for as already
noted there is the absence of it in the case of Lake Tanganica and the compar-
ative immunity of the Inarilus of Australia, even contrary to the older
opinions to Inalaria necessarily limited to anarly regions for it is found
in many cultures forms in many extremely dry regions as in parts
of Spain, the Incas of the Persian Gulf
and in the Central Provinces of India
in which last named place I have
had opportunities of observation.
In these provinces there are large districts
which though cultivated during the
few months some water is available
are for many months almost desti-
tute of surface water and yet at
that dry season Inalarial fever
abounds. Again Inalaria is met
with in rocky areas as at Gibraltar,
Malta, the Ionian Islands and—
Hong Kong. In some of these backwater places however there is a certain amount of soil which is composed largely of disintegrating and weathered granite or metamorphic rock, and it seems almost inevitable that the local fevers should not be grouped as a separate type by themselves rather than included amongst malarial fevers.

Malaria has been known to appear in places which had previously been regarded as free from it, and in some instances extraordinary outbreaks have occurred, for example in the Island of Mauritius in 1866-1868. Previous to this the island had been regarded as healthy and it was commonly visited by fever-stricken patients from India for change. But an extraordinary outbreak of malarial fever of a very severe type took place in these years and since then the island has never been free and has been subject to
intervals to similar outbreaks though
not of such a disastrous character.
Similarly in India, too, and several
other spots which used formerly to
the cities of large cities are now
scarce inhabited or completely
abandoned, and though this de-
crease in the population may have
been partly brought about by change
of commercial or other prospects which
has produced the like changes else-
dere there is evidence to lead one to believe
that at one time these cities were not
so populous by Incharia. Incharia
at times seems to spread from a
centre over a considerable area of
country and assume almost a
pandemic form. At other times
it has been observed to show in
certain districts a progressive in-
crease in successive years which
has been termed by Dr. Cornish a
"Incharia wave". This wave of
increase with an intervening period
of lesser activity can be traced in
the Sanitary Commissioners' Annual Return to the Government of India, and it would be difficult to assign a cause to it. In instance during the year 1880-81 there was a steady increase in the mortality from Malarial fevers. In 1882-3 there was a marked decline. In 1884 an increase again occurred which was continued through 1885-6-7. There was then a period of two years of decrease followed by another wave of increase.

On the other hand Malaria has been known to disappear suddenly from places where it had been prevalent—a most remarkable example of this occurring during the construction of the Peninsular Canal in 1866. Malarious tracts also when placed under cultivation, especially in combination with artificial drainage become comparatively innocuous. For instance in the Roman Campagna the great campanian drainage system of the
Imperial era which has recently been
revealed was the means together with
cultivation of permitting the district
to be at that time well populated,
and again the rice fields of the tropics
under cultivation together with sub-
mergence are not by any means dan-
gerous though a neighbouring uncult-
ivated marsh may be highly so.

Outbreaks of malaria have been
said to follow volcanic eruptions and
earthquakes, but the evidence of this
is not of a very satisfactory nature.
It may however leave some relation
that observation that recently disturbed
a recently turned over soil in a malar-
ious country is very poisonous and
often provocative of an outbreak.

The occurrence of malarial fever
on board ships at sea may according
to Maclean be due to several causes-
1) the sufferers may have had their
systems charged with malaria before
embarkation, 2) they may have used
water drawn from a malarious

source, c) the source of the Malaria may lie in the brackish water of the ship, or...pne malariaious land as in the case of H.M.S. Powerful when returning from India.

Malaria is found in mountainous regions and often at great heights though as a rule these places are regarded as likely to be free from it. Various elevations have been mentioned in relation to latitude as likely the the limit of Malarial production, but as pointed out before latitude influences this only in an indirect degree. It is found in the Alps inines at 6,100 ft, in the Pyrenees at 5,000 ft, in Ceylon at 5,600 ft and in the mountains of Peru at 10,000 ft. The neighboring plains in some of the last named being curiously comparatives free or only subject to a mild form.

In the production of Malaria heat within certain limits plays a most important part and the withdrawal of it is followed by a
determination. This has been already implied in the remark as to the increased activity in production during the drying up of marshes in warm countries after the rainy season at which time it usually happens there is a period of increased heat and pestis in many countries. Illness completely disappears in winter to reappear with the summer. Last to reappear during any summer is found to depend largely on the continuity of hot weather. An instance of this occurred in the summer of 1846 in the Netherlands. This was the hottest of a series of summers, and it was observed that malaria increased greatly during that summer. From this and other observations of a similar kind it has been said down by Merech that the average summer temperature will be found to indicate closely and truly the true explanation of the seeming irregularities.
in the geographical distribution of malaria. The cold limits to which the
consider lie about the isotherm of 59°F, the hot limits are apparently
not reached under ordinary conditions
of the earth's surface.

Though heat plays an important
part in the development of malaria
there is also a powerful modification
produced by seasonal influences
in combination with atmospheric
condition. Thus, according to Birk's
malarial lessens. 1) in the tropics be-
come prevalent with the onset of the
rains and are at the maximum
when the monsoon ceases and the
country is drying up, diminishing
again during the cold weather;
2) in subtropical regions the period
of greatest intensity is during the
hot weather and the minimum
intensity is in the cold weather;
3) at the extreme limits of subtropi-
cal regions and in high latitudes the
maximum intensity occurs.
the Spring and Autumn, the maximum intensity being during the cold weather. The action of atmospheric moisture in excess is similar to that of the submergence of quarters. Thus during the length of the rains when the atmospheric moisture and the saturation of the soil are at the greatest among most subterraneous regions may comparatively safely be entered. For then not only is the production of the soil decreased, but the excessive moisture in the soil becomes of rare usefulness and precious. Thus for instance in the Anamalai hills in Southern India the months of August when the rains are at their height is selected by sportsmen for their shooting excursions, the jungles there are thus comparatively safe though most motion at all other seasons. As a striking example of the influence of season together with the benefit resulting from a careful selection of circumstance draws a comparison be-
During the Ashanti expeditions of 1864 and 1873 in both of which malaria
prevailed caused the greatest proportion
of the sickness— in the first expedition
and in the early part of the second the
operations were carried out in the
hot and rainy season, the resulting
sicknesses and mortality amongst the
troops was very great so much so
that it became a question whether
the expedition should not be abandoned;
the latter part of the second ex-
pedition was carried out in the cold
and dry season and the mortality
increased to more than a fifteenth what
it had been.

The agency of wind and of currents
of air has long been recognised in the
transmission of malaria and it has
been thought by some that the distance
to which the fevers may be wafted
away by very great, but this is doubt-
ful. According to Parkinson the limit of
horizontals spread away in open down
as 1 to 2 miles, but across water
something less - 3/4 to 1 mile. As the
limit of vertical ascent is given
1500 to 1200 ft, but figures such as these
are calculated to be misleading for they
depend on some few observations into
such a large element of error is
likely to enter. They give roughly through
the results of experience in this connection,
and in the selection of campings
grounds there are points requiring
consideration. Distances are given
by Guellian of the civil results fol-
lowing the selection of a site too
near the edge of ravines up which
slow currents of malarious air
Again some protection against such
poisons is current has been ob-
served. The approach by any imped-
iment interposed between a camp
and a malarious spot such as
a belt of wood or some rising ground
Apart from such mechanical action
however true, that is not brushed
off jungle, are of themselves a protection.
Though military camps can seldom
take advantage. Such sheltered jungle
camps are in India always placed
under trees where at the same time
a benefit accrues in that the extremes
g of temperature are modified greatly.
Jackson observed during the early
wars in America that the clearing
of woods in camp districts was
followed by outbreaks of fever and
that in camps situated in the neigh-
bourhood of woods the occupants of
those tents that were close to the wood
and who were able to seek the shade
of the trees during the day usually suf-
f ered least from malaria. On the other
hand brushwood and jungle are
formed nearly always to the malarias.

In an area of saturation of the air with
malaria seems to increase with the
proximity to the ground, hence it is
that in many malarious countries
the natives find comparative safety
by raising their dwellings on piles as
in the Indo-Malayan peninsula on
the branches of trees as with some of
the jungle tribes of India. Samancos of hunting fame who had had much experience of some of the most feverish of Indian jungles consider that a great protection is afforded by the smoke from camp fires and by the use of fire mosquito curtains. The latter he thinks has a sort of purifying action on the air. This is a belief which is shared by many people in India and Burma, not only amongst Europeans but natives also.

Individual predisposition is an important element though it seems impossible to say what is or may exist in the case of man can be said to the pressure of events and though the Negro seems to suffer least of any this is apparently not because he has become immune but rather because by a process of selection he has become more able to resist the attacks. All periods of life are equally liable to attacks but at different ages the resulting manifestation that follows
infection differs — in infancy there is a tendency to intermittent bowel complaints, in youth most commonly the continued and intermittent forms occur, in midlife all forms and in old age more frequently the most permiscuous forms prevail. Tension of resistance is commonly having failed, here are said to be more liable than women. Weak and anaemic individuals are more prone to suffer, and also those who at the time of exposure to infection are suffering from any of the numerous causes which produce either mental or bodily exhaustion or depression even though of a temporary nature. Former days of India that the natives appear to suffer more than the Europeans and assert that this may be partly due to their being well housed and fed and also better guarded against the numerous insanitary influences of the country. It has been well remarked that "good house accom-
Inoculation is a great safeguard against malaria. Previou attacks produce very strongly and there is no acclimatization. A comparative power of resistance or perhaps rather an accommodation of the system and the general habits to the surrounding of a malarious country provides a partial resistance. It may lie dormant in the system for long periods and even after removal from malarious surroundings until some exciting cause occurs which induces an attack. A this peculiar dormant condition may as Gayer points out produce a depressed state of health analogous to what which result from exposure to un pure air from drains and sewers — inducing a fluid of diabetic condition.

The relationship that exists between outbreaks of malaria in other periods when malarial frenzy are more abundant and epidemics
of other diseases is obscure. During epidermics of influenza it is said to be rarely present but will recur later. During cholera epidermics and in cases when dysentery & bowel complaints appear in a severe form there is usually in India according to the annual returns an increase of febrile fever. In the opinion of Russell, endemic febrile fever in India underlines or is intimately associated with the fever of cholera, of dysentery and of diarrhea, but more probably the conditions favorable to all these diseases appear concurrently a view of the matter which I would be inclined to take. Observations however to the contrary have been made elsewhere and it is said that endemic fevers disappear while cholera is epidemic to reappear afterwards. Dysentery is said to increase when malaria tends to increase but in the case of dysentery no special relationship has been noted.

In some in Micer malaria
entire the system was at one time
seriously debilitated, but it is now general
ly conceived, that the poison may
distribute itself through the alimentary or
respiratory tract. Incubation by
means of bites by the mosquito was
at one time thought to be the means
and of late the idea has been revived.
There is no communicability
between one man and another.

The domestic animals are
liable to it but their tendency seems
to be less than among man. Parkes in his
travels in Africa mentioned the case
of his monkey which suffered from
fever very much at the same time
also as he did himself. Dogeera
the very susceptible and in the case
of an English breed of which I found
in the tropics I found it suffered more
from fever and in its case the symp-
toms progress or treatment of the disease
were very much the same as in man.

The period of incubation appears
to be a matter of great uncertainty.
for the time of infection is necessarily a period difficult to determine. According to some observers a few hours suffice while others say so many days are required. Great recently Lavranos from observations made in the case of fresh arrivals in Malarious regions states that it may be put down as varying from 6 to 10 days.

Having considered the circumstances and conditions in which Malarial fevers occur it now remains to examine the nature of the poison Malaria which causes them. This has long been the subject of discussion and inquiry. Some observers thought it to be gaseous and an exhalation resulting from the decomposition of vegetable organisms. Others thought it might be due to exhalations from living plants. It was very early suggested that it was due to a ferment, an idea that was revived in the middle of this century by Mitchell.
and to which there is now in a modified sense a return. By Oldham, febrile fevers were ascribed solely to the effects of chill and in this view he was supported by Sydenham, Bell, and to a less extent also by Locke and Parke. Since last qualified their views later and considered that the tendency to acknowledge the presumed entity of malaria was a matter which required further consideration and alteration. Oldham, the predecessor of whose work will certainly interest though it may not convince one, arrives at the following conclusions regarding chill as the cause of febrile fevers: 1) Exposure to night in malarial countries involves exposure to chill, 2) All the effects of febrile influence can be produced by rapid extraction of heat from the body, 3) Chill is admitted as the cause of the disease associated with febrile fevers as well as of the relapses, 4) Continued exposure to heat diminishes the heat-generating power.
of the body and hues Chills ensued. How
been however in criticising these ar-
gements has pleasure that Chills can
only be looked on as one of the many
exciting causes of an attack and
cannot of itself be production of
malarial fevers.

After Mitchell had stated his
cryptogamic theory of the origin of malaria
the next step was taken by Salisbury
an American observer who in 1866 de-
cribed a species of paludella which he
considered to be the cause of malarial
fevers, but Starkness a few years later
disputed this as he had found the same
species growing in the bowels of some
of his own Alpes where such diseases are
non-existent.

In 1879 as the result of a long
series of observations Klebs and Donovan
simply described a spirochaete bacillus
to which they gave the name Bacillus per-
arial and which they considered to
be the cause of the fever. They formed
artificial inoculations and by fractional
cultivation of these they obtained revelation of the Bacillus. They found that in nature the production of malaria requires the presence of 1) a high temperature—about less than 20°C, 2) a persistent humidity of the soil, and 3) the access of air to the moist strata of the soil. These conditions were also requisite for the growth of the Bacillus artificially. They describe the Bacillus (cultivated in plate gelatine) thus: "Rods of the length 5-10 μ which in developing are converted into tortuous filaments, divided into joints by means of clear spaces in their protoplasm, or more rarely by dividing membranes. These filaments in the surface exposed to the action of the air produce rows of very short joints, and develop in their interior spaces before their division into joints or after this has happened. These spores occupy the middle or extremity of the joints, or both at the same time; when the division into joints does not happen they are multiplied by beco..."
ing still smaller and the interior of the filament is filled by a granular mass. The results which they obtained have been summarized as follows in the Medical Record—“1) The poison is contained in great quantities in the soil of malarious districts at all seasons even when no fever is prevalent. 2) It may be collected from the air immediately above the soil by an aspirator and a sheet of glass covered with gauze. 3) Stagnant water contains a deposit usually to contain organisms peculiar to malaria.” They also made a series of inoculation experiments and in regard to these they claim that they prove “1) that malarial affections may be produced artificially in animals in the identical forms known to human pathology; and 2) that these artificially produced malarial affections are excited by organisms which are found in the soil of malarious places before the appearance of the fever, and are
even then appeared in the strata of the air nearest the soil." In support of this they have tabulated their experimental results thus: "(a) Rabbits inoculated with emulsions of soil or of fluids in which the bacillus had been cultivated suffered from intermittent fever, the interval being in some cases 60 hours and during the attack the temperature rose to 104°F. (b) Filtered liquids caused only slight symptoms even if five times the original quantity was used. The fever was of an intermittent type. This seems to show that the actual organisms are more easily separable than those of Anthrax Septicaemia 9c. (c) Some of the animals which had not been inoculated but had been normal--accidentally had Septicaemia and showed a different temperature curve. (d) All the animals with intermittent fever had marked splenic enlargement. The spleen sometimes being 9 or 10 times the normal size. (e) Many of the spleens
contained black pigment especially those from greener cases—just like
effects of persons suffering from Ague.
(1) The Bacilli were found in the
eyeless and marrow of animals as
well as in the soil. They were at first
void, mobile eluding fluids which
developed in the body, as well as in
cultivation apparatus into long
threads homogeneous at first but soon
dividing into portions each of which
gave rise to new threads. (2) These
bacilli could not develop without
oxygen and required a richly
nutritious medium for their
growth and cultivation. The most
favorable soil appears to be the spleen
or marrow or urine.

In 1850 Cruceli published a
note to the above being a summary
of further results from observations
made by him. (1) The Bacillus may
be found in any quantity in the soil
of the Campagna or Pontine Marches
and may be grown from in that
2) During the hot weather the air in typhus districts was charged with numerous bacilli that they could be found in the sweat on the heads and faces of persons at work in those places. 3) Spores of the bacillus were constantly present in the blood of infected rabbits, in that of persons suffering from typhus and in blood aspirated from the blood of the fever. These spores when cultivated gave fully developed bacilli while those from other patients gave negative results. 4) Venous blood from typhus patients gave intermittent fever to dogs when injected subcutaneously. 5) Blood deceased during inoculation always gave numerous bacilli but at the acme they disappeared and only spores could be found—a circumstance similar to that found in relapsing fever. Caudal tail advancement
the hypothesis that the rigor mortis is due
to the irritation of the muscles caused by the Bacillus in the circulation, that
the fibrillar attack may be due to a
discharge of Bacilli from their special
roots and that their development
and disintegration is favoured by
high temperature, moist conditions and
oxygen in the blood. In these conclu-
sions and statements of Crucelli
Izquierdo and Fager, the evidences adduced is not sufficient
because — the temperature curve of
the rabbit inoculated has not been
marked paralyzico; healthy rabbit
sometimes show annual vari-
ations; the changes noted in the
spleen are not peculiar as similar
changes occur in death from Septi-
acidemia, and the changes noted as
related to dark colored pigment in spleen
and marrow of rabbit are for
similar reasons not peculiar. In
this opinion Izquierdo is to some extent
supported by Stemberg of New York but
to allows that these researches which go to prove the parasitic or bacterial origin of malariaal fever explain as far as
by ' 1) Malaria occurs at certain heights and it is not necessarily connected with the presence of
malarial fevers, ponds or rivers, nor with
the admixture of fresh or salt water,
or with the production of an organic
substance. 2) That the production
of malaria ceases if the air can no
longer act on the soil as when the
most pestilential malarial ceases to
be so if there is plenty of water, or
when the air is excluded by any in-
terposing substance. 3) That a very
moderate degree of humidity will
produce malaria, some malarious
fevers insidious during hot and
dry weather becoming dangerous
after a shower, and also in the
case of the upturning of new ground
or the cutting down of jungle.'

Guarchiapura has in a series
of experiments made some obser-
actions confirming those of Cruickshank, he mentions (1) the anatomical change observed in animals in which malarial infection has been induced—
a) the peculiar change in the form of the spleen which distinguishes it as malarial, b) the presence of black pigment containing iron and therefore derived from the blood. (2) The Bacillus malariæi was obtained from a lesion of the body of the infected animal without the addition of any other substance and these Bacilli thus obtained were identical with others obtained by means of the first cultivation of the crude malarial soil and subsequent cultivation of the same. (3) The Bacillus malariæi was found in occur—in the autopsy of one case quantities of spores were found in the blood, in another case of puerulent fever cultivation of the spleen pulse produced forms identical with the ascalia Bacillus malariæi; in a third case rode and
Anucleated bodies were found in the spleen and blood identical with those of the spleen and blood homogeneous and jointed plateaus were found identical with forms already described.

A French observer, Laveran has during the last ten years published intervals descriptions of what he considers the true Plasmodium parasite in the blood. In 1891 as the result of his most recent investigations he describes two as occurring in four types or forms.

1) Spherical bodies.
2) Flagellate bodies.
3) Crescent-shaped bodies.
4) Pigmented or bodies in clusters.

The 1st have ameboid movement, are hyaline, colorless and very transparent of various sizes, the smallest being about 1/1000, the largest equal to or slightly larger than blood globule. Their edges are marked by a fine line which on treatment with reagents shows a double contour. The smallest element
have one or two pigment grains as they increase in size the pigment grains increase in number commensurately.

2) Attached to the margins of the large spherical bodies may be seen flagella one, two, three or more from which in length are 3 or 4 times the diameter of a blood globule. They have a flagellate movement and the free extremity is often pyriform. After the flagella become detached the pigment

ated bodies to which they were attached become immobile and the pigment collects at one or more points. This form was only observed to occur during the parapsyonal phase, it was invisible during the intervals and rapidly disappeared altogether under the action of quinine. 3) The crescent-shaped bodies are transparent and colorless except about the central part where pigment grains similar to those above described are found. A fine line is often seen join

ing the extremities of the crescents. The
Lengths of these bodies is a little greater than the blood globules - 8 to 9, etc. The margin is a fine line which with repeated views a double contour. The pigment granules in the centre are more usually agglomerated. There are some forms also found with similar characteristics which would appear to be the same bodies but in a different position. 4) The segmented or bodio in clusters usually present the pigment in the centre and appear to be the form in which multiplication of the parasite is taking place. In models of segmentation is described as being different in certain and in quartan ague. Lastly he concludes that he considers to be corpse forms - these are irregular in shape, immobile, pigmented and lymphatic. There are also endothelium leukocytes found in conjunction with these bodies. The examination of the blood for the observation of the parasite showed he says he once or during the process of
the parasitism. Out of 432 cases in which observations were made by Laveran in former—

<table>
<thead>
<tr>
<th>Description</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spherical bodies</td>
<td>266</td>
</tr>
<tr>
<td>Crescentic bodies alone</td>
<td>43</td>
</tr>
<tr>
<td>Spherical + Crescentic together</td>
<td>31</td>
</tr>
<tr>
<td>Spherical + flagellate together</td>
<td>59</td>
</tr>
<tr>
<td>Spherical + flagellate together + crescentic</td>
<td>33</td>
</tr>
<tr>
<td>Spherical alone or with others</td>
<td>389</td>
</tr>
<tr>
<td>Crescentic alone or with others</td>
<td>107</td>
</tr>
</tbody>
</table>

Flagellate (which were always with the spherical bodies in 92 cases)

Since his first description of them in 1882, have been confirmed and extended by other observers. 

Guardiana, favus & Celli have described similar bodies. 

Falci comprises ten descriptions, also, and adds that in quartan Ague the globs of the blood have a tendency to attract while in tertian Ague they tend to have larger dimensions than those of healthy blood. In tertian Ague he says that the protoplasm of the spherical bodies is very transparent
and the contour is not well defined. In quartan again the protoplasm is less delicate and the contour plainer. In quartan also the pigment shows itself in the form of grains or masses larger than those in tertian, and the colour of the pigment may also be different. Lastly the segmentation of the cluster bodies is different — in tertian the number of the segments is greater than in quartan. In quartan, agues and especial types were observed.

Conceivably and also in America have confirmed Lancaster’s observations and have also remarked that it is at the onset of the initial period of the attack that the parasite elements are found in the greatest number. Another American observer — James — makes the following observations: 1) he always found the parasite 2) the excentric bodies he found only in chronic cases 3) the excentric bodies he found before and during paroxysms 4) under the influence of quinine the parasite
with the exception of the crescentic forms, rapidly disappear. Coley from experiments on animals inclines to the opinion that the Bacillus Oculariae of Klebs and Crusali had no connection with the production of Ocularial fever, but that the forms described by Laveran are more probably the true parasite. Indeed Laveran advances the theory that the parasite may existe inside in some plant or animal before it completes its cycle in the human body and he revives the old suggestion that the mosquito may be the proper carrier to man.

Concurrently with the examination of the blood for the detection of the parasite of Ocularia Incertifacies and Cetti have made some observations on the "Alterations in the Red globules in Ocularial affection and on the origin of Malaria." They found that malaria produced Hypoglycaemia very rapidly, the blood globules being reduced from the normal 5,000,000 to 1,000,000 or even
less per entire multitude. In diminution in its maximum degree took place at the outbreak and its progress decreased as the obstetricians increased. In the cachexia the ammonia remained at a low stationary proportion. Besides the normal red globules they found other red globules which contained corpuscles in varying numbers and of different size and form - a) granules round in shape and often resembling crescents one or more in a globule; about 2/3 - 3/4 of the red globules contained one, two rarely three or four of these corpuscles, their size varied some being very small others large. b) Larger corpuscles with a vacuole in the centre as to give the appearance of a ring with a greater or less thickness one, two, three or four. Might be found in one blood globule, some being small others large and irregular rounded shapes. c) Large corpuscles with granules or masses of black or crusty black pigment in their interior. Be-
red to altered red globules they found coloured bodies in clusters or granules which apparently were the last stage of the blood globules devoid of haemoglobin and containing pigment. In the autopsies of several cases similar corpuscles were found in the spleen pulp, bone marrow and blood from almost every organ—especially of the brain. They conclude that in cerebral infection a change in the red globules takes place—this begins with the presence of small granules and progresses with their enlarge-ment and fusion and the formation of pigment in granules or clusters ending in the reduction of the globules into a pigment granular body which is destroyed; the freed pigment is enclosed in the leucocytes and by them excreted in certain organs—spleen, bone marrow, liver. They attempted to cultivate these corpuscles taken from the blood but without success. The pigment which caused
Melaenaemia: 1) is found in the circulating blood, 2) is derived from the colouring matter of the blood floccule, and 3) is found in the protoplasma of the same. These two observers describe further having found in the blood red nucleolated globules, large red globules (macrocysts) and red globules which were coloured more faintly than ordinary red globules. The first named sort, which are found among the first few days after birth, in the same essential and symptomatic anaemias, are also abundant in the marrow and spleen pulp. Their presence in placental blood would then seem to indicate a greater energy of function of the hæmopoetic organs which has been rendered necessary by the more rapid destruction of the normal red globule. The macrocysts and the faintly coloured red globules are probably young globules which had recently lost the nucleo.
the present knowledge on the subject of malaria finally considers the several manners in which the malarial poison may affect the body and produce before one thinks—

a) malarial poison may be an intoxication resulting from a toxic agent produced by living organisms outside the body, b) it may be an infection resulting from germs born in the soil which enter and multiply in the body and do directly produce the diseases. c) it may result from germs born in the soil which multiply in the body and produce a toxic agent to which the phenomenon are due. If this last supposition be the state of the case it is then possible that the parasites may not invade the blood at all but remain in the alimentary canal the contents of which would afford insufficient palatable for its growth. So this theory Starling himself includes the second supposition is that which is favored by Cruickshank & Lowan.
From the foregoing details it will thus be seen that though the present knowledge regarding malaria has been greatly extended of late years it still presents a somewhat vague and apparently contradictory nature. All the later observers are agreed on one point how ever much they may differ on other points and that is that malaria arises probably result from the growth of some one of the low forms of vegetable life that Bacteriological science has of late years shown to bear so important a part in the production of disease. It is only possible it seems to one on whom such supposition to understand and explain the apparently anomalous experiences in the incidence of these diseases. The observations of Cruickshank and those who support him seem to require further confirmation and extension they would appear to be negatived by those of Laveran and his followers, but it may be that they are in great extent complementary. Personally
I have not been able to observe the parasite as described by Crusoe. Laveran's observations on the changes in the blood supplemented as they are by those of Marchiafava in Encephalica are of most interesting nature. Some of these changes in the blood globules I have been able to detect in my cases, notably the spherical and the crescentic shaped bodies, also the granules and the vacuolated blood globules described by Marchiafava. An organism very similar to the flagellate bodies of Laveran's has been informed in "Eurys" a disease of horses and cattle, which is characterized by continuous high temperature, rapid destruction of the blood globules and which usually occurs in malignant districts. Until the parasite was discovered the disease was commonly regarded as a remittent fever of horses. The blood of an animal suffering from this disease turns with the parasite which obtains...
its vitality for some time after removal from the body and exhibit vigorous movements amongst the blood globules by means of the flagella. A full description of it is given by Dr. Dames with whom I had the opportunity on several occasions of examining the parasite in material from Egypt. Evidently the changes in the blood are the result of the direct action of the parasite and its products or the result of the ferrous state in dissolving the blood globules. It is difficult today, but I am inclined to take the former view as the changes present several characteristics.

In conclusion I may remark that the study of these diseases through one of difficulty and perhaps, rather barren of results is one of great importance in consideration of the mortality and suffering caused by them. So are it is not only of interest but importance for the British army to extensively locate in malarious countries some in each of the most feverish in the
world. The clearer views which one has obtained in regard to these diseases will enable one to take more efficient steps in the prevention of attack, and doubtless also in the treatment of the different forms.

R. Kirkpatrick M. D., M. B.
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Alumcanyar, India
March 1874.

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