The Climate of the Western Intertropical Coast Regions of Africa.

Every observer of diseases of "Tropical Climate" claims by the title he uses that climate is a factor of prime importance whether as the cause, or, as in the case of Malaria, the modifying agent of disease, which exists in other climates under forms more or less clinically distinct. Even those who to this day deny "Malaria" to be a disease of itself, only do so by utilizing "chill" or some other one or more manifestations of climate, as not merely the immediate, but the essential cause of the clinical features resulting from what must now consider as a parasitic infection. Witness Moore, who after strenuously questioning the existence of a definite malarial poison goes on to describe conditions so definite that he can but avoid himself of the secured term "Malaria." "Covering" says Heisch, "a broad zone on both sides of the Equator the Malarial Diseases reach their maximum of frequency in Tropical and Subtropical regions." On the West Coast of Africa, as in most intertropical climates, Malaria occupies the leading position among the diseases of mankind, whether in its most violent, or its most insidious forms. To the European it is the deadliest foe and more than once have British armies had to retreat before its attacks. The maximum intensity even among intertropical regions is reached here. To attack the disease then in tropical regions the first essential is to understand the Climate and this knowledge the physician must (after that is immediate means) avail himself of as the foundation of his treatment, or, much more where climate is unalterable, of his
was a great lack of accurate knowledge as to the comparative climatology. So forcibly was I struck with this fact, that it appeared to me that any remarks on malaria on this coast ought to be accompanied by some definite information on this point. The task I undertook upon both so light a heart I found much more difficult than I expected. I have however attempted, by collating the statements of observers throughout the region, & comparing them with the more general meteorological theory, to provide an outline of the climate, brief indeed & insufficient as a meteorological guide, but I hope, such as may elucidate to the physician, the resident, or the voyager of all kinds whom Providence may further send, the apparently so complex constitution of the seasonal & climatic conditions found in the regions of the W. Coast of Africa.

Physical Geography: Our general study of this may be divided into 2 sections (a) the general conformation or elevations of the continent as a whole (b) the conditions more peculiar to the regions under our immediate notice.

(a) We notice firstly that the mass of the continent extends to a nearly equal extent North & South of the Equator but that the extent of its superficies, as is the case with the terrestrial surface taken as a whole, is much in proportionance to the north of the Equator. It is on the Northern side that we have the greatest expansion terminated southwards by the line of the lower part of the Upper Guinea Coast which for more than 1000 miles has a general E\&W direction.
Comparing this continent with other Equatorial lands we find that both in breadth at the Equator & in the total amount of surface presented within the tropics it far excels any one of the other continents. As to general relations of the continent we notice that from the north to north east the influences must be nearly entirely continental. From all other directions the influences will be oceanic in character. First we note that peculiarity of its general conformation invested on by Sir Rodrick Murchison - its peculiar saucer-like structure: the whole continent presents a characteristic low-lying coast line of very varying width: this terminates in a mountainous wall and of very great height: on the inner aspect of this range is found, no valley, it is merely the outer edge of a vast plateau rising towards the central lakes & marshes. Through this outer rocky wall all the rivers from the interior must force their way. I have considered this mountainous region to be the natural landward boundary of the coast region we are to examine. Next we note that at either extreme is a desert region: to the North the great Sahara extending nearly across the continent: to the South the less important Kalahari Desert confined to the Western side of the continent. The former exerts a great influence on the Climate of the Soudan & Guinea Upper Guinea.

(b) To confine our observations to the Western Coast. We have noted that a portion of this coast has a general
East and West direction. From Cape Palmas to Cape Verde, nearly 1000 miles, the general direction is N.W.; from thence the Tropic of Cancer it is more northerly. The general direction from the Cameroons to the Southern Tropic is S.E. somewhat East. The elevation of this coast region, as already hinted is not great. The whole extent of the immediate coast is below 500 ft., with the exception of a few spots as the Sierra Leone Inlet, C. Mount &c., often the elevation is but a few feet in the positions of old lagoons &c. it may even be below the level of the sea. The consequence of the slight elevation is a slight inclination so that the tide can be felt a long way up the streams. The natural drainage is very feeble. According to Heidelberg (P. Geogr. Soc. 1888) the mean elevation of the continent is N. 10° 20' - 161 ft.; S. 10° 20' - 3007 ft. All Senegambia is low; 0° 10' - 1106; 0° 10' - 2720. Numerous rivers, creeks, marshes, mangrove forests characterize it. The breadth of the low lying land is greatest here reaching 400-500 miles into the interior. There are many considerable rivers as the Senegal, the Gambia, the Pra, Blu, Grand &c. Sierra Leone has its low lying parts relieved by the beautiful mount.ains reaching in the highest peak, the Salama, to 3000 ft. Liberia the whole coast are fairly elevated in parts but else where are very depressed. The more elevated ground exists about C. Mount &c. Monrovia. The British Ivory Coast has been described as a "fresh-water archipelago". The Gold coast is composed of a fairly elevated ground often presenting small hills but nevertheless is very marshy in
the rainy season. The countries bordering on the Ridges of Benin & Biafra are very low scarcely elevated above the water & are filled with a network of interlacing creeks. These however some considerable elevations similar to the Sierra Leone mountains, Mt. Albert of the Cameroons being 13,129 ft. & the Mté Intu near C. Jofa being 3,937 ft. while the peak of Fernando Po is 10,190 ft.

These regions as well as the Gaboon & Ogowe deltas might all be called "fresh water archipelagoes." The use of the term "fresh" however to the lower parts of any of these slow streams is very doubtful. The whole is overgrown with half sub:merged mangrove forests through which the creeks are the only roads. The southern half of Nigeria is less forested than the northern. At the Congo the forest returns again Angola is generally better elevated & but lightly wooded, vegetation decreasing till at C. Niollaen between Benguela & Kowamades we reach desert, a desert occupying but a narrow coast strip of some 50 miles breadth beyond which is sparse vegetation or savannah. About 20° S. this desert suddenly widens out so as to include 300 miles or more., the major part of Namibia land being of this description. Lord Mayo calculates the ascent from Walvis Bay to the higher flats to be about 4000 ft. Harrini believes the elevation of the Kalahari flats to be about 3000-4000 ft.
Notion the Temperature of the Approximate Ocean Surface

Commander Burke, Bous, Mayo, Galton, & others have referred to the effect on the coast climates of the cold polar currents. Some observations of Mr. T.S. Buchanan illustrate by the temperatures noted during the Challenger Expedition are noteworthy. He points out that the Sun's heat affects water to a greater extent than it does air but much less than that of land. Deserts such as the Northern and Southern African and others are the result of the drying power of the wind as are represented on the Ocean surface by spots of greater density, i.e. salinity such as exist on the eastern sides of both Africa & America. The N.E. & S.E. trades also impart to the surface water a motion generally west. The warm dense current of the Atlantic will thus tend westward towards S. America where, on the eastern side of each continent there will be a tendency to accumulation of heated water in these equatorial latitudes. Observations on the Guinea Current were made by the S.S. Buccanneer. A very close correspondence of increase of surface density as they she passed from the shores towards from the fresh water was noted. West of C. Palmas, in January, when the Sun's calm belt were near their most southerly point, was found a strong Easterly current of warm light water which struck Easterly across the Bight coming very close in at Capes Palmas, Perse Points, T.S. Paul but here its density was firstly high, showing increased evaporation. After T.S. Paul, being a rainier district, the density rapidly fell, another.
very rapid fall occurred near the mouths of the rivers. After leaving St. Thomas there is a rapid rise in surface density. Then the Equator causes a fall. The greatest rise is between here & the Congo which river affects a reduction in surface density over 200 miles stretch. St. of the Congo the density is similar to that St. of it there being no important river influences. The Guinea current press itself St. of St. Thomas between the superimposed fresh water of the ocean water but St. of this Islet was not found. North of St. Thomas the cold water (65° F) was found at 35 fathoms. St. of this point it was found at 60 fathoms (at 60° F), while after the Congo Equatorial influences cease near St. Paul de loanda the cold deep water approx. 65° F. being at only 15 fathoms. This point is the beginning of the cold water region of the windward coast. The surface of the water is about 17° to 18° hotter when the sun is vertical than it is during the cooler season. When the "Buccaneer" came North in March, the sun being now vertical over the region of the Easterly current in January, the had now disappeared. Its position when noted was from 5° to 10° N. corresponding with the mean centre of the calm belt-region. The transition from Equatorial to Extra-Equatorial regions is well marked taking place in the bath about 1°. Verde & in the South about C. Frio, the cold region extending north & south of these points on the Western aspect of the Continent. Off Mogador, the temperature of the surface water 20 miles
out is 70°, whereas only 60°. Connected with the rising of the cold water may be the fact that the fish obtained on this coast, far beyond C. Verdi however, are very like those we have at home if some are not identical. If the comparative constancy of the position of the East Current when it exists be verified some account may be given of this by the existence of a belt of shallower water of less than 1000 fathom stretching from 6° to 20° S in the midst of which is Ascension Island. Commander Burke found the water of the Southern cold region or Southern Polar Current, as he calls it, to be of 6° C. Frio as low as 45° F. in May. The corresponding Northern Current was 65° in March off the Gambier but here it was affected by the warm river water. Off Goret it was 63° in February. He also noted the rapid seaward increase of temperature. He states that the 2 currents pass, the one S.W. from C. Frio, the other S.W. from C. Verdi united produce the Western Equatorial current. This however would only occur in the Hot Season of the Southern Hemisphere. In the Southern winter he holds that the South Polar current extends to the Equator from thence outwards to 30° W. inferring plainly the complete identity with the Western Equatorial Current. Thus in July 1873 he found the temperature of this current at the Equator 5° 9° W, 78° F, the water to the north being 80° to the South 79°. The maximum temperature of the Equatorial Current 80°-81° occurs from Jan.-April, the Southern Summer; the minimum 70°-71° (2 S. 6 W.) July - Sept. The Northern
The Earth moves in a horizontal ellipse about its own axis, the major axis of which is the Earth's equator. The Earth is not a perfect sphere but is slightly flattened at the poles and bulging at the equator. This causes the seasons and the changes in the Earth's orientation to the Sun. The Earth's orbit around the Sun is also elliptical, with the Sun located at one of the foci. The Earth's orbit is inclined by about 7 degrees to the plane of the ecliptic, which is the plane of the Earth's orbit around the Sun.

The concept of gravity was first considered by Isaac Newton in his Principia Mathematica. He explained the gravitational force between two masses as a property of nature that causes objects to attract each other. The gravitational force is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. This law is the basis for the theory of general relativity developed by Albert Einstein.

In science, the process of reducing and analyzing complex phenomena into simpler components is called reductionism. This approach has been applied to many fields, including physics, biology, and psychology. Reductionism allows scientists to understand complex systems by breaking them down into their constituent parts and studying the interactions between those parts. It has been a powerful tool for scientific discovery, leading to many important breakthroughs in our understanding of the natural world.
process being repeated "ad infinitum," a continually ascending column is produced, the vacancy being continually supplied from either polar region. The atmospheric circulation is rendered complete by the passage in the upper regions of the atmosphere of the air of the ascending equatorial column to renew the air thus drawn from the poles. But to these currents with their clouds a tendency even more lastingly than northerly or southerly is imparted by the rotation of the globe on its axis; this lasterly motion is constant in our temperate climates but in equatorial regions at or near the Equator it is liable to reversion. This forced accounts to be a deflection after crossing the Equator of a current passing from the opposite hemisphere, it being the winter of the latter at the time. This E to W. current in the highest strata, was noted by Dauke: man at Kiva on the Congo, as much the commonest motion. He tells us that on Sept. 2 1882 he observed white cumuli from the S.E. that were transformed first into cirrho-stratus then into fleecy cumbo-curnuli which made their way E. W. Herein may lie an explanation of the reverse E. current: the hot air in rising will tend to take a direct course from the surface upwards and in a direction (Relatively only) opposed to the motion of the earth. As we shall see the great S.E. current has been already so heated in the earl in part of its passage over the continent that it has risen, and its place is supplied on the Western coast by a division from S.E. E. or S.W. of a more Western part of the same
great S.E. trade current. The first and already heated portion of this current would join with the ascending Equatorial column and give it an E to W. direction. The same rotation of the globe which acts on the other strata affects also the lower or cold strata coming from the N. T.S. but they are impeded, or rolled as it were between the earth or lowest strata the highest and accordingly to them is impeded a relative, though some degree of contrary motion, from that is East to West & they become thus where they affect the immediate surface of the land or ocean the great N. E. S. E. trade winds.

These trade winds converge then towards the equator but between them will always exist a region where the ascending column shall cease with such constancy that their influence will be lost. This region is that of the Equatorial Calms. It must be remembered that this region is only the practical centre of a region, the intertropical region, exposed to the vertical rays of the sun. The influence which produces the Equatorial Calm belt would therefore operate in a diminishing degree as we pass towards the tropics throughout the whole of that region. We shall better appreciate the force of these influences when we find that they are capable where the land is notably uneven to create a sort of backward pressure current over which the trades must make their way. Where these influences of the vertical sun cease we find the Tropical calm & dry belts. The nature of these two great currents to form the Equator.
All regions is very different. The hot air of the ascending column is more or less saturated with moisture which as the air ascends cools will be condensed to form cloud or rain. This condensation is accompanied by an evolution of heat which will tend more or less to maintain the temperature. The cold currents on the contrary from the icy polar regions are excessive but dry. Therefore though low in temperature greatly of water the amount they absorb will be principally in proportion to the amount of water surface they have crossed but also will be related to their rate of temperature. The table diagram from Terpsichore on the Winds depicts the condition of the earth's atmosphere, where the Northern and Southern Hemispheres similar in their characters. But this is not so. Through the preponderance of land in the Northern Hemisphere two important modifications, at least, are produced. The passage of the H.E. trade wind must be principally over land; that of the S.E. over ocean. The latter then must arrive at the African continent moist. The former correspondingly dry. Secondly land having a much greater heat-retaining power than water the Northern must be considerably warmer than the Southern Hemisphere. But a yet more important cause of variation is that continual seasonal oscillation of the axis of the globe by which the Sun's rays are made to run a course once a year from the Tropic of Cancer...
23° 27' 30" N. to that of Capricorn in the South, back again. These vertical heat rays being the source of the highest elevation of temperature drag with them on their yearly course the attendant Equatorial Calm belt and its concomitants. Thus over every point we consider between these two extremes the Sun's rays yearly become twice perpendicular; but the nearer we approach either tropic the closer will the days of the Sunth over any given point, and accordingly the seasons induced by the Equatorial calm belt be approximated; until at a region more or less definite between the equator and each of the tropics they coalesce. The intervening seasons at the equator must but be equal in length: the one lengthening in proportion to the decrease of the other; for every degree we approach the tropics till the one disappears altogether. Hence the great primary division of Intertropical climates into Two Seasoned or Diöric and Four Seasoned or double Seasoned Diphöric.

Atmospheric Pressure: as ascertained by the Mercurial column of the Barometer has an average of 29.92 in. (760 mm.) for the whole earth. This pressure is that at 45° lat. at the sea level: between 45° and 0° the reduction is negative: between 45° and the poles it is positive. Within the tropics there is very slight variation in pressure: such as compared with Extratropical: it is however remarkably regular here. The diurnal variations within the tropics are greatest near the equator; the maxima being at 10 a.m. and 2 p.m. the minima at 4 a.m. and 10 p.m. In explanation of this variation it is suggested that when the Sun is directly over a spot as it may be accounted from 10 a.m. to 2 p.m. the increased heat
causes rapid evaporation. The weight of aqueous vapour being to that of air as 623 to 1000 the gravity of the atmosphere is reduced. After 4 p.m. especially when the sun sets the ground rapidly loses heat by radiation: the air in contact with it is cooled & dew is formed. The place of the deposited water is taken by the air gradually displaced by evaporation from the contiguous surface of the globe on which the Sun is now shining. From after 10 p.m. till 4 a.m. the air still deposits moisture as dew but is now beyond the reach of replacement from the sides by air expelled by evaporation under solar influence which is now operating on the opposite aspect of the globe: accordingly there is a barometric rise till 10 p.m. & after that a fall. An other rise succeeds as the region under notice becomes once more affected by the turning of the east & neighbouring quarter of the globe to the sun producing an inflow of air from that aspect. This will occupy from 4 a.m. till 10 a.m. As in Europe the mean pressure is greater or less in inverse ratio to the rise or fall of temperature. Alexander Ramsay (Essay on Scientific Rom: 1854) seems to hint at least the acceptance of the theory above given of the diurnal variation.

March of the Sun: We know that the northern solstice is about June 21st & the Southern about Dec. 21st. The time occupied in the passage from Tropic to Tropic & back being about equal. Never: the less the rate of transit is unequal: there being about 8 days less occupied by the Equinoctial passage in the Southern than in the Northern Hemisphere. This fact combines, no doubt, with the others we have noted in projecting the Southern Hemisphere climate.
somewhat N. of the Equatorial limit. Accompanying the 
Sun's Zenith is the resulting 
Equatorial Calm Belt which is also the Cloud belt or Ring, at 
least, if not identical, they are local results of a common 
cause. The Cloud belt, however, extends towards the Equator 
somewhat beyond the limits of the Equatorial Calm Belt to an 
indefinite & uncertain degree. Similarly it surpasses it to a 
degree towards the Tropics varying in its extent from year 
to year. This may be seen in the varying rainfall it brings 
in its extension towards the Tropic of Capricorn. The origin of 
the cloud ring is easily found—not, as was once held, in the evap 
oration of water from the earth immediately under the sun's 
rays, for, not to reckon that the cloud-screen formed would 
much limit such an action, how could that complete saturation 
be reached which evidently returns to the land more than 
conspiration has ever relieved it of? Its origin I have already 
hinted. The N.E. & S.E. trades started both from their origins 
dry: the N.E. has met little water surface such as the little 
Mediterranean before the dry-thirsty Sahara; it is far from 
saturated with aqueous vapour as we shall know when we 
meet it in upper Senegambia. The S.E. wind has traversed 
little but a mighty plain of ocean: much of it being a drif 
:son of a more Western portion of the current has not even 
passed over S. Africa. Israel reckons the evaporative powers 
of these winds at about 3,000 per dem: compare the amount 
of surface from which evaporation goes on with a condensing 
belt—perhaps 300 miles wide & the explanation is very clear.
He may now consider the more important winds of the coast. The Harmattan (from a significant combination of two Greek words meaning "blow" and "fat") is nothing more than the N.E. trade which has gathered little moisture, has passed over the dry hot furnace of the Sahara sands & arrives dry & scratching dust by reason of its dryness both invigorating & barometrically positive. During nearly half the year it is felt in the more northerly parts of our subject region; but as we pass south it rapidly dies out or rather perhaps becoming lighter as it become moister as well as hot it is displaced above the "monsoon" or corresponding wind. Wherever it reaches it brings with it a fine impalpable dust which produces a peculiar hazy or fog. This hazy is to be seen in Serra Leone during the Harmattan season obscuring the upper atmosphere even when the Harmattan cannot be felt on the surface. The same may be said for places on the Gold Coast. A little doubt may be allowed as to the extent to which fine dust from the desert sands is the cause of this hazy. In Senegal there can be little doubt if the importance of this element; but in more Southern regions at least a considerable element is probably to be found in the mists ashes produced by the fierce fires of the interior plateau. The east winds are sometimes bearers of immense swarms of locusts.

Monsoons of Africa are so only in name; in some parts they partake of the veritable nature of a monsoon; in other parts they are the constantly prevailing winds. The heat absorbing power of the land much exceeding that of the ocean the continent has the higher temperature; consequently the
air tends to rise more rapidly from it: a tendency appears for a flow of air to occur from the ocean towards the continent. A monsoon however is only constituted when alternating influences cause a regular land wind towards the sea for one half year and the reverse for the other half.Burks and others have pointed out that on this coast the land winds seldom extend more than 20 miles to seaward. During a certain portion of the year while the sun is North of the equator the air is drawn in from the S. E. W. direction in Upper Guinea & Senegambia, towards the Sahara whose extensive heated surface may be considered as at this time producing an enormous extension of the ascending air column. When we reach so far as S. Louis however there is a rotation in the direction of this Atlantic wind so that S. W. winds are rare and displaced by Westerly. This latter is probably a diversion of the Atlantic portion of the N. E. trade wind already superheated as it has neared the limit of the calm belt which is of course considerably N. at this season. These variously modified W. winds may be looked upon as a whole as diversions of the N. E. trade similar to the analogous division of the S. E. to S. W. which we shall meet below the equator: the division will be more complete in consequence of the greater mass of the northern part of the continent: they are less constant because of the dryer character hence higher gravity of the N. E., it does not therefore rise so readily at a given temperature in the Gulf of Guinea however, on the Gold Coast \\thereabout one cannot doubt that during the short dry season at least
The S.W. monsoon is a division of the S.E. trade similar to that which obtains elsewhere to the S. of the line. Again, W. of the Gulf of Guinea & dafkia is a wedge-shaped region of calms, light variable winds extending far into the Atlantic, but whose limits importance have been a good deal disputed, especially about the time of the Northern Solstice the winds blow sometimes directly into the interior. Sool & marks that this tendency to draw winds towards the Sahara counteracts the regular N. E. trades up to about the 13° caus: ing an apparent widening of the equatorial calm region. But during the Southern Summer a similar order occurs in the more Southern part of Tropical Africa. Then a S. W. wind often blows into the Gulf of Guinea. I am led to believe that too much is accounted for by the Sahara in the S. the Kalahari cannot take its place as precisely the same phenomena take place in a division of a Western portion to of the S.E. wind to form a SW. or W. wind, which we have seen to be for certain reasons more constant, & which the more uniform nature of the heat renders more constant in its direction. I am however inclined to think that it is the heat of the Sahara in the north, the lesser heat plus moisture in the South, which give to the N.E. & S.E. winds respectively a tendency to rise before they can cross the continent completely. The effect is that they cut off, as it were, the normal supply of wind from the surface between where they cause the ascent of the Atlantic Ocean. But this surface is itself heated & steadily adding to the ascending column
to supply what would become a potential vacancy a diversion of a more western part of the same S.E. or N.E. current is called in. It is not then the Sahara but the lands nearer to the Western coast which draw in the "monsoon" wind. It thus comes about that the atmosphere divides into several strata as indicated in the diagram. There are several proofs of this theory, instance the haze in the harmattan season at Sierra Leone & the Gold Coast even while a S.W. breeze or a calm is present on the surface. Again were it Sahara so to speak "the centre of attraction" we should not expect the ocean winds to die away as they generally do long before they reach it. Moreover though the Saharan heat is undoubtedly an important factor it is quite inefficient in itself as a rule to cause an ascending column of air (though one cannot deny it may do so during the Northern Solstitial season): as a rule some moisture at least is needed as may be proved by the long distances its scorching breath may travel without rising while the surface is intensely dry or even only comparatively so. Lastly I will remark that the theory will to some extent account for the heavier rains we shall find in the Northern part of our subject region than in the corresponding Southern part. We have seen that heated moist air as it ascends cools & its moisture consolidates as cloud; this every consolidation will however by the release of energy in the form of heat cause a rise of temperature. But the N.E. rises with deficient moisture, it will then
as it ascends its temperature have little means of compensating for the loss by condensation of moisture: it will cool rapidly and tend to sink. But its course has now placed it superior to the monsoon wind or its ascending column (see diagram). Mixing its now cold air with this moisture laden stratum it will result in rapid condensation and rain. It is easy to see that a similar but more rapid action might result in a tornado should the cooling be sufficient to enable the current to force its way at some point even to the earth's surface. One would not be justified, however, in laying stress on the relation unless one could prove that 25 of the Equator tornadoes were commoner than in the S. or that some other factor could account for the want of absolute relation. Tornadoes may now be fitly discussed. I need not describe closely what many writers have graphically told, the ominous silence of the preceding calm, the oppression, the rapid bank of clouds. Suffice to say that the phenomena may here terminate, or else with an outburst of lightning loud crashing of thunder the tornado suddenly bursts upon the unsuspecting land followed by a downpour of rain. From what I have hinted as to their causation at least sometimes it would be expected that these winds should be in a direction contrary or nearly so to the then prevailing wind. This is so. Mr. Bosies has made some interesting notes on the tornado. He traced their courses by means of the Telegraph Stations. He traced one on July 4th 1873 passing from S. to N. through Dakar, in Bédjem & Besle: between the first two stations
The rate was 56 kilometres (34.8 miles) the hour between the second and third it was only 28 kilo (17.4 miles). Commandant Burke traced the course of another tornado 120 miles. Bosia holds that their diameters may be even 100 kilometres but the country being flat and the upper atmospheric strata being principally involved it is not necessarily manifested except over a part of the underlying surface. N. of the Equator he holds that the general direction is S.E. as regards their origin: their motion is a gyration one. The general direction in Senegambia being S. & W. with a tangential deflection from E. to W. Dry tornadoes are the most destructive: they start from the E. then shift to the N. & die out by getting round to the W. completely disappearing in ten minutes to quarter of an hour. Tornadoes diminish in force as we pass from the land. Burke notes them as common about Sierra Leone & Fernando Po. Remarks that these two points would roughly be the northern & southern extremities of the wedge-shaped calm region. Each moreover presents ser: 0. and Sierra whose influence in cooling condensing the high boiling atmosphere must be considerable. We find also, as we should expect, that tornadoes are commonest when the seasonal & therefore wind current changes are occurring that is at the opening & end of the rainy seasons specially the opening. S. of the Equator the N. E. is the quarter from which they more usually originate.

Land and Sea Breezes: are of the same kind as found elsewhere & prevail throughout the coast. They result chiefly
from the rapid heating of the continent compared with the ocean during the day, the air ascends more rapidly then from the former and air is drawn in from the sea. But during the night the reverse occurs towards the ocean which does not radiate its heat with nearly so great rapidity as the land. Clear nights allow greater radiation and promote the land breeze. For some reason the neighbourhood of capes is antagonistic to their formation hence they are absent at C. Verri. Whether the lesser capes as Mertenolatae have this effect I have been unable to learn. Their alternation is somewhat irregular: the sea breeze may be said to generally start about 10 a.m. and go on till 4 p.m. or mo. The land breeze starts about 10 to 12 p.m. and similarly an uncertain close. They are evidently only local winds extending far neither land nor sea wards: and even then subject to obliteration or modification by a more general prevailing current.

Rainfall: We have already noticed the origin of the clouding and its close connection with the equatorial calm zone. The connection is so close that some French writers identify them completely under the term 'anneau opaque'. I have hinted too that this clouding influences the Northern to a greater extent than the Southern Hemisphere, because of the projection of the climate of the latter into the former. In fact it holds its mean position to be between 8° N. and 20° S. while its average extreme limits are 17° to 18° N. and only 10° to 11° S. while its average.

He complete his theory by observing that from the North at the northern solstice there is a descent to meet this clouding from
As the equator of the Tropical Clouding in the latitudes of Cancer. But by reason of the narrow limits of the Equatorial Clouding to the South, the clouding at Capricorn Tropic does not reach it. Thus he explains the nearly rainless gap between 10° S. and the Tropic of Capricorn. But we object that the Equatorial clouding he has clearly demonstrated and ask a similar proof for these Tropical ings. On the contrary in the little diagram from Dr. Stedman's treatise there is marked at the Tropics, a band called "dry and calm." And if in fact these cloudings did exist at the Northern and Southern Tropics would not the common causes which rule the varying economy between the tropics affect these in the same way and direction. A more appropriate explanation may be surely found in the analogy between this Southern Desert region and the Sahara itself; it is merely a northward extension from the southern dry and calm belt: resulting from the narrow Southern limit of the Equatorial Clouding which is the chief factor in the Intertropical rainfall. But a question remains to be answered: how is it that we find a long narrow stretch of desert coastline between 20° S. and 20° S. While the rest of the country to the interior particularly the higher plateau is on the whole well supplied with rain? Is this interior supply a consequence of a general northward of the extratropical pluvial economy or invasion of the extratropical regime? Or is it that the clouding can extend far below 10° S. Where and when circumstances favour its formation? As to the first suggestion the facts do not make us
Think there is reason to believe so. We will first deal with the
deficiencies in general between the Northern & Southern halves
of the Intertropical region relatively to its régime. The
moisture-laden S.E. trade wind having made its way will
over the Equator, is counterbalanced by the N.E. As far as
its clouds can get across the cloud ring there will be a proportion
of rainfall reinforced it may be by such little moisture as
the N.E. may bring. I have expressed my belief as to how the
heated air from the desert may assist condensation & the
opposed tendencies of the superficial & higher currents must
here be aided by their opposed direction. The first is W. or
S.W. the latter is E. or N.E. At the Southern Tropic we
have the same desert influence but in much less proportion
while the nearly continual S.S.W. or W.S.W. Trade winds are
not by any means so diametrically opposed to the higher
S.E. wind. And now to examine some of the causes
that will account for the peculiar local extension of the
strip of desert referred to. In the first place we note that,
according to Heitrich's calculations previously given the
altitude between 10° & 20° S. is nearly double that between
10° & 20° N. This will affect principally the interior relief as
an important factor in the rainfall. Next it is possible that
the immediate proximity of the Polar current will unite with
other factors to moderate the climate close to the coast & reduce
the probability of violent atmospheric changes: this will however
combine with the sandy nature of the soil, a soil therefore
readily permeable to heat irrespective of it but not absorptive
of it & tending therefore to promote the formation of dew rather than rain. Lastly, the constant blowing of the breezes from the S. W. or about that point — for this is rather an extension of the dry belt than the "calm" — makes but little tendency to the accumulation of cloud. I have described the S.E. wind as passing above the S.W. winds but I should note that this is only hypotheses from a comparison with the northern regime it is very possibly absent or not always present so far West.

Order of the Seasons: Bearing in mind that the clouding is the moisture brought to it in the S.E. tradewind is the chief de-
termining factor of these rainfall we may proceed to investigate the distribution of the rainy seasons. To begin then at the S. we find a fairly accurate boundary marking the furthest extension of the cloud ring drawn for us in the Senegal River beyond which we enter, after leaving the vicinity of the stream, a comparatively calm, dry region. South of this line to a point near the Equator we find an increase, more or less regular in both the quantity and duration of the rainfall. The farther S. the rainclouds come the less moisture will they have left in them. Thus in comparing S.Davis 1868-1870 S.Davis: N6° 0' 45". Gorse N4° 9' 37" with Gorse we notice both these effects. As we get well into the clouding regions we expect to find a considerable increase which shall maintain itself till we approach its southern limit. In accordance with what we previously noticed of the movements of the cloud ring.

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<tr>
<td>Days</td>
<td>2.25</td>
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<td>MS</td>
<td>4.01</td>
<td>10.87</td>
<td>4.63</td>
<td>21.97</td>
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we shall expect that after an increase to a certain length the rainy season will tend to separate into 2 portions between which the short dry season will be inserted. Thus at Bissau 10° 30' N we find already 6 months of rainy season. At Grand Bassam about five degrees further south the short dry season is clearly though not very regularly developed. The latter station is well within the mean limits of the clouding within which limits the influence of the cloud-rain never thoroughly ceases, hence the dry and rainy seasons are only relatively dry or rainy. But we have seen that the mean limits of the portion of the clouding extend but a very short distance to the south of the equator, at least at the immediate limit: hence south of the equator whether in two-seasoned or double seasoned climates we shall find a much more marked distinction between the characters of the seasons. To resume our thread, however. The rainfall of Dj. Bassam is not very unlike as regards its distribution, though not as regards amount, that of the rest of the northern shore of the Gulf of Guinée. At Fernando Po & Gaboon some writers have not seem distinguished at all between the first & second rainy season. This is due to their position both geographically & with regard to the cloud-rain. They have a most heavy rainfall which renders the portion of the intermediate short dry season very arid. When may even eliminate it. Passing now from Gaboon 0° 25' N to Chunchoro 5° 9' S. we witness a great decline in the fall 9475 ins. (2383 mm.) being according to Dandekar the annual mean of the former 34.18 ins. (870 mm.) in 1876-76 being that of the latter, where however there is considerable variation from year
to year, however. Thus in 1874 it amounted to 19.72 ins. (501 mm) or rather uncertain figure however, in 1875 it reached 55.25 ins. (1418 mm). Both here and at Vivi the front of length of the intervening little dry season is various; it may be seen itself subdivided into 2 parts by a week or more of rain or may be absent. At Vivi, 5° 45.5', 115 miles up the Tonga, the annual fall (1882-83) was 43.19 ins. (1097 mm); we are however 15.4 metres or 37.2 feet above the sea-level as well as considerably inland. In these regions though the lesser dry season is so irregular the greater has a well distinguished character. Unlike the relative dryness we found within the mean limits of the clouding. At Loanda, 8° 49.5', we find a steady decrease in the rainfall here only 13.64 ins. (344.9 mm) 1879-83. Thus decreasing rain supply continues as far S as the Cunene Rive between which & Mossamedes it is recorded that in 1883 heavy rain fell for the first time after seven years. The same year the exceptionally heavy fall made great havoc among the houses of Benguela & Loanda. Commander Burke states at least from 10° 25.5' S. is rainless; but Johnstone's statement, which makes the absolutely desert region begin only midway between Benguela & Mossamedes, is probably more accurate. To the North East of this desert is a great expanse of scanty vegetation or savannah. Near the Southern Limit as nearer the Northern there is but one season of rains.

Arrangement of Rainfall in Each Season: We may now proceed to investigate shortly the rainfall in the individual seasons or where the two rainy seasons unite to form but one. The outstanding facts as to the amount of rainfall during the parts of that Season.
The sun in his march from Solstice to Solstice each has an influence in dragging after it the attendant calm cloud belt in its progress; but their progress is not uniform for the progress of the cloud belt is at a slower rate than that of the Sun's march. The uniformity of their progress in yet further impaired by the projection of the climates of the Southern Hemisphere into the Northern, so that in. June as we have seen holds that while the Northern mean limit of the cloud belt is 19° N. the Southern limit is at 10° S. if they're not quite accurate the figures are sufficiently so. Thus constant relation of the cloud belt to the rains of the rainy seasons to the March of the Sun has resulted, thus modified, in the division of the forms of climate into 3 principal groups the two-seasoned, the four-season double-seasoned, and the rainless or droughty. The last will be found outside the influence of the clouding belt near the poles and at both extremes of the mean limits of the equator. The second is found about the equator. The first will be found at and near the limit of mean salivation of the clouding. Twice a year the Sun's march crosses the equator each time going in the opposite direction so that we may consider the year divided into two halves, the first occupied by the march from the equator to the Northern Solstice. The second occupied by the march from the equator to the Southern Solstice, from what shorter than the first. In either hemisphere the great rainy seasons correspond more or less to the time of the Zeniths at any given latitude; but since the cloud band lags as it were, we find that as we move from the equator the rainy
Seasons somewhat delayed. The zenith of the Sun will then rather correspond with the beginning of the rainy season. Thus nearer the northern tropic we shall find the rainy season commence about July; nearer the southern tropic it commences about December. But it results also that nearer the equator we shall find two rainy seasons, one corresponding to either passage of the Sun and two intervening dry seasons. But since the Sun in making his passage, let us say north, from a vertical position over some southern latitude will take longer time to traverse the distance from that latitude to the northern solstice, that he will take to reach the nearer southern solstice in his journey south from the same latitude, similar periods being taken to return to the starting point in either case: since the lengths of period taken are exactly reversed from a corresponding degree of northern latitude: it results that the long dry season should coincide in the northern hemisphere to the time of the short dry season in the southern hemisphere. But it is also stated that the greater rainy season is that occurring during the passage of the Sun from Capricorn to Cancer. Thus in D'Arcy's explanation, by supposing that the Sun in its passage northward is followed by the rainband, nearer renewed by the S.E. trade wind with moisture; this is reduced on the way northward so that on the southward passage, the rainband so closely押ündigly impoverished of its aqueous element. But against this explanation, if we attempt to ride against a rainstorm, we shall stand a chance of being wet through by the force quantity
of the rain: if we turn our backs to the other way we shall diminish both the force & amount securred by us. In the same way when the cloud ring is passing Southward meeting the moist SE wind it will rapidly accumulate moisture: the moment it turns both cloud ring & trade wind move in the same direction the tendency to accumulation will diminish in rapidity. It might be supposed that an extension of the calm & cloud ring beyond 10° S, but, through deficiency of the necessary actual cause of rain formation, no discharge of rain, causes an accumulation of aqueous material in the atmosphere. This would involve an admission that the mean limits of the cloud ring are actually considerably South of 10° S. I am not aware that this is claimed except in the distant interior, where however it does cause a discharge of rain. Thus to Mr. iris's tabular classification

Northern Hemisphere

Great Raining Season
Little Dry
Little Raining
Great Dry

Southern Hemisphere

Great Raining Season
Great Dry
d
Little Raining
d
Little Dry
d

I propose to make use of such a table as follows.

Northern Hemisphere

Great Raining Season [corresponding to passage to June Solstice] First Raining Season
Little Dry
d
Little Raining
d[corresponding to passage to Dec. Solstice] Second Raining
great Dry
do

Little Dry
do

Southern Hemisphere

Great Raining Season
Great Dry
do
Little Raining
do
Little Dry
do

Here it is seen that while I maintain the previous classification
for the northern have rejected it for the Southern where statistics do not seem to favour the thing advanced. Thus I have compared March: April: May: the principal figures in the percentages

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<tr>
<td>Cir</td>
<td></td>
<td></td>
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<tr>
<td>Chuchoro</td>
<td>21:1:25</td>
<td></td>
<td></td>
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<tr>
<td>Gobon</td>
<td>17:30:39</td>
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Of rainfall, tabulated by Danchelman for the Chuchoro & Gobon, which last place though slightly N. of the Equator is by reason of the projection Northward of the Southern Meteorological régime, included in the latter. The rainfall in each is seen to reach its maximum intensity as the Sun is nearing the Southern Solstices. It must however be acknowledged that when we add use the monthly percentages of rainfall reckoning the rain till the end of December as belonging to the period of the Southern March that after it as belonging to the Northern Solar March they show an advantage, only in one case important, in the other direction in the proportion of 51% to 49% at Cir: Chuchoro 64% to 36%: Gobon 51% to 49% or 53% to 47%. That of Chuchoro is perhaps somewhat abnormal: so small is the predominance of the percentage of rainfall during the Northern March in the other two; that the distinction is annulled when we remember that the movement of the cloud ring is not so rapid as that of the sun's march. We may consider the time occupied by the Sun in passing from 0° to 23° 27' N. the first rain of importance does not fall till October in Gobon on the Equator practically; while in the other two places 5°-6° S. it begins only in November. And when we consider consider that the effect is due to the cumulative effect of successive days of vertical heat on the Earth's sun: face it is only probable that this relatively slow reaction shows
A star not only in the farthest depth of the [inaugural speech], one would believe the accumulated statistics of the [inaugural speech].

This confirms the statement that [inaugural speech] falls as compared to [inaugural speech]. It may be safely assumed that [inaugural speech] falls as compared to [inaugural speech]. It may be safely assumed that [inaugural speech] falls as compared to [inaugural speech].

According to my figures, the [inaugural speech] falls as compared to [inaugural speech]. The figures for the [inaugural speech] falls as compared to [inaugural speech]. The figures for the [inaugural speech] falls as compared to [inaugural speech].
include the day with the heaviest rainfall: that is today it is about the middle of the rainy season which may be said to extend from mid-March to the beginning of December. At Goa the rain is heaviest about August. The same is true at St. Louis: that is, rather nearer the beginning than the end of the season. The velocity as well as the amount of the rain is very important in the hygiene of these regions. I have noted the ruinous effect of exceptional rains in 1883 on Cakinda & Benguela. I saw C. Coast Castle Town looking like a great ruin from the disastrous effects of a heavy rain on June 17th, 1891: even zinc roofing could not protect the houses from it. Even the solid-looking old castle of the coast have been known to partly succumb. Roads must be very carefully constructed or they become the beds of rushing torrents; they may be destroyed by a single heavy downpour. A deceitful fall of a certain rainy season is "little" compared with the other "greater" when really the apparent difference is due to the fact that in the "little" there is a tendency for the rains to come down heavily for a certain number of days and then remit for a day or two. When we see, as we have done, how heavy the total fall in this season may really be, we shall recognize how heavy the showers must sometimes be. Where desertic climate permits me I have stated at what time the heaviest fall in a given number of days is usual.

Temperature of the rain: This is a most important factor to
bear in mind. It is very much below that of the atmosphere as widened by the immediate cooling effect it has on the latter. It is even much below that of the river water heated by its contact with the earth. So that nature fear it exceedingly & will leap up to their necks in running water to avoid the chill its contact produces. The low temperature adds much to its dangers for Europeans also.

Atmospheric Temperature. A priori we should suppose the highest mean temperature to exist at the Equator. As a matter of fact the mean is here 22° lower than we find North & South of the Equator. Were the equatorial cloud & calm region also maintained at a temperature such as its geographical position would justify on expectation the combination of subterranean heat & general insalubrity would render it uninhabitable by man—at least in this quarter of the globe. But the same clouding which seems to render the climate so unbearable is the influence which tempers at most the continual stagnation of atmospheric moisture whether that supplied by the evaporation effected by the sun's rays or by the shade bands induced not only the supersaturation of the atmosphere but a protecting veil of clouds softening the glaring heat of the vertical sun. Thus, corresponding with the mean position of the Equatorial clouding there results a thermometric band with a comparatively low but very constant mean. There is no Thermic Equator to correspond with the physical one some prefer, with Bories, to consider as a Thermic Equator that line of maximum mean temp.
Situation, which is most elevated, or which is found on the coast at about 10°-11° N. (Rio Tumuc), outside the mean limits of the clouding. But if we accept this we must look for another through perhaps less marked corresponding line in the Southern Hemisphere about Gaboon or a little to its South. We have not data to fix sufficiently accurately this latter line. Both will rapidly diverge from the Equator as they pass inland or the mean limits of the cloud ring expand. In four- or double-seasoned climates under the influences more or less constantly of the clouding it may be generally claimed that both maximum and minimum mean temperatures are in the dry season months. In the two-seasoned it may be generally stated that the mean maximum in the hot rainy season is the absolute maximum in the hot dry, or dry, at least in the Northern Hemisphere where the E. wind influences. In the Southern Hemisphere however, in four-seasoned climates, the mean and absolute maximum occur both tend to occur in the rainy seasons, but with a tendency specially in the mean maximum of the first rainy season, towards the end of the preceding little dry season. In the Southern two-seasoned climates, with a desert or bare land, cloudless sky we may expect the absolute and mean maximum to occur at the season of the summer solstice, a absolute and mean minimum to occur at the season of the Winter (i.e., Southern winter) solstice. This yet needs proper proof. Mr. Dove (la loi des vents froids) is referred to by Mr. Forbes, as stating the following to be the
The usual degree of mean variation of temperature accord- 
At 0° = 1.30 mg to altitude. The table at least illustrates 
10° = 2.25 well the very uniform temperature of Equator. 
20° = 6.50 ial, with ‘Jubilant’ and subtropical climates 
30° = 12.25 compared. This he claims to be due to the 
high hygrometry of the latter: most air having a heat- 
absorbing power 6 to 10 times greater than dry air. At 
night it equally prevents radiation: while the energy 
released in the deposition of dew at sunset may even 
raise the temperature in the shade higher than during the daytime. 
Hygrometry therefore fully comes under our discussion. 
Throughout all the region we shall consider the hygrometry, 
that is, the amount of moisture in the air, as demon- 
strated by comparing the wet and dry thermometers, is 
very high. It will be easily imagined, that the further 
from the equator, or higher the altitude, or whatever 
circumstances were causing a rapid evaporation by 
day, to be followed by cooling and condensation of dew by 
night, the more variable, in a hot climate will be the 
hygrometry. It is the constancy of the cloud band re- 
region that keeps it so saturated. Observers have accounted 
for the fame of the negro’s nose by its necessity for more pe- 
ignant + voluminous expiration in atmosphere, so expanded 
by temperature + still further replaced by heated aqueous 
substance. Others claim that his respiratory capacity is increased, 
speciali in the superior + special parts of the Thorax. 
Careful investigators deny however any real increase of the
length of the clavicle which is said to be only an appearance due to a shortening of the humerus. Considering the well-recognized fact that the forearm is so much elongated one may ask whether the shortening of the humerus is not the merely apparent factor. Certainly the observation of an apparent expansion of the upper thorax is easy but one does not note such an extreme shortening of humerus by simple external observation. The real test however, of the size of the thoracic cavity must be an examination of the actual lung. Nebulosity must be considered as directly a much more important factor in tropical climatology than in our own. We have seen the important effects of the clouds in lowering the mean temperature or in the region of the cloud ring's mean limits. We may further say that this influence is concomitant with the rain band in every part where the course of the sun may lead it, and not only does it exist its effect while rain is actually falling or threatening, its influence predominates throughout the rainy season. The eastward or gradually outward movement of the light blue clouds may be seen in all latitudes. I noticed previously the curious reversal of this current sometimes seen near the equator. A cloud is the indicator of the direction of the current that bears it. The various winds I have spoken of show their movements more or less by these clouds. The tables of nebulosity are very scanty.

Fogs, mists on this coast may be considered under various varieties. An arbitrary but useful division will I think be
into Dry season high fogs, morning mists including the Cacimbo or Scotch mist, & sunset fogs. The dry season
high fogs I have to distinguish rather to distinguish their
method of origin. There are at least two varieties. The one we
have met with as the peculiar obscuring dust haze accompanying
the H.S. wind from its journey over the desert. I have added that
after, at least, its passage over the Mendoza limestone it is
probable that the incinerated particles from the prairie fires have
added their quotient. This second element is the principal
cause of the second variety which is to be seen in many especially
more inland parts, over the whole continent. This has been
specially commented on at Vivi by Danselsman. During the
dry season, he tells us, the sky is overcast by a peculiar mist
which renders the horizon & all distant objects indistinguishable.
The cause is abundantly attested as the prairie fires of the inter-
ior from which the heated air carries up heated material
to disport it slowly even at great distances. Can this material
give rise to the haze? Dr. Danselsman inclines to think
that these small particles may attract to themselves minute
droplets of water thus adding to the density & refractive power
of the atmospheric medium. The cacimbo, the name
given by the Portuguese to that impalpable fine drizzle we
call Scotch mist, is a phenomenon noted over the South West-
Coast & other parts, and occurs specially at the period when
the dry season is drawing to its close; thus at Vivi it is common
est in August, September, & October. It declines when the atmos-
phere becomes sufficiently heated. Another type of morning
fog is that which may be witnessed in particularly moist hot localities: the moisture rises like steam from the ground under the increasing solar power. The night fog is due to condensation of aqueous material by the cooling of the atmosphere near the earth. The fog however seems to some extent to check active radiation which renders cool, cool nights equally dangerous to those who do not sufficiently protect themselves.

The Climate at various Stations: We shall proceed now to shortly consider the various available stations. Available through various observers proceeding from the north and southwards. Any remarks must be brief, as in too many stations the data are very inadequate. Though some effort is made, yet it is astonishing that the British Government should have encouraged so little hitherto on its extensive territories on this coast, a science upon which so much of its ultimate success politically and commercially on this coast must eventually depend. The French Government is much more liberal; it was M. Bouss who sent for Meunier to Tongvin, who under French patronage did so much in Senegal for science & for France. Even the Portuguese have an observatory on the S. West coast, while the Congo Free State & the Germans already establish their in their infant colonies. We will not detain ourselves to describe stations so closely situated as to be subject to the same climate or nearly so. We have already described the insular climate of
S. Helena & Ascension. We shall adopt the following general division.

I. Northern single-seasoned or dioic
   (a) Lateral (b) Interior.
II. Northern twin or double-seasoned or dioic or (a) Lateral (b) Interior.
III. Southern twin or single-seasoned (a) Lateral (b) Interior.
    (a) Coast (b) Interior.

Ia. S. Louis: 16° 0' 48" N. 16° 30' W. Altitude 16½ ft. (5 metres) is built on a sandy island at the mouth of the Senegal River. The island is very low and still subject to alarming inundations though much improved. The climate is much modified by close proximity to the Sahara. M. Bouyer attributes some effect also to the appearance of the great polar current at the surface. Its effect must however be limited by the fact that, especially in the dry season, the prevailing winds are from the land. He gives 29.84 m. (98 m.) at 30° at the level of the sea as the mean barometric pressure. As we have seen in the rule there is a tendency to diurnal maxima and minima, the maxima towards 10 a.m. and 7 p.m., the minima towards 4 a.m. and 4 p.m.; the oscillation is nearly constantly 2 m. This annual oscillation is also very regular with maxima in January and June and minima in April and November. Mean temperature is 74.6°F (23.7°C). This is 1.44°F (0.8°C) less than the mean between the maxima and minima or more correct, because the endurance of extreme height of temperature is always short. The mean of the dry season is 69.26°F (20.7°C) that of the six months containing the rainy season (26.7°C) 80.06°F.
The extremes are excessive: on December 27th 1877, a strong S.E. wind blowing 46.32 F. (7.9 C) was reached; on April 13th 1878 in the shade the same wind blowing 112.64 F. (44.8 C) was reached. 105.8 (41.5 C) and 88.35 F. (31.2 C) are more frequent extremes. Though the hottest occasions are in the dry season it nevertheless has considerably its lowest mean. Hygrometry: during the dry season the vapour tension may fall to practically nothing or to only 0.39 to 0.78 in (10 to 20 mm). The tension during the same year with a difference of but 7.2 F. (42 C) may rise to 30 mm. 1.81 in. but a mere shifting from N.E. to S. wind may increase the tension five times. These changes then have little connection with temperature though they give such an impression to the skin. Rain: 35 days of rain with a fall of 16.33 (415 mm) is the mean. The rainy season is extended over 4 months from July to October. The rainfall is a much less important factor in the increase of the surface water than is the annual overflow of the Senegal River. The Bosies illustrate well by a diagram the rise of the Senegal according to months at Dagana 109 miles (176 kilo) from St Louis and at Bakele 478 miles (769 kilo), during 1871. At both places the main rain was reached at the end of April and beginning of May. There a steady rise till the end of May resulting at Bakele in a height of about 16½ ft. (5 m), at Dagana of but 39 vis. (1 m). Through August the increase was rapid and during half September was reached and maintained at Bakele the maximum of 51 ft. (15½ m). At Dagana the full height of 17.2 ft. (5½ m) was reached by much slower increase during October, after which was a steady fall to the minimum. At Bakele at first a very rapid
fall of 32 3/4 ft. (10 m) was registered by a little after mid-October. The fall after this was slower specially from January to April. While the river is at its height the whole land is flooded. Winds: The S.W. exceed in frequency those of S.E. This is brought about by a rotation of the axes as the day advances from S.E to S.W. In the same manner during the rainy season W. rather than S.W. blows prevail. Land breezes are then very rare being replaced by calms. Storms or tornadoes occur most in the rainy season especially at its opening and close. The general origin of the tornado is from the S.E. with an apparent gyration by E. S. W.; the general direction being S.T. in S.E W. it is strongest nearer its point of origin. In Barcis tornadoes are local cyclones moving at about fifteen leagues the hour. Reliability reaches a minimum in April during the dry season a maximum in August-September. The daily minimum is towards the evening jogs are rare. Seasons: The dry extends from December to May; the rainy from June to September or October but the first three months are transition periods.

Dakar & Gorse (altitude 20 ft.), are two stations at C. Verde very near to one another about 14°40'S. + 17°28' W. Gorse is built on a basalt island in the bay which faces South; Dakar is on the low and S.W. shore of the same bay. And though thus near together Gorse is the healthiest & Dakar the unhealthiest of the French ports on the coast. The observations are those taken at Gorse. The mean Barometric Pressure and the oscillations are according to M. Barcis practically identical with those at S. Louis.
The Mean Temperature is (23.8°C) 74.8°F, the lowest observed in the latitude: while it is thus elevated but a degree above that of St. Louis there are not nearly such great extremes. The mean of the dry season is 69.0°F (20.6°C) that of the rainy season 80.6°F (27.0°C). Yet the difference is still sufficient to markedly affect vegetation. Some tells us that though the Banana fruit is all year round at Grand Bassam yet at C. Fort it fruits only in the hot rainy season. The minimum mean is in February 66.0°F (18.9°C); the maximum mean (87.9°C) 82.2°F in September. The greatest extremes noted have been 57.2°F and 91.4°F (14°C - 33°C). The diurnal variations are slight especially during the hot rainy season. The mean rainfall is 20 ins. (532 mm) in 36 days: the fall of one year may however double that of the preceding. This same fact applies whether in St. Louis or in Sierra Leone. The rainy months are as at St. Louis: August has the heaviest fall. The dry season from mid-November to May has very rarely any rain in it. 

**Hygrometry:** The mean vapour tension is about 19 mm Hg. It rises 4% regularly with the temperature. In the dry season it ranges as much as from 8 grammes to 25 per cubic metre. The relative humidity is much greater in the temperature in the rainy than in the dry season.

**Winds:** The F.E. or h. trades commence about October 15th and go on till the end of May. For the other 4½ months of the year the S.W. and W. monsoon winds prevail with frequent calms specially by night. Parallel with the diurnal increase of heat a breeze from seaward will increase a from landward diminish.
Sea breezes do not as I have already mentioned prevail in the vicinity of Capes. The N. W. wind is here not nearly so dry as it is at St. Louis. It has lost much of its dust and sandy particles but gathered up a good deal of marshy emanations. Its down wind direction taken to reach Dakar which is less sheltered and further still its necessary transit over the sea to reach Goree prevent its exertion of much harmful influence. These winds are still dry enough to refresh or, at night, even to chill. If these winds blow at all during the rainy season, they are slow and nervous, by the time they reach this point. The N.W. and W. winds are healthy, but to Dakar the N.W. carries with it emanations from a neighboring marsh left by the rains. The sky is clearest in the dry season, especially in April-May. M. Bosius says that the further one passes from the sea, the more prominently does the beautiful azure of the African seaboard, sky give place to a peculiar pale blue or greyish appearance. In the last during the dry season are some greyish clouds of the horizon is clouded by a thick layer of grey fog heaped at its base. This is the result of suspended dust. In the rainy season the sky is generally clouded at least a part of the day.

**Seasons:**

- The dry season extends from mid-November to May.
- The rainy season from June to September.
- The monsoon season is from October to May.

**S. Mary, Bathurst:**

13° 20' N. 16° 20' W. Bathurst Town is on S. Mary's Isle, a low sand-bank on the Southern Bank of the R. Gambier, some miles from its mouth. So the S. W. it is screened seawards by C. Bacche and S. Marys which is rocky. The observations are taken at an altitude of 6 feet below the level of the sea. The island is itself scarcely more than two feet above the level of the sea. During the rainy season a
large part is inundated. Some partial observations were made by Horton during the rest of a year. A maximum thermometer was not found but in Berries calculations it from his tables at 104.3°F (30.7°C). The minimum observed was 59°F January 20th. The maximum was towards the end of April. Further series of observations were made by a number of gentlemen during 1869 (Army med. Rpt.). The absolute maximum was 110°F April 7th. The absolute minimum was only observed in January to May 36.4°F January was the lowest. The mean in April at 3 p.m. was only 82.1°F. The highest monthly mean at 3 p.m. was Dec 84.9°F. The barometric pressure is not observed. Hygrometry the vapour tension was taken at 9 a.m. and 3 p.m. The highest tension was in October 91.5 at 9 a.m. 92.6 at 3 p.m. The minimum at the same hours were 49.4 and 63.9 in February & 50.0 & 51.0 in May. The relative humidity was least from February to May varying from 49.7 to 62.9. It was greatest in August 81% - 75%. The rainfall was observed May to September 1869 by Horton. There were 50 days of rain with 40.82 m. of water. The rainy days are about 1/3 more numerous than at Joris according to this observation. In 1869 the fall was observed from June to December: 47.36 m. fell in all during this period. There were 25 rainy days in August but the heaviest fall was 19.17 m. in September. No rain fell in November or December. Berries, probably by calculation, concludes that the rainy days average 84 & that the Rainy Season commences about June 20th. It ceases about the end of October. Storms & tornadoes are frequent. The temperature above indicates that the maximum towards
The end of the dry season is becoming more prominent.

José Island of Bissau: 11° 30' N, 15° 35' W is at the northern shore of the mouth of the Rio Gíba. The town is low, the fort is more elevated. It is a Portuguese possession & its statistics as published by M. Bovis are those of Dr. Santa Clara 1872. The mean temperature was 78° 38°F (26° 2°C). The temperature is very constant - during the first half of the dry season December to February 76° 28°F (24° 6°C). The highest absolute maximum is in the second half of the season, (30° 4°C) 86° 72°F 3pm March. The mean of this season is rather higher than that of the first half. The constancy of the temperature is seen when we note that between the mean of January the coolest, and May, the hottest month is only 5° 76 (3° 4°C).

Hygrometry: The vapour tension 1871-72 increased steadily from the beginning of the dry season to the end of the rainy. The relative humidity was greatest when there was mists from the sea. Rainfall: In 1871-72 the rains were still heavy in November. December is a gap: perhaps the rainfall was abnormally prolonged in time this year as Rey states the season usually ceases about October. The amount was unmeasured but Bovis calculates the number of rainy days as 31. The rise of the Rio Gíba is at its maximum in July & August. The fall proceeds rapidly from mid-September to October. From the above temperature note we see that here the mean temperature is highest no longer in the rainy season but in the Spring; May particularly is hot. January is the coolest month. May to mid June & the end of September to December, the extremes of the rainy season, which extends perhaps from mid-May to November, are accounted by Rey the most unhealthy periods.
Boke: 10° 42' N. 14° 5' W. is situated on the left bank of the Rio
many 45 miles from its mouth. In Bowes (Malak. de
mile) gives some interesting points from an unpublished
manuscript of observations 1878-79 by Mr. Bowes. The station
is interesting for its position is far from other stations that
have been described by meteorologists but I have been unable
to discover that the manuscript was ever printed. Mr. Bowes
gives a diagramatic chart showing 2 maximum minima,
1st minimum, 1st maximum, 1st minimum, 2nd maximum.

About: 26.4° 79.32° 30.3° 86.54° 25.7° 78.26° 27.7° 80.86

The rainfall extended over 187 days; there were storms on 87
days. The rainy season commences about the end of April. The
heat is intense for but short periods without little energy.

Fire Town: Sierra Leone: This is the only real colony on the coast.
It was founded by the British Government 1787 for colonisation by
negroes who had assisted us during the American War. The site
of the colony has not always been the present, which, convenient as
it is for commercial purposes, is most unhealthy. The mountains
of Sierra Leone have been called the Alps of West Africa if their
extent, height, and grandeur cannot claim this title the relation they
should have to the coast as a sanatorium fairly justifies it.

Of note. Forte Djalon Int. Sugar Loaf Int. 3000 ft. is the loftiest.

But if the country is so comparatively salubrious for one so near
the equator 9° 28' N. 13° 15' S., being the position of Fire town, no
spot could have been chosen in it better adapted to malign
its character than that of its capital but not only so, the day
of national rejoicing of Freetown's enlightened citizens is the Finessey's day, annually kept in honour and memory of the abolition of taxes in the colony by the late Sir John, when governor of Sierra Leone. The rates being levied on important public works are carried on, the drainage is from a sanitary point of view, and the water supply is worse. The mortality among the Europeans is great but nearly as great as when a cynical writer was able to write of it that Sierra Leone always had two Germans, one going out alive, the other coming back dead. Among the black population about Freetown numbering about 30,000 the mortality is very heavy. Many but generally not very complete series of observations have been taken here by various officers and others. Thomas Wentworth in 1793 calculated the rainfall to be 86.28 in.; in 1794 82 in.; 1795 63 in. He considered the rainy season to be the 4 months June to September. He fixed upon 84° as the mean temperature, not only the annual barometric variation of the harmattan and its dust fog. Boyce's statistics of 1820 are the most available. Comparing these with his own figures Africans Horton concludes that the mean temperature is about 80°. The absolute maximum occurs towards the end of the dry season; the absolute minimum towards its beginning. The year 1882, in which however throughout the figuring is suspicious, is an exception. In 1887 both maximum and minimum occurred in February. The minimum 61.0 on the 8th, the maximum 98.0 on the 1st. These are the lowest and highest figures recorded in Sierra Leone. The mean of the month was 81.6. The rainfall is enormous. An average of the years 1849-51 and 75 to 85 taken as a * See Army Med. Dept., each year.
representative series is 158.63 in. in 141 days. Over 300 in. in a year is not rare; it is possible that the amount of 303.90 in. in 1829 may be fairly accurate; 33.130 inches in 73 days is the number given for 1882 but may with the other figures of that year be doubted. Barometer shows no marked peculiarity. Horton states that its maximum is in April or May. The hygrometry as far as it has been studied shows that it is high but not peculiar. The West Wind is most prevalent; they are not I think very accurately observed. The statistics of the h. wind are most peculiar e.g. it is noted 240 times in 1876 and only 17 times in 1878. Hogs, tornadoes & storms are common. **Seasons:** Comparing the various statistics of the Army Medical Department for a series of years it may be said that the dry season includes most of December till the first half of March, during which time the average number of rainy days does not exceed half a dozen. The rest of the year forms a long Rainy Season. Locally however the latter part of the dry & beginning of the Rainy, Feb.-May to April is called the Summer. Because it is the hottest period: the latter part of the rainy season “Harvest Season” & the succeeding part of the dry the “Harvest Rainy Season”. Gore was of opinion that as a general rule the sickness & mortality are in inverse ratio to the rainfall.

**Liberia:** This backward Republic which occupies but does not advance the Grain & Rice Coasts has no available published statistics of its meteorology. A few scattered points are worth collecting. Benjamin Anderson notes that in Massarde in
Grundungsland he first felt the harmattan on December 15.
At 6 a.m. December 17th he notes a fall of the thermometer to 52°F.
The association between the harmattan dust fog with the burning of
the plains. Horses thrive readily here apparently. Loomis
quotes from Berghaus's Physical Atlas the rainfall of C. Palmas
4° 21' N 7° 44' W at 82. 07 in. The original authority I don't know.

16. Interior Northern 2 Seasoned or doric climates.

Bakel: 14° 53' N; 12° 30' W; is an important fort on the upper Senegal, situated on a rocky declivity facing towards the side of which
it is on the left bank. Its latitude, nearly the same as that
of C. Verde gives it special interest. The altitude is 500-600 ft. (150
to 200 metres) yet it is elevated above the river 30 to 80 ft. (24 or 10 metres)
according to the fullness of the latter. Mr. Bowles obtains his figure
by the comparison of 6 incomplete statistics collected between 1822
and 1873 relying most on the data of 1860-61. The most distinctive
feature in the climates of which this is a type is in the temperature.
The annual mean is stated at (38° 7 C) 83. 66 F but probably this is
excessive. The peculiar character is not in the rainy season which
maintains much the same character through out both litoral and
interior regions, but it is in the dry season which here presents
two subdivisions, the dry and cool December to February, the dry
that March to May. While at the coast at an equal latitude there
is a slow increase of temperature from winter to autumn here
inland is reproduced as even exaggerated a condition which the
Temperature curve does not begin to show on the coast till we are
much further South. Thus the temperature of the dry season is
84.38 (29.1 C) that of the rainy is 82.94 (28.3 C) only 2.34 (1.3 C)

* * * Dr. F. Bacon: J. Roy. Geog. Soc. 1882 p. 201.
above that of Gorse. But the mean temperature of winter is 77.54°F (25.3°C) that of spring 89.96°F (32.2°C). This does not altogether depend on the frequency of the winds: the N.E. actually blows 76 times in winter as compared with 47 in spring. Probably some of the excessive temperature results from the rocky surroundings of the fort. The absolute maximum (43.6°F) on April 29th 1861 is the highest recorded here. (13.7°C) 86.6°F is the lowest was noted by Anne Raffend in January 1827. April is usually the hottest month: sometimes May: in 1861 the April mean was (34.1°C) 93.3°F. The body is actually for some hours a day at this season in an atmosphere superior in temperature to its own conductors burn them when touched. The nights of the hot season are pleasant. In the rainy season the nights are miserable for very little rain: soon influence reaches here. The daily variations of temperature are least in August 9-14°F (3-5°C): but, for the latitude, enormous in the dry season as 69.4°F (20.8°C) December 1st 1861; this makes the season though invigorating to Europeans very dangerous for natives. The winds are practically the same as at S. Lobis & Gorse but the N.E. which here prevail during 8 months are dryer: the S.W. & S. less pure, fuller, and more often replaced by calms. Rain: increased usually as we pass inland: perhaps the 21.6 ins. (560 mm) collected in 1862 was below the average. Storms & tornadoes are frequent here as on the coast. The rainy season commences and ends rather later than at Gorse. Its season is really pleasant: the desire of every season is for the next. The Baromtery & Hygroometry are not ascertained.
George Town. In Aathy Island. The town is on a low island 91/2 miles long and one mile broad. 250 miles up the Gambie; so low is the island as to form a swamp in the rainy season the pools of which when partly dried up exhale noxious vapours. Its position is 13° 32' N. 14° 42' W. The climate is very similar to that of Bakel. The mean annual temperature is 86°. By way of illustration the monthly are as full:

<table>
<thead>
<tr>
<th>Year</th>
<th>Winter</th>
<th>Spring</th>
<th>Summer</th>
<th>Autumn</th>
</tr>
</thead>
<tbody>
<tr>
<td>1865</td>
<td>Dec. 77.5</td>
<td>Mar. 88.4</td>
<td>June 90.13</td>
<td>Sept. 84.21</td>
</tr>
<tr>
<td></td>
<td>Jan. 81.9</td>
<td>Apr. 92.8</td>
<td>July 85.35</td>
<td>Oct. 84.89</td>
</tr>
<tr>
<td></td>
<td>Feb. 86.4</td>
<td>May 93.88</td>
<td>Aug. 83.25</td>
<td>Nov. 82.96</td>
</tr>
</tbody>
</table>

The parallel to Bakel is easily seen. The extreme maximum of 108° was noted in April 1864; the extreme minimum 64° on January 2nd. The winds are as in Senegambia generally, but here the monsoon specially from the N.W. T.S.W. was some times even violent at the beginning of the rainy season. The 22nd June precisely was the opening of the rains in 1866: it was apparently preceded by a S.E. tornado or cyclone. The rainy season is well marked off from the day in which scarcely any rainy days occurred. In 1865 there were 60; in 1866 64 rainy days: August had the greatest number, 19. The end of the rainy season may be said to be in October with 5 rainy days; only one occurs in November.

The literal division of Northern Diphthonic or Double Seasoned Climate.

Grand Bassam 5° 11' N. 3° 60' W. Assino 5° 8' N. 3° 8' W. and Dakon on the Brie lagoon and East of Grand Bassam 46/2 miles, are so close together and so similar in climate that we may best consider them with Mr. Bosius together. This author (Ann. de Soc. Meteo 1879) has collected
and compared together the statistics of various authors at each place. The sun is vertical over Grand Bassam on April 16th and September 19th. The barometer shows the lowest depression during the Great Dry Season 29.65 to 29.66 in (780.8-781.9 mm). During the next, the Great Rainy Season is the highest elevation 29.606 to 29.653 in (782.0-783.2 mm). Similar but less depression and elevation mark the nature of the two lesser seasons. Temperature annual mean is according to Formé 82.4°F (28°C), but this is almost certainly excessive. The Great Dry averages 84.2°F (28.4°C); the Great Rainy Season 82.0°F (27.7°C); the Lesser Dry Season 78.6°F (25.9°C); and the Lesser Rainy 81.8°F (27.2°C). These figures represent a mean between the midday and 6 a.m. temperatures. M. Bourns does not believe the absolute 55°F. Formé puts 98° and 99°F (35°-37°C). The mean annual from 1879-60 after Formé is interesting if correct. It was lowest during the Lesser Dry Season, rose to 25 mm during the Lesser Rainy Season and Great Dry. The maximum, 28.76 mm, was reached in April and was followed by a rapid fall. The relative mean however reaches its maximum of 92% in October 18. In the Lesser Rainy Season it fell to 88% during the Lesser Dry and part of the first Rainy Season. The Seasons are thus distributed: The Great Dry from December to March; the Great Rainy from April to July; the Lesser Dry from August to September; and the Lesser Rainy from October to November inclusive. Rainfall: the average number of days on which rain falls is 116. In the year 1859-60 during 88 rainy days Formé calculated a fall of 246.97 inches (6,273 mm). But the accuracy of his figures is uncertain as illness prevented him from making always personal observation.
Winds: A S. or S.W. wind starts in the morning; during the day it tends to rotate round to the West. E. or E.S. winds do not occur at night. They occur in the morning but rarely between December 4 May. They are very unhealthy bringing a scourge of fever with them. Bonis distinguishes these from the harmattan which, he states, implies certain physical characters. Mawe assures us that tornadoes are frequent during the first rainy season. The S.W. wind prevails all the year round but specially May to November. Legrain mentions that a very fine penetrating rain (Scotch mist) is common in the morning as the weather falls. The thick fogs of the dry seasons are specially prevalent on low coasts and at the mouths of streams. Some would rename these seasons the "Saisons de Bouillards." The Great Dry Season is agreeable; the great rainy is the intermittent fever time; the little dry seems cold to anacrinated Europeans: land breezes do not appear in this Season: the little rainy is most fatal because it is the last of a succession of debilitating seasons.

Climate of the Gold Coast: Africanus Horton provides some tabular statistics compiled on this coast 1859-60 at various posts, and I mention them shortly because it will be seen that the period observed corresponds nearly with that of love at Grand Bassam on the Ivory Coast. The first observations from January to June belong either to Anamabos, a little East of C. Coast Castle, or to the neighbours.

Slave Coast: Those of August to November of September onwards to Christianiaburgh. The notes of locality are not satisfactory. The mean monthly maximum temperature is 90° F in February. The mean minimum monthly is 72° in September. But Spec.

* The latter of Dr. Berenger-Glaude show this to be the least healthy French settlement on the Coast.
Philly do we note the enormous decrease in rainfall which I note in full as the difference between night and day fall is interesting.

Days: 1 2 3 4 5 6 7 8 9 10 11
Nights: 1 2 3 4 5 6 7 8 9 10 11

Hanna has however presented us with a more exact account. According to her write the mean Barometric Extremes are 30.06 in. and 29.74 in. The absolute temperature Extremes for the whole coast are 89.6 and 61.7. The yearly evaporation amounts to 54.80 in. The S.W. wind prevails all the year round, its maximum strength being from June to August and its minimum from December to February. S.W. and N.W. winds alternate the former blowing till 9 p.m. the latter to 9 a.m. The harnattion is occasional only: thus it was noted in November once, in December 5, in January 10, in February 2, times & in March once. Its direction was mean N.E. but the wind oscillated from N.W. in the morning to S.W. in the evening. It reduced the mean humidity to 47% 27% below the normal figure. The mean which is 74% it did not affect the mean temperature the morning's evenings being colder & midday hotter. On the contrary Gironde from the S. E. reduced the temperature 9° & made the barometer rise.

Elmina: 5.5° 130° W. altitude 57 ft. Both Hanna & Danchelman have treated the observations made here. The mean barometric pressure is 29.9 in. The mean annual temperature is 79.2°. The absolute maximum is 89.1°: the absolute minimum 65.1°. Danchelman (1871) states that the maximum 81.68°F. (27.6°) is the mean of March; that 75.02° (23.9°) in August is the minimum monthly mean.
The relative humidity is given by Hanks as 81%. Danckelman states that a maximum mean of 89% is reached in September and October; the absolute maximum 22.8 occurs in March or April. The mean rainfall (Hanks) is as follows:

<table>
<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2</td>
<td>4</td>
<td>7.3</td>
<td>13.7</td>
<td>11.3</td>
<td>63</td>
<td>7.3</td>
<td>8.0</td>
<td>7.3</td>
<td>7.3</td>
<td>7.0</td>
</tr>
<tr>
<td>Rainfall: 1.12</td>
<td>0.04</td>
<td>1.93</td>
<td>1.89</td>
<td>3.23</td>
<td>7.40</td>
<td>6.73</td>
<td>1.69</td>
<td>1.06</td>
<td>0.91</td>
<td>2.36</td>
<td>2.13</td>
</tr>
</tbody>
</table>

The mean total rainfall during 3 years was 30.79 in per annum.

While Gordon states that the second or lesser rains are ushered in by a breeze along the coast, interrupted by tornadoes. He mentions also the alternation of S.W. and S.E. breezes in the dry seasons. But such cannot be said to exist on the rainy. During January to March an irregularity is caused by occasional E. winds along the coast bringing also heavy rains mixed with tornadoes. In 1848 he notes the arrival of the Harmattan on February 9th, nearly a month late, and preceded by a tornado. He gives an interesting enumeration of the native division of the seasons in his "Life on the Gold Coast."

Christiansburg: 5° 36' N, 0° 10' W, Altitude 66 ft. Is the ancient Danish fort a little to the W. of Accra. The mean barometric pressure here according to Hanks is 29.885 in. The diurnal range is 0.99 in. The monthly average through slight the variations are very regular.

Barometric 1st min. 1st max. 2nd min. 2nd max.
Pressure: 21 Mar. +0.084; 27 July +0.087; 4 Dec. +0.032; 31 Dec +0.028 in.

The non-periodic oscillations do not exceed 197 in. The mean annual rates of rains are 31.099 and 29.701 in. The absolute 30.123 in and 29.654 in.

Danckelman shows that the daily oscillations of mean humidity were very great: 67% was the mean of June and 57% of September.
Temperature: according to Dr. Hann the mean is 80.8°F; the mean maximum is 100.3°F; the mean minimum 67.6°F. Dr. Danchelman's later observations (1870) showed that the maximum variation of temperature per month was 14.2°F (7.9°C) in April. The Government statistics for the Gold Coast for the 11 months preceding December 1856 show that the highest and lowest absolute maxima and minima for any one day were 91°F and 80°F (Hann). The extremes of absolute minima ranged from 65°F to 85°F. The daily oscillations of temperature vary from 12°F in February to 16°F in December. The maxima and minima (Hann) are: 1st minimum: 85°F; minimum: 1st maximum: 2nd minimum: 74°F; Jan: 80.4°F; Apr: 83.5°F; Aug: 76.1°F; Nov: 81.5°F. Hann thus states the mean of the Annual Rainfalls for 9 years:

Days of Rain: Jan: 2.1; Feb: 1.3; Mar: 2.3; Apr: 4.3; May: 5.5; Jun: 8.8; Jul: 10.7; Aug: 5.3; Sep: 6.7; Oct: 5.2; Nov: 2.6.

Rain in inches: Jan: 0.51; Feb: 1.06; Mar: 2.17; Apr: 1.46; May: 5.63; Jun: 5.63; Jul: 2.01; Aug: 0.39; Sep: 0.67; Oct: 1.73; Nov: 0.71; Dec: 0.67.

I give also Danchelman's averages of the fall during 4 subsequent years:


Rain in inches: 0.43; 1.32; 2.55; 2.66; 6.53; 5.42; 1.45; 0.04; 1.02; 0.89; 0.90.

The total fall in the first period was 22.64 in per annum during the second 27.66 ms. per annum. The totals of percentages of Rainfall Jan-Mar: 73%; to the quarters of the year are of interest. The prevailing winds are similar to those at Elmina. The Seasons Sept-Nov: 13%; May readily be deduced from the rainfall. The Dec-Feb: 9%; Jan is vertical during the first week of April and second of September.
Slave Coast: Our meteorological statistics of this coast are very deficient. Dr. T. F. in his description of it describes it as a low country where fort is sandy on a clay base. The mean temperature is 79.1°F (26.2°C); the absolute maximum was (35.2°C) 95.2°F in November 1876. The absolute minimum 68.9°F (20.5°C) occurred in August. February was the hottest month with a mean of 82.2°F (27.9°C); March had the same mean (1877). August 1876 with a mean of 74.8°F (23.8°C) was the coolest month. The difference is thus very slight.

S. S.W. winds prevail all the year. The sun is vertical on March 11th or 12th and September 15th or 21st. To select briefly from his remarks.

First Rainy Season is from March 15th to July 15th. The heat main are greatest in April. By June the rain is generally only fine. The rains are at their maximum height in June.

Little dry season: 15th July to Sept. 20th. July and August are still cloudy. W. W. winds prevail.

Second or less rainy: 20th September to the beginning of December. The conditions are as those of the first rainy; the humidity is specially great at night. S.W. W. alternate with landwinds.

Great Dry Season: December to March 15th. Thick fogs at sunrise are until 8 a.m. The temperature and barometric rise + the heavens clear.

The S.S. S.W. breezes alternate regularly with the S. W. land winds. The N. S. harmattan blows in January & February: it is but very feebly starts but 2 or 3 days: it is preceded by a heavy harse. On land this is the healthiest season but the reverse afloat.

Lagos: 6.12 3.25 E. Altitude off. Dr. Charles Burton has given us observations made during seven months from June to December 1863. The maximum mean barometric pressure was 30.047 in.
August. The minimum 29.920 in. in November. The range was great: 51 in July 0.136 in. The highest temperature noted was 96.5 in December. The lowest, 60.8 in the same month, which also had the highest daily range of 22.4 F. The least range noted was in July 11.1 F. The highest mean monthly temperature was 80.6 in December. The lowest 75.5 in August. The mean humidity was highest 97% in October. The sun's rays were hottest in December 132.7. During the time observed 60.32 in. of rain fell in 62 days. Less than two inches in each fell during August, September, and November. The wind was S.W. and W. from June to the beginning of August; then a change occurred and a land breeze blew, the bar improved, heavy fogs, which were "as thick as a London fog but of a much whiter colour and when inhaled tickled the throat," and dew appeared. The fog came on before 7 a.m. and lasts on till 8 or 10 a.m. The thermometer began on December 17th. Squally with intervening calms alternated at night; the grass became parched and nearly every one was down with fever. The force of this wind was slight.

Akassa: 6°20'10" E. 4°26'10" W. Altitude 21 ft. The station is the principal depot of the Royal Niger Charter'd Company, and is on a low swampy island about 3 miles from C. Han; the Niger is here 1½ miles wide. Records have been registered during periods of 1877-88 and 1889-90 by Mr. Frank Russell. During the first period the barometric pressure had a mean of 29.987 in.; during the second 29.982 in. The highest pressure registered was 30.184 in. June 29th 1888; the lowest was 29.735 December 19th 1889.
The oscillation was greatest 1889-90 in December and June, 4° least in August and July; during the first period observed it was greatest in May. The mean temperature for the first period was 77.4°; for the second 78.1 and 78.2. The highest temperature recorded in the shade was 92.5° in February 1887; the lowest 60.5° in August 1890. The range of temperature on a single day was as high as 82°F. There appears to be but one maximum in the mean temperature curve about March or April, and one minimum about July or August. They are separate but 3 or 5 degrees. The sun's rays are hottest about October to May and coolest in July or August; but in 1889 August was unusually hot and dry and had the highest temperature in the sun, while September had the coolest.

Humidity: The actual amount of vapour present is greatest in March or April and in December 96% at 9 a.m. in October is the highest relative mean observed. July showed least humidity. Rainfall: may be best exemplified by the 2 complete years February 1887 to January 1888 and 1890; during the first 186.841 in fell on 106 rainy days; during the second 183.351 in. in 144 rainy days. The distribution I thus illustrate

<table>
<thead>
<tr>
<th></th>
<th>1887</th>
<th>1887-88</th>
<th>1889</th>
<th>1889-90</th>
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<tbody>
<tr>
<td>Dec.-Feb.</td>
<td>...</td>
<td>15.322</td>
<td>...</td>
<td>15.705</td>
</tr>
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<td>Mar.-May.</td>
<td>29.210</td>
<td>35.724</td>
<td>...</td>
<td>32.099</td>
</tr>
<tr>
<td>Jun.-Aug.</td>
<td>21.250</td>
<td>36.441</td>
<td>62.403</td>
<td>31.557</td>
</tr>
<tr>
<td>Sept.-Nov.</td>
<td>61.639</td>
<td>...</td>
<td>57.055</td>
<td>24.715 (Sft only)</td>
</tr>
</tbody>
</table>
The oscillation was greatest 1889-90 in December and June, and least in August and July; during the first period observed it was greatest in May. The mean temperature for the first period was 77.9°; for the second 78.1° or 78.2. The highest temperature recorded in the shade was 92.5° in February 1887; the lowest 60.5° in August 1890. The range of temperature on a single day was as high as 322.5° F. There appears to be but one maximum in the mean temperature curve about March or April, and one minimum about July or August. They are separate but 3 or 5 degrees. The sun's rays are hottest about October to May and coolest in July or August; but in 1889 August was unusual, being hot and dry and had the highest temperature in the sun while September had the coolest. Humidity: the actual amount of vapour present is greatest in March or April and in December; 96% at 9 p.m. in October is the highest relative mean observed. July showed least humidity. Rainfall: may be best exemplified by the 2 complete years February 1887 to January 1888 and 1890; during the first 136.841 in fell on 186 rainy days: during the second 163.351 in. in 144 rainy days. The distribution I thus illustrate.

<table>
<thead>
<tr>
<th>Year</th>
<th>Dec-Feb</th>
<th>1887-88</th>
<th>1889</th>
<th>1889-90</th>
<th>Dec-Feb</th>
</tr>
</thead>
<tbody>
<tr>
<td>1887</td>
<td>...</td>
<td>15.322</td>
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<td>1888</td>
<td>39.210</td>
<td>35.724</td>
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<td>32.099</td>
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<tr>
<td></td>
<td>21.250</td>
<td>36.441</td>
<td>62.403</td>
<td>31.557</td>
<td></td>
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<tr>
<td></td>
<td>61.639</td>
<td></td>
<td>51.055</td>
<td>24.715 (Sft only)</td>
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</tbody>
</table>
In October and November 1880 no observations were made. Mr. Russell divides off July to October as containing the chief rainy days and November to February as containing the dry. As a rule there is most rain in September and least in January. In July and August 1887 and 1890 was a distinct remission in rainfall, even though it was distributed over many days; in 1888 a similar remission occurred in August and September but in 1889 there was none such. During March to June the fall increased continually. The heaviest fall noted was on August 28th, 1889 8.35 ms.

Winds. The harmattan is occasional from March to May. The S.W. is the commonest breeze; calms are very common. The average velocity is 5½ miles per hour by day and only half that speed at night. Clouds are always prevalent especially from June to November. The nebulosity is least in January. Fruit and figs are most abundant in June and July; least in May and September. The harmattan dust is dense enough to check the light rays but not the heat rays of the sun. Flies of various sorts multiply rapidly in the harmattan months. The wet season nights are clear but very oppressive. Tomatoes are frequent. After violent storms from the S.E. or S. the direction of the Guinea Current is often changed for a day or two so much that sailing vessels take the opportunity to make their way in its course.
Fernando Pó: 3.46° W. 36° S. Altitude: 98 ft. This island is a volcanic peak mounting up by densely wooded slopes to a peak of 12,190 ft. Clarence Cove, the harbour, and San Isidro, the little capital, are on the North side of the island and are also sheltered towards the West by Balloon Cape. Situated at the base of the mountain where they may obtain so much of the moisture and as little as possible of the troops one cannot be surprised to know that so many have written against the health of the island; they should have written against the salubrity of that part of it. The higher parts have a much more fortunate character. Daniell in 1849 made a comparison of his own observations with others of Heeley's &c. The highest mean monthly temperature according to this author is 81.1°F in February, the lowest 73.5° in June. There is a rise of two degrees till August followed by another slight fall to 74.7° in September from which time till February there is a steady rise. January and February are the most variable months in temperature. He states that the great dry season commences in November, the first rainy season which is also the greater, begins towards the end of April. More exact information is afforded us by the statistics of Sr. Pellon of Rodriguez collected during 4½ yrs 1859-63. His observations were made at an altitude of 98 feet. The mean barometric pressure is 29.81 ins. (757.3 mm). The maximum is 29.84 ins. (758.1 mm) in August. The minimum is 29.78 ins. (756.6 mm) in April. The highest mean temperatures are 81.86°F (27.7°C) in January and (26.6°C) 81.69°F in February. The highest mean of the absolute maximum is in February (32°C). The lowest of absolute minima in September 62°F (16.7°C). The greatest mean variation is in March 13.86°F (7.7°C).
The mean relative humidity is 89%. The maximum is 91% in June to August. The minimum is 86-87 in December to February. The average rainfall is Dec. to February, 57.5 ins., 13.2 days (2337 mm) 100.67 ins. in June to May. 25.7 ins., 44.2 days. The table demonstrates: June to August, 28.5 ins., 54.3 days. The distribution: The N. E. Sept. to Nov. 40.7 ins., 53.2 days.

Wind only blew in January to March: rarely in April. Tornadoes are from E. or S. E. very rarely North.

II.6. Interior Northern double Seasoned or Diploeric Climate.

Aburi 5° 31' 0.9' W. Altitude 1542 ft. is about 25-30 miles inland from Accra. The temperature were not ascertained except for an incomplete period. They suffice to show how soon the same influencer cease. There were 75 rainy days with a total fall of (108.45 mm) 42.69 inches of rain. The fall of the first rainy season is nearly half as much again as that of the second. 4 yr. on these individual rainy days. The heaviest rains must have been in September and October. I give the table of rainfall.

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<thead>
<tr>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>June</th>
<th>July</th>
<th>Aug</th>
<th>Sept</th>
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</table>

Rainy days: 0 2 2 11 9 12 6 12 8 5 8 7 5 3 5 1
Amount in inches: 0 9 3.3 6.6 7.7 5.9 86 2.9 4 5 5 4.8 9

Abetifi: 6° 29' 0.6' W. Altitude 2198 ft. (Dr. Fröhly 1885 in Runzenbach.)

This station appears to be about 80 miles inland from Accra. The observations here were made by the missionary Ramsay in 1883 January being omitted. This gap being filled up. 73.76 °F. (23.2 °C) is calculated as the mean temperature for the whole year. The greatest variation (January being unnoted) was (7.4 °C) in 13.32 °F in February. The least (3.9 °C) 7.02 °F in June. During the year...
41.22 ins. (1049 mm) of rain fell, distributed over 98 days in appreciable quantity. None fell in January or in February.

Mar Apr May Jun July Aug Sep Oct Nov Dec
Inches of rain: 4 : 3.6 : 11.4 : 8.1 : 1.3 : 0.2 : 1.25 : 1.16 : 2.8 : 0.23 in.

Here again the first rainy season is also the greatest; in it also was the heaviest fall in a single period during the 10 rainy days of May October; however, witnessed the maximum monthly fall.

Bismarckburg: 8° 12' 0.34 E; altitude 2330 ft is a post in the new German Territory of Jogoland on the Slave coast. Dr. Wolff (now deceased) and others made careful observations from 1888-89 (see Danchelman) and from 1889-90 (Meteorologische Zeitschrift Feb. 1892). Mean barometric pressure 1888-89 27.54 in. (699.7 mm) 1889-90 27.51 in. (698.9). The greatest monthly variation 212 in. (5.57)
July 1888: 204 in. (520 mm) July 1889: Surpassed by 216 in. (5.5 mm) November and 263 in. (67) February 1890. Mean temperature for both periods 74.84 (23.8°C); mean amplitude 12.6°F (7.5°C). The lowest mean was 69.8°F (21°C) July 1889: (25.0°C) 77.0°F was that of November 76.46°F (24.7°C) December, 79.88°F (26.6°C) February. The variations during the other periods were unimportant, as regards the temperature curve. The absolute extremes were 98.42°F (36.9°C) March 1889 and 52.7°F (11.5°C) December 1888. Mean temperature amplitude was 18.5°F (10.3°C): it was least in July or August at 12.96°F (13.8°C) with 5.7°F (7.2°C) and greatest from December to March 24.14°F (12.8°C) with 23.58°F (13.1°C). The mean absolute humidity 1888-89
was (5.6 mm) per cub. cm. The relative mean was 75%, 1888-89 and 78.6%, 1889-90. The maximum rainfall was 95% in July and the minimum 38% in January 1890. In 1888-89 (1505 mm) 59.29 in. of rain fell in 174 days: in 1889-90 63.55 in. (1614.4 mm) in 202 days. More by 33 in. to 26 in. fell during nighttime than during the day; in 1889-90 but the reverse in the proportion of 17.70 in. to 45.75 in. during the next year; but on this occasion the day fell was at least excessive to the night diminishes as during the last two months the register was taken at 9 p.m. instead of 6 p.m. The heaviest fall in one day was 3.36 in. (85.5 mm) in June of the first year. Rain fell in November to January: Rain: 1888-89: 1889-90

Winds: The S.W. is: March-April: 42% 42%
The prevailing wind: it was: June-Aug: 19: 22
Noted 129 hours in the first and: Sept-Nov: 33: 28
138 times in the second year: it: Dec-Feb: 6: 8
is commonest march to May. The W. is frequently ended with S.W. winds July August and September: but during the second year it was represented by a W. & W. wind. W. winds were noted 147 times in the first, only 66 in the second: the W. & W. 69 times in the first and 109 in the second. R.C. occurred 134 times each year, specially from October to February. Storms were mostly prevalent March to June, and about September. The wind is strongest in June and weakest in April. The cloudiness is greatest in June to August or September and least from December to February.
Southern Double or Fourseasonal (Diphloënic) Climates.

Gaboon: 0.30 hr.: 9.30 E: observations taken at various slight altitudes. Griffin de Belay and Trouard produced a good climatology of 1862. Their division of the seasons is interesting, showing that though Gaboon is North of the Equator, its Climate is a variety of that found South of it. Thus:

- Lesser Dry Season: 1st January to 15th February or the beginning of March.
  - High Temperature; a heavy atmosphere; land breezes.
- First Rainy Season: 15th February to 15th May; frequent and violent storms.
  - Temperature not over 72.4°F (22°C)
- Great Dry Season: 15th May to 15th September: relatively fresh, specially the nights: rains by sleet or sometimes in the afternoons.
- Second Rainy Season: 15th September to 15th January: is much as the first: alternately wet and dry.

Thus instead of finding at the equator two Dry Seasons of equal length; we find that the one nearer the Southern and more distant Solstice is but 3014 weeks long: and, as a matter of fact it is much more irregular in time and duration than the table of these two gentlemen's observations would lead us to suppose. Lieutenant Murray omitted it altogether and held that there was but one rainy and one Dry Season at Gaboon: and indeed we shall see that in this region this season may be absent some years.

The barometric mean for 1862 was 29.921-29.960 m (760-761 mm) March to May: 29.99-30.078 (762 to 764 mm) in the Dry Season: 29.960-29.99 (761-762 mm) for the rest of the year. The mean daily variation was constantly about 0.0007874 m (0.2 mm).
nature at 6 a.m. of 78.8-84.2°F (26-29°C), at 2 p.m. 86-89.6°F
(30-32°C), in the evening 82.4°F (28°C). In the next table
the authors mentioned agree:

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</tr>
</thead>
<tbody>
<tr>
<td>Average Temperature</td>
<td>92.1</td>
<td>88.5</td>
<td>93.7</td>
<td>91.1</td>
<td>94.0</td>
<td>84.6</td>
<td>83.0</td>
<td>79.7</td>
<td>86.8</td>
<td>91.1</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>77.7</td>
<td>78.7</td>
<td>75.7</td>
<td>75.7</td>
<td>76.7</td>
<td>75.7</td>
<td>72.8</td>
<td>80.3</td>
<td>81.3</td>
<td>82.8</td>
</tr>
<tr>
<td>Daysôrain</td>
<td>6</td>
<td>12</td>
<td>15</td>
<td>25</td>
<td>8</td>
<td>16</td>
<td>2</td>
<td>7</td>
<td>0</td>
<td>28</td>
</tr>
</tbody>
</table>

Abdelin writing in 1872 contributed their statement that the rain is
more abundant in the first rainy season; he observed a fall of 40.12
in. (1,019 mm) during the first, and 53.7 in. (1,362 mm) during the second.

The opinions differ as to the comparative salubrity of the seasons but the
great dry and great rainy seasons seem healthier than the lesser seasons; most sickness seems to occur during the first
rainy season.

More recently the observations of Dr. Tricent
have been published by M. Berrias (1881), for the years 1869-71. Dr.
Dancheulian has also published the observations of Hern. Soyer
during 1882-83, made at an altitude of 108 ft. at the A. Munda
(0.25° N. 43° E.) a little South of the Gaboon River. According to the
latter there is a minor maximum of barometric pressure during the
little dry season 29.842 in. (759.7 mm mean for February 1882) or 29.881 in.
(759.7 mm Jan. 1883); a minimum follows closely 29.83 in. (75.877 in. Mar. 1882)
or 29.818 in. (75.7 Apr. 1883); the highest mean was 29.999 in. (762 mm)
in July 1882; the lowest minimum 29.846 in. (761.1 mm) in December 1882
was less depressed. The maximum barometric variation was (6.4 mm)
26.7 in. in August; the minimum 14.9 in. (38 mm) in June. The
Temperature has 2 maxima corresponding to the heights of the Sun, that
10 in each rainy season, and a minimum in each dry season; But the
minimum of the little dry is not nearly so low as that of the greater.
St. Vincent's observations gave an annual mean of 79.16°F (26.2°C).
The highest monthly mean was 80.96°F (27.2°C) in May; the lowest
77.18°F (25.1°C) in July was not observed. A second lesser maximum
was noted during autumn or the beginning of winter, and again
a slight depression. March to May was the hottest, and June to Aug-
ust the coolest period; Boreas is of opinion that the doubling of
the maximum & minimum ceases at 80°. The Yogswa statistics
are very similar. Thus in 1882 77.9°F (25.5°C) was the mean of February
and was the first & least important maximum: 78.6°F (25.9°C)
the first & major maximum was in March: a gradual fall to
the lowest minimum (32.7°C) 71.7°F in July: another rise suc-
ced to 76.8°F (24.9°C) in December it was however exceeded during
the same season in January 1883. The extreme temperatures he
accounts to be 92.3°F (33.5°C) and 60.8°F (16.0°C) (1880-2-3).
The average number of days of rain is about 154 but this is not
accurate as I have added averages instead of original numbers: the
greatest number of rainy days as well as amount of rain occurs
in the second rainy season. Instance the average of 1880-83:

In these years 20% fell in November compared with 17% in April.
44% Oct-Dec: 42% February to April. An even more favourable
result to the excess of rain in the 2nd rainy season is got by
examining a more general mean. The force of the wind in 1882-3
was computed as least in July August and December, greatest
in January and April. Mr. Bates illustrates by good tables the preponderance of S.S.W. + S.W. in the mornings rotating round to W. and N. W. about 2 p.m. + returning to S. W. about 9 p.m.

The festal brow is greatest during the second rainy season: least during the dry season. Contrary to what we might have expected the statistics show a greater dryness than those of five but possibly the differences of observers may account for this. The great dry season is even more cloudy than the first rainy season, but perhaps this is partly due to great inland plains fires seasons.

The lesser dry season has a most varying position in December and January thus from December 31st, 1880, to January 5th, 1881, December 19th, 1881, to January 20th, 1882: in 1883 there was no such season. The great dry season begins about mid-May and ends about mid-September but is also very irregular in position.

S. Thomas Island: 0° 20' N. 64° 43' E. altitude 15 ft. like Aranda Po the island slopes up to a lofty peak 700 feet in height. Its chief town S. Anna de Chaves is unhealthy. Meteorological statistics may be found in the works of Danchelman and others. Its latitude being nearly that of the Gaboon: modified by its mountainous character, its climate is very similar in many points to that of the latter place. According to Dr. A.W. Worrall its rainfall is 40.16 in. Under the circumstances I do not detail it.

Chunchoro: 5° 9' S. 12° 3' E. altitude 39 ft. The meteorology and climate of this part was studied by Dr. Gussfield 1874-75: his information was arranged and published by Dr. Danchelman. The maximum barometric pressure 30.01 m. (762.3 mm.) was in August: there was a steady fall till 29.830 m. (762.2 March 1874) or as far as
29. 830 ins. (75.77. February 1875). The mean daily oscillation is only .03937 in. (1 mm). The temperature has two maxima, a major 79.34-80.24 (26.3 to 28) in March, and a minor 78.26-78.81 (25.3 to 26°C) in November, and 2 minima, the Lowest 71.06°F (21.7) in July, the other 77.36-78.44°F (25.2 to 28) in January. The mean is 76.55°F (24.7°C). The absolute extremes were 96.62°F (35.9°C) and 58.28°F (14.6°C). 91.22°F (32.9°C) was the mean maximum for January and February, 58.64°F (14.6°C) the mean minimum for June. The rainfall was accurately measured only in 1875. It is very indicative of the irregularity we constantly meet with on this coast to find the maximum fall was in January 1875 12.25 inches (311 mm). February is closely upon it with 11.850 ins. (301 mm). In 1874 January was not observed upon, but in February and March 2.16 ins. (55 mm) each was the fall while in November fell 10.5 ins. (266 mm). The force of the wind was greatest in February, May, and October. The cloudiness was highest in August in September, and after that month in March. It was lowest during the short dry season and the beginning of the longer dry. The little dry season at Gabon holds an irregular position in December or January. The great Dry season may be broadly stated as extending from mid-February to the beginning of October.

River: 540 S, 13.49 E; altitude 372 ft. is situated on the northern bank of the Congo about 115 miles up. Its situation is on the mountainous edge of the plateau through which the Congo here faces its way. The effect of its elevated surroundings on its
Meteorology is only to the diversion of its winds to a slight extent. At other points on the coast observations have been made: specially at Ponta de Donha by C. Phillips, and by others at Boma, Isangela & Stanleypool. The maximum barometric mean in 1882-83 was in July (755.7 mm), 29.751 in.; the minimum in February 29.547 in. (750.5 mm). It is believed that the atmospheric pressure on the S.W. coast was abnormal in the year observed. During this year the extremes were both too far from the mean. The daily oscillation is about 0.62 inch (1.6 mm); it increases from the coast to the interior. The absolute extremes varied from 2738 mm (90.0 mm) on February 22nd to 1496 mm (58.8 mm) on August 6th. Temperature. The sun was vertical on March 6th and October 8th. The most elevated mean temperatures were 79.52°F (26.4°C) in February and 78.6°F (25.9°C) a little less in November. The minima are more widely apart: 69.2°F (20.7°C) in July and 77.2°F (25.5°C) in December. June to September is the coldest part of the year and is the pleasantest and healthiest season. At Ponta de Donha on the same bank of the river but near the mouth (5°56.8' 12°45'E) with an altitude of 194 ft. the temperature was both a little higher and rather more sustained preventing but 2.28°F (1.6°C) monthly variation compared with the mean 10.26°F (5.7°C) at Vivi; at Chinchoro the mean variation was but 6.3°F (3.5°C) at that point 3.9°F (3.3°C). The absolute extremes observed at Vivi were 97.1°F (36.2°C) and 53.6°F (12°C). The humidity is less than that of the coast; the absolute means were 68% (17.3 mm) and 55.1% at Chinchoro they were 760 m. (19.3 mm) and 85.8%. The monthly mean variation is 30.3 m. (7.7 mm) at Chinchoro.
The absolute minimum 890 m (2904 f) was on July 31st 1882; the absolute maximum 893 m (2908 f) on March 11th 1883. The daily curve of pressure variation is different in the interior and on the coast; in that on the coast there is always a fall at midday, not so in continental climates. Winds: the direction of the upper winds as shown by the clouds are S.W. and N. most regular in the dry seasons; N. winds preponderate over the S.E. in the rainy seasons, but there are a considerable number of winds from an easterly direction also. The highest strata of all, as previously stated in the general introduction, make their way here principally from East to West. I enumerate the percentages in which the principal inferior winds were noted S.W. 39% W.S.W. 9% W. 15% Calms 18% The rains were observed at Vivi and Ponta da Linha in 1881-83 nearly simultaneously: from May 1882 to April 1883, 19 ins. (099 mm) fell at Vivi; from September 1882 to August 1883 29.1 ins. (738.9 mm) fell at Ponta da Linha. The maximum fall of either was in November 1882, 11.3 ins. (288 mm) at Vivi and 9.8 ins. (249.6 mm) at Ponta da Linha. June to September at both were practically rainless. The spring maximum for both was in February 1883, 1.4 ins. (36 mm) Vivi, 2 inches (50 mm) Ponta da Linha. Excluding in either case the intermediate January rainfall the proportion of rainfall to the 2 rainy seasons was thus: the first rainy season at Ponta da Linha 11.6 ins. (294.6 mm), at Vivi 14.21 ins. (361 mm); the second at Ponta da Linha 13.8 ins. (351.7 mm), at Vivi 20.8 ins (528 mm).

The mean rise of the lagoons at Vivi is 15 to 18 f. The rice begins at the end of July or beginning of August; it reaches its height about December 1st to 15th. Then rapidly abates. The waters remain low
till mid-February or March when there is a rapid rise till the end of April, which shortly a decrease again commences. Storms and tornadoes are commonest from the N, E and S, and occur mostly in November and April: they become commoner as we go farther east and inland. The Nebulosities has been carefully studied by Dr. Danchelmen. The clouds predominate during the rains so that there is scarce a clear day, more specially in the mornings do a scene and clouded sky alternate. There is a general tendency in this season to clear towards midday and to cloud again as the day wears on. Storms often occur about 1 or 2 p.m. During the dry season the sky tends to be covered with a greyish or broken veil forming vague, indefinite clouds and caused by the particles ascending from the burning fringes: it forms especially a continuous veil to about 20° above the horizon. Our author believes that 1/6 of the surface is thus burnt down year by year. He considers it possible that the incinerated particles may by attraction of atmospheric moisture form a mist but he doubts the theory that they may actually cause rain. The tables demonstrate clearly the general tendency to morning cloudiness. The cloudiness of the dry season even exceeds that of the rainy but it steadily decreases in the course during the day while in the rainy it increases again in the afternoon. Seasons have been observed more or less carefully at the following stations: Port de Lonha, 45 miles up the river, Boma 60 miles up, Visa 115, Bangila 167, Stanley Pool, 335. The division of seasons is most irregular. The average extent of the great dry season in all these stations was from about the middle of May to the middle of September or
beginning of October but it may even be cut short to the end of August. The desert dry season is particularly irregular, its length is very variable. In 1882-83 at Vidi it began Dec. 25th and ceased in February the 17th but was divided into two by nearly 2 weeks of rains from January 8th to the 20th. This is a good example of its varying duration and irregularity together.

*Paul de la Landry (8.4°S; 13°E; altitude 194 ft.) was observed by
Sir George Betho 1879 and 1882-83. The barometric pressure was
at a maximum monthly mean 29.882 in (750.0 mm) to 29.905 in (756.9 mm)
in July; at its minimum 29.724-29.685 in (755-754 mm) in December.
There was a slight rise in January and February. The mean
varied from 29.783 in (754.8) in 1879-82 to 29.760 in (755.9 mm) in 1882-83.
During 1882-83 the amplitude of the mean monthly
variations averaged 248 in (6.3 mm) as compared with 189 in (4.3 mm)
during the other years. The year had an abnormal pressure
here just as favored by Danielewicz in Vidi. The maxi-
mum variation is 275 in (7 mm) in May during 3 years out of the
four observed. Temperature: The coolest season of the year is:
tends here to October. The maximum monthly mean is with
but one year excepted in February 78.4° to 79.7° F (25.8°-26.5° C). The
minimum in July 66.02 to 66.38° F (18.9°-19.1° C); another and rather
lower maximum of 77° F (25°C) occurs in November & December.
There is a slight fall of less than a degree a month on fall before
the return of the February maximum. The mean is 73.6° F (23.1°C)
in 1882 it was 74.3° F (23.5°C). The absolute extremes were 89.0°F
(31.7°C) and 56.3° F (13.5°C). Humidity (4 years). The means are
absolute 716 in (18.2 mm) and relative 83.9%; the mean monthly ampli-

*Southern Africa Seasoned or Diori climate (begins here)
The altitude is 311 m. (7.94 m): the extreme yearly amplitude, has a mean of 496 in. (12.6 mm). It is the lowest only on rare occasions.

Most rainy days were observed in April, 7 days being its average, but 13 in 1883. June and July, and practically August and January were rainless. There was an average of 34.3 rainy days of which 9% are attributed to the first and 2% to the second rainy seasons. In 1882 only 6.14 ins (156 mm) fell: the average however was 13.64 ins (344.9 mm): of which 2.28 ins fell in March, 4.3 ins in April, 3.2 ins in February, only 2 ins in December and 1.6 ins in December: January though with an average of one day of rain has a heavy fall for the time, witness 1.5 ins compared with 1.2 ins of February. Wind is fairly evenly from the S. but with rather frequent calms. At midday it becomes chiefly W. but still more certainly so about 3 p.m.; while to wards night it is again S.S.W. or S.W.: there is never much tendency to move towards the E. W. The commonest wind of all is the N. S. W. 18% of the total. At 3 p.m. the wind is W. 74% of the occurences noted: the S.S.W. and S.W. are 26% and 21% at a later period of evening. The maximum force as in all continents is from 2 to 6 in the afternoon. It's usually about 2 hours covered so that the whole year is more serene. Seasons: the great dry is very varied: reserving a month at latitude at either end we may claim for it from May to October. The lesser dry as observed was fairly regularly from the
last week in December to the first week in February.

Malangé: 9°30' S. 16°40' E. Altitude 3380 ft. was observed upon by

Major v. Scherow 1879-80 during eleven months. The results were edited by Ramm. Other and less complete in time, others were made at Pungo Andongo 9°43' S. 15°50' E. altitude 3900 ft.

The mean atmospheric pressure at Malangé is 26.075 ins. (662.3 mm); the highest mean was 26.150 ins. (664.2 mm) in June: the lowest 26.004 ins. (660.5 mm) in January. The absolute maximum was 26.216 ins. (665.9 mm) in June: absolute minimum 25.921 ins. (658.7) in February. The greatest diurnal variations were from 25.976 ins. (669.8 mm) to 26.110 ins. (663.2 mm) and from 26.039 ins. (661.4 mm) to 26.157 ins. (664.4 mm); both annual and diurnal are increased as compared with revolver. The mean temperature is lower than that of revolver: it is 68° F. (20° C). The maximum monthly mean was 72.32° F. (22.3° C) of January: the minimum 64.04° F. (17.9° C) of June. January and October and November are nearly of one medium temperature. The absolute extremes were 89.6° F. (32° C) in October and 39.74° (4.3° C) in May. The greatest variation were in May, the least in November. The absolute vapour tension was 15.92° in April: it was still 15.4° from October to December and in March. The highest relative humidity was 99.7° a.m. in April: in June 15°. The mean was but 31%. The mean of April was 78° of August 64%: the annual mean 77%. The rainy days were in all 118, the greatest number in a month was 21 in April: November had 19.
The fall was not noted throughout the whole period; it is, compared with Lwanda increased. The results at Malange for 1881 are those of Wisdom (see Danchelma's Var. and Royal Geog. Soc. 1882.)

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Precipitation is greatest September to November. E. winds tend to blow in the morning and W. in the afternoon. The cooler was noted 452 times, the S. 420, and calms 199. Calms are specially common about April and from then till June, the W. wind was at a minimum. From May to August there was scarcely any rain. The S.E. predominates from March to August and the W. from August to March. The force of the wind is greatest in September. Storms are about four times as numerous as at Lwanda; they are rare from May to August. Fogs are common; the usual tendency is for a cloudy, and foggy or calm morning to give way to the morning easterly wind which in the afternoon is replaced by a westerly. Seasons: The available data are scanty yet, but as far as observed, the dry seasons extend the greater part of the beginning or middle of May to the end of August, the shorter (1879-80) from December 24 to January 11th.
Various observations at places further South: Lord Mayo noted at Erciston's Camp, 18° 86' 13.80 E altitude 5400 ft. a temperature of 31° F on July 27th 1882; at the same place the annual variation, (date unrecorded) was from 71° in the daytime to 38.5° at night, and an abundant hoar frost was present in the morning. At Caprangombo, just below at the foot of the Sierra Chella, 77.5° at midday and 49° at night were recorded. At Humbo on the R. Cunene, 16° 60' S 15° 7. E. The first rain in the autumn of 1882 was on October 12th. The Omaruru River in Damaraland. 21° 35. S, 16° 13 E, altitude 3,500 ft., was inhabited by the German missionaries there from December 1882 to May 1883. This year it was very interesting; it was published by Dandelman. The temperature is most varied. Thus in December, the mean maximum was 58° 702 F. (35° 39 C), the mean of the minima 56° 17 F. (13° 71 C), the absolute maximum noted 103.5° F. (39° 7 C). The annual rainfall (rainfall) was 8 inches. 3.2 ins fell in summer, 1.68 ins, in autumn, none from June to August, 1.12 ins in Spring. The last of the rain was on May 15th; they disappeared in mid October. Asholt both 23° 20. S, 17° W. The German missionaries here noted in 1883 the first autumn rainy storm in September 17th. Quetton found the intermediate coast region here much colder than the interior; this he attributes to the Southern Polar Current. He notes also the Cacumba mist and attributes it to the same cause. During Lord Mayo's journey some of his men were attacked by intermittent fever in this region but quickly recovered when they reached the higher plateau. The Boers throve while colonising the plateau of Hamphata: on the lower grounds the Portuguese were begun.
...state and infested. Garrawe confirms Bains and others who have asserted the moist character of the subsoil of the Kalahari Desert. He illustrates the force and coldness of the W. wind by the fact that the nomadic Kafir make their huts so as to protect them from the W. wind but not from the East. He computes the general altitude of the Kalahari at 3000 to 4000 ft. and the general summer temperature at 80° and winter at 60°. Dr. Stafleff points out that the rise of the land in Great Kamqua land to the desert is not sudden. There is a slowly ascent to 200 ft. and here isolated mountains occur rather than the ordinary distinct coast range which however they really constitute.
Malarial Disease as met with in Western Subtropical Africa.

The principal types of malarial manifestations in man are in no way peculiar. They are those of Intermittent and Remittent Fevers, and Malaria Cachexia. Both forms of fever are subject to the same varieties of complications, though in differing degree, while their commonness and severity are greater in the intermittent form of the disease. It will not be our purpose to study nor repeat what may be found in any textbook about the disease; it will suffice if we dwell shortly on the more striking features of it, such as may seem to be of more peculiar interest in this region.

Simple Intermittent Fever. The commonest form of fever according to Dr. Eyler's observations on the Gold Coast is an "irregular quotidian" irregular, that is, not as to its quotidian character, but as to its form or type assumed by the paroxysm. The cold stage is almost entirely absent and even the sweating stage may be ill-marked. The period of intermission may be exceedingly short. Among natives, however, though the quotidian is still the commonest form, it is regular with well-marked stages but of short duration. Dr. Ewens's observations on the Ivory Coast notes the frequent lack of intermission or even absence of the cold stage, so that the access may actually commence with the hot stage. Boyle long ago described, more particularly, it would seem, as experienced in his own person, this fever at Sierra Leone. The coldness he pointed out was but partial, and varies in position as though a piece of ice were
being applied to different parts of the body, the other parts feeling even hot. The symptoms might return again after suspension, as the sensation of some acid substance applied to the superior part of the shoulders and back "the loins being immersed as it were in a clammy perspiration which feels like so much coddled water." The head was confused rather than painless. Rehot writing in 1848 of Sierra Leone says again—

"The intermittent differs from the ague of other countries chiefly in the stages not being so well marked; often a person will go about with "merely a sensation of chilliness or discomfort, a creeping sensation down the spine, which in some instances is so severe that the patient feels his spine like a bar of ice. This in a severe form seems to consolidate the fever and ague...... to which natives and old residents and persons coming from other tropical countries are liable." Horton, however, who had the longest experience of fevers on the coast describes them with reference to no marked peculiarity. A want of personal and local colouring is however a feature of his book on Tropical Diseases. When we reach Senegal we find the three stages ordinarily well marked. Gastric embarrassment is a very common complication. The quotidian type among Europeans, the tertian among natives are commonest. Mr. Bowis by examination of the old medical reports found that tertian fevers were common among Europeans more especially when the dread of demonic prevailed. It is to be
noted that at that time Europeans were not only longer resident on the coast but mercury and bleeding laid the system more open to chronic recurrences. Léonard at Sirohoun and others confirm the statement as to regularity of the fevers in Senegal. Rowe writing of Lagos states that there the natives were very subject to the less severe forms of the disease; in them also he notes the comparative regularity of the cold stage. At Gaboon, as at Bassam, Malaria is more intense and the forms are more irregular. In the dryer regions towards the Southern Tropic intermitents are common and generally regular. Some other points may be shortly noted. Léonard, de Granié, and many others note a tendency with the approach of the dry season for fevers to change their type from a more severe to a milder, as from the quotidiens to the tertian, to the weekly, or even fort nightly types. Mahó (1868) notes that hebdomadary relapses are common especially in those long exposed to malarial influences; ferruginous attacks are more commonly the third. Chassanié states that both the tertian and quartan types are frequent in Sirohoun; and that the "térèus" (the complication from which they nearly always suffer) Joubin says that Senegalese brought to Grand Bassam are nearly as subject to fever, and even to its severer forms, as Europeans, while those men from the neighbouring coast are comparatively immune. A curious tendency, well known to the natives themselves (see the case of King Eyé's mother)
is for an intermittent fever of little intensity, as that in chronic subjects, or where the fever is giving way, to anew perceptible lengthening of the interval so that the access appears it may be, an hour later day by day. Dr. Panira de Amold (Raj, Rewa) states that Portuguese become more or less acclimatised after a time. It is well known that Negroes from the West Indies arriving on this Coast are at first very subject to fever, but they become so acclimatised after a time, that Rowe (1871) was of opinion that the 3 years service of the West Indian Regiments in West-Africa—might be long enough seen with advantage.

I may here remark that there is not nearly the same unanimity among West African, as among East Indian writers as to the best suited temperament for the climate. The reason is that the stock argument of the latter for the "sanguine" temperament — the prevalence of this latter type among natives of the country — is not at all borne out among the natives of West Africa: there is rather a modified "sanguine" temperament. Remittent and continued fevers must be looked upon as intermittent fevers in which the paroxysms are so lengthened at the expense of the intervals, that the latter are either entirely abolished or are not completely represented. The passage from an intermittent form such as represented us by Fylle, with an interval of but two hours, to a sub-continued or continued type, is easy — is, in fact, common. That Remittents should therefore be severer in their nature than are intermitents, is obvious: they are indeed the expression of a more complete poisoning of the system. Now it is a common belief that
all newcomers to the Coast must be subjected during the first 6 months of their residence, or at least within a year, to an attack of the Remittent type, and a second belief logically follows that the sooner he has it, the fresher he be, the better for the newcomer. Hence, this attack is called the "seasoning fever" and it is supposition that one who has recovered from it is now less liable to further febrile attacks at least of the fever kind. There is a germ of truth in this ancient belief. In the old days of mercury and bleeding and, can it be said, worse hygiene, he who managed to emerge successfully from his struggle with the disease and its cure and to remain still at his post, was indeed one with a constitution for the climate; this was an example of survival of the fittest. His energy was broken, however, reduced as he was, he was certainly liable to frequent "chronic fever" which he should have regarded as not modified merely by his seasoning fever, but as the actual result of it. The name has sustained the belief till today and it is indeed a fact that hardly one in a hundred newcomers escape. We have now however, a very different interpretation. Having regard to its immediate danger, its debilitating effects, the resultant resulting anaemia, and the uncertain convalescence together with the nearly certain return under one form or another of the disease, it becomes our duty, from the beginning, to warn those under our charge to adopt precautions, not to fatalistically accept as a necessary evil a parasitic foe which will cling to them during life, or at least inter tropical life. Even
if with Rsho (1848) and later and earlier writers, we believe that
one or more previous attacks of malaria have a modifying
effect on ensuing attacks let us believe that milder attacks
will have the same effect as severe. It is a thing well known
that this fatalistic belief handed on often encourages the exces-
ses which so much predispose to "seasoning" attacks and
may even render them fatal. The disease (remittent type),
uncomplicated, shows no peculiarity on this coast. It may
be noted however that it is commoner about the rainy
season especially the beginning, if there be two rainy seasons
it is most severe in that with the highest mean temperature.
The rule is only a general one. Land winds in the dry season
increase very much the fever rate but apparently the cases are
not so intense as a rule.

Complicated forms of Intermittent or Remittent Fevers. I embrace
this in one description the complications of both the chief types
and for this reason. An examination of the nomenclature
alone of the various varieties would convince one of the difficul-
ty attaching to a lengthened individual description, and further
the complexity, useless repetition, and pedantry involved would
make such a classification thankless. We may consider the
complications in the following order, namely as they affect
(1) the abdominal (2) thoracic (3) cranio-spinal Caverns (4)
the skin and mucous membranes (5) other structures.
Abdominal Cavity. It has been well pointed out that just as Cheyne-Stokes and others differentiated Typhoid as having a special affinity for the right hilar region of the abdomen, Typhus for the thoracic, and infective meningoscpinal for the cranial cavity, so do malarial affections have a local predilection for the upper part of the abdominal cavity, for the liver, spleen, oesophagus and duodenum, liver, and, we may add, perhaps, for the kidneys. In this order we may consider the organs.

Spleen: Acute case is too common to need much comment here. It is common, specially among the natives of the coast. But in connection with this common form of hypertrophy of the spleen an important use of it is worth remarking. Mr. Dempster, a member of a commission to examine into the effects of public health of canals in India suggested the utilisation of the pathological enlargement of the spleen as a test. The results given by him are most interesting and conclusive proofs of the value of the suggestion. Mr. Dempster did not procure but the spleen in the classest cases which could be palpated only; and chose his subjects among ordinary members of the local population. The results compared were considered as an index of comparative healthiness or the contrary between the different localities.

Physiologically one duty of the spleen is to act as a reservoir for the blood in the abdominal viscera. Thus on the completion of food digestion the abdominal vessels regain their tone while the spleen undergoes a physiological expansion by
reason of increased blood supply through the splanic artery. It is believed moreover that the spleen has some active function to undertake with regard to the food material in the blood. Having regard to this normal function of the spleen as a diverticulum for blood to the abdominal viscera it is asserted that its dilatation in malarial disease is merely a passive function, and that its overwhelmingly commoner association with this rather than with any other diseased condition is the result of frequent periodical recurrence in malaria. The spleen being an organ ill-supplied with contractile muscles, is said to be specially liable under the circumstances to a chronic vascular congestion. This view is supported by the fact that though there is very rarely increase in the capsule the splanic pulp shows marked and disproportionate increase, readily explicable by increased vascular supply. A new complexion may however be anticipated for these facts in the now established fact that the parasite elements in malarial individuals are more safely detected and more frequently flagellated than otherwise, when the blood for examination is taken from spleen directly. The experiments and observations of Damilewsky on the somewhat analogous organism found in birds have shown that in the birds the spleen and bone marrow act as kind of blood filters. The development of large phagocytes in the spleen and liver has also been demonstrated. It is probable that the splanic congestion is, at first at least, the means of supplying the
natural call of an organ which must do more than its normal amount of work. In Beville (1887) denied that in Senegal in fatal cases much enlargement or softening of the spleen was found unless there was preceding chronic malaria. He was supported by Del Petit who, however, had noted the contrary in Madagascar. The opinion of most authors is that the spleen is almost invariably enlarged though to a varying degree: in acute cases it is not even unless chronic disease has preceded, enlarged to the excessive extent common in chronic cases. In acute attacks there is often a dull pain in the left hypochondrium, due it is probable, to the tension of the capsule of the spleen.

Stomach and Duodenum: Gastric irritation is a very common and often most severe symptom of malarial fever. Dr. Russell (1880) attaches great diagnostic importance to spigastric tenderness. Gastric irritation was the great bugbear of our predecessors of the last century and the first half of this. In accordance with the views of the day as to its causation so did the treatment vary. Was it inflammatory or due to bad blood or humours in the stomach wall — then bleeding was necessary. Was it due to a noxious or petrified secretion or to bile — then evacuation in either direction was the rule and so on. What are the actual lessons found. In B Jerusalem-Friederden denied absolutely any chronic congestion in fatal cases examined by him unless in chronic alcoholics.
Roman Chever's claims that chronic congestion and some
dilatation are to be found. Occasionally signs of more
acute inflammation and even softening or ulceration about
the larger curvature of the stomach, or near the pylorus, or
a reddened band in the first part of the duodenum have
been observed. All these are only rarer features. The
real cause of the gastric embarrassment is no doubt
nervous both central and possibly colic: to this nervous
origin are added a vitiated secretion, undigested food, and
regurgitated bilious secretions. The nervous origin is further
confirmed by the frequency of hiccup, a common symptom
but by no means so bad as in some other febrile diseases.
Dr. Russell is of opinion that the opium habit owes its widespread to the
great relief this drug affords to the gastric tenderness. It would be
interesting to know if any similar drugs is used in Africa by natives.
Levi: So the more purely gastric forms older physicians would
apply the term "mucous": to those in which hepatic symptom
became more prominent they gave the term bilious. It is certain
that this organ is much affected in malaria: but our information
on the state of the organ in the disease is far from clear. Bengoechea
Frauda (1874) made autopsies on 32 malaric subjects. Out of
these in all but 8 cases the liver was increased to 4/7 th to 5/2 or
rather more pounds; he could find no relation between the in-
crease and either the duration of the disease or length of residu:
ence in the country (Senegal), granting, that is, there was no
concurrent liver disease. The latter facts are the result of a much more extensive experience than the melanotic cases mentioned above. The malady is therefore distinctly attributable to the malady. He noted a marked distention of the venous portal system each little vessel appearing as a distinct vein of mean size; but further, was not equal throughout the individual vessels, but dilated and narrow parts succeeded one another. But he discovered an important distinction between cases. When the subject had died early, in the acute stage of the malady there was found a congested state of the parenchyma, exaggerating somewhat the normal colour, not, however, regular but disseminated throughout various centres so as to produce a coarse, marbled condition on section. When death had been delayed 15 to 25 days and when the acute stage had given way or had been even succeeded by a new access the condition described above had given way more or less according to the length of time death had been deferred. The vascularization was greatly reduced till at last a section reveals a parenchyma nearly exsanguineous or apparently entirely so, while throughout the organ are certain spots from which blood oozes; these are considerable veins. Both this author and Bartholomey Benoit note the black-violet colour and oily character of the blood from these sections. The latter notes the complete absence of a tendency to fatty degeneration. Both authors remark the constant and extreme
distension of the gall-bladder in melanuric subjects: its colour externally is yellowish brown. There seems to be no obstruction of the bile ducts, they are indeed usually gorged with bile. Both note that the bile is dark brown or nearly black, whilst that which is vomited has been altered by the gastric juices to green. It is always abnormally concentrated its consistence varying from oily to syrupy: it tinctures the skin like Iodine. In only one case of Bartholomew - Beneit was it found of a waxy solid-ity in a subject who had succumbed rapidly.

In the above description of the post-mortem aspect of the liver and its appendices in hæmaturic malarial fever we have an example, it is probable, in an exaggerated form, of what constitutes the ordinary lesions in malarial fevers. The acute condition may terminate occasionally in abscess. Thus Maclean states that it was not till he saw men from the West Coast of Africa brought to Hotley that he saw suppurative inflammation running its course in men suffering from an unmistakable malarial fever. Norman Chevallier (1886) in his "Diseases of India" does not even mention this condition described, under "malarial hepatic disease" but throughout that section he deals with what is really only a chronic condition resulting from acute attacks, namely with a chronic choriomégalie form. This may take on either a smoothe or a holed-ened form. This condition, like the analogous one of the spleen, taken early is remarkably amenable to treatment.
Pure cases of the chronic variety are not, by reason of the
usually much briefer period of residence, so common in
West Africa as in India, where a man may go to reside
for a lifetime. After a time in chronic cases of the disease
the liver loses activity, the deficiency being accompanied
(Russel) by diarrhoea and whitish stools. To return a
moment to the pathological anatomy: we find in it an
excellent cause, in the highly engorged and active liver
at the acute stage, for the bilious vomiting &c. Compare this
view with the older ones, for instance, that of Morehead who
thought the "bilious jaundice was a mere coincidence in a
Gauche case and the result of an inflammation of the mucous
membrane at the duodenum. Berenger-Feraud is of op-
inion that the liver has some active part in the production of
melanuria which is at its height with the highest conjestion
and activity of the liver and that as the liver loses its activity
so does the melanuria subside. In Connell (Jas. re) contains
French statement that the pigment in the brain is confined
to the capillaries: but it is certain on the contrary that
both in spleen and particularly in the liver it affects not
only the connective tissue but the parenchyma cells: being
in the liver both free in the lobules and enclosed within the
secreting cells proper.
Kidneys: We have stated that between malarial disease and some other febrile diseases there is an analogy in the tendency each to choose a special place of predelection in the system. That of malaria is in the superior viscera of the abdomen. The kidneys will therefore not, in accordance with anatomy, escape, for anatomists now insist on a position considerably superior to that formerly assigned. Yet in India lesions of the kidney have attracted little attention. There are signs however that they are by no means infrequently implicated in that country. Morehead, who claims first to have published observations establishing the frequency of Bright's disease in India (Medical & Phys. Soc. of Bombay) gave two instances in his paper of intermittent albuminuria associated with intermittent accesses. Maclean, Moore, and Chevers, all agree that albuminuria is very often to be observed in Europeans in India who have frequently experienced the various forms of malaria. Maclean is however inclined, against the usual opinion, to attach little importance to the symptom. Moore notes its frequency as a transitory condition after a fever attack. Ewart in 1855 showed the striking frequency of albumosis of the kidney among natives of India. It is certain then that malaria does predispose to this lesion: to this most tropical writers now agree. Dudor (1869) noted on the West Coast of Africa the occurrence of haematuric fever aboard: he believed the condition which we shall consider later on was a result of bile. Dr. T. Ferricks has shown that injection of bile into the blood produced in the
urine in 17 out of 19 cases (1) Albumen (2) a blood red colour. Paroxysmal hæmoglobinuria is, however, not inappre-
sent specially in the cachecotic children of Sutjacons in Bengal. R. H. Frith has described two cases of hæmaturia or hæmoglobin-
uria in remittent Fever; in the two cases much bloodpig-
ment and few blood corpuscles were found, but only in
the fatal case was bile pigment present. Hence he concludes
on rather scanty grounds that the presence of bile pigment
in the faeces symptoms: the bile pigment representing a more
complete disintegration of the blood corpuscles. And now
we may consider melanuria as found on the West Coast
of Africa. We have mentioned this condition already in our
study of malarial lesions of the liver. It is known under sev-
eral names as "Blackwater Fever" &c. The condition was first
carefully studied by Bartholomé-Bonnot, though Dr. Pellion
had previously made some useful notes on this coast while
 varias observers described it in Madagascar &c. Many have
believed that the melanuric form of the disease is a new disease
or new development of malaria first appearing about the time
it was described by Daubi (1853) and this. It has been shown
however by Berenger-Graud to have been exemplified in St. Louis
in at least 1841 and probably much earlier. The same author
notes among premonita that a long cold stage is common. The
common form of fever complicated by the condition is a continu-
ous fever of an invalidic character rather than one with a high
temperature. Accoing to a common feature, Mr. Berenger Straud describes a case where a jalof creative was the subject. In all *Dudon’s fatal cases the end was preceded by suppension of urine. The pathological Anatomy has been given us by both Bartholomy Benoit and Berenger Straud, but the latter was the first who, as he found under the same conditions in the two, clearly demonstrated two different stages, one of congestion, a second of exsanguinity. As to the size of the kidney Bartholomy Benoit notes that it is most uncertain: but the two glands were generally of one size. In 5 out of 14 cases no enlargement was noted. Berenger Straud notes the same differences in size and weight: the cause assigned by him is the congenital variations in size between the kidneys of various individuals. Both authors note as characteristic of melanuria the deep red brown colour of the fae. and haemorrhages. Here and there are haemorrhagic centres of various size from that of a bean and upwards, situated chiefly in the colical or glomerular tissue but nevertheless extending sometimes inwards so as to cover 4/5ths (Berenger Straud) or the whole (Bartholomy Benoit) of the organ. The haemorrhages are chiefly into softened tissue: but whether the softening is primary or secondary is uncertain: sometimes they produce true clots. Berenger Straud holds the softening to be the natural result of the congestion and states that it may go so far that the organ becomes a soft jelly. Further the veins are enormously congested. In patients who die at a later stage when the urine is again nearly a quite limpie
a condition of vascular contraction is found corresponding to that previously described for the liver. It is highly probable that in those who recover the acute condition just described must often result in some permanent change. Berenger Gerard has noted often transparent and opaque tubercles in the urine of those who recover. In the bladder and ureters nothing noteworthy has been found. Hence, before we describe the urine in this condition we may remark that in an ordinary malarious attack the specific gravity and solids (M. d. Krieller) increase generally from the cold to the swelling stage. In Melanuria the most characteristic feature is the colour of this fluid. At the beginning in the prodromic stage we have the limpid urine that is common to it. Rapidly the change takes place as the access begins and perhaps the first time that the patient anticipates the urine is red or even ink-black—the "Black water" of the Coast. As the access terminates, but not so completely or suddenly, so does the urine rapidly regain or nearly regain its normal colour. The amnion that voided is very varied being from normal, at times to an increase of many ounces in the hour. The urine is sometimes of a golden blood colour, or even as that of blood mixed from the body. Usually, however, deeply coloured, it is limpid and transparent on emission. As it cools it becomes turbid and the particles fall to the bottom of the vessel till they form a layer 1/16th to 1/32nd the height of the column of the liquid, and of a greyish-ash or red colour. During convalescence and once the red
colour has gone, the specific gravity is only 1006 to 1010 and the colour is pale ambo: all the constituents are reduced, and both sugar and albumen absent. Tubular desquamation may cause some deposit. What is the cause of the characteristic colour? Many claim to have seen the red corpuscles in the urine; indeed we can hardly doubt they are correct, but all agree that they cannot be always found and are never numerous. Béranger-Jeaud states that he and others have examined many times with great care and they never found any. He also denied that the colour is due to haemoglobin released by destruction of the corpuscles by the alkaline urine. It is he claims due to bilirubin and biliverdin in the urine; but this cannot be shown by the ordinary nitric acid test because of the great abundance of albumen precipitate.

Bartlemy Benoit never ocularly satisfied himself of the presence of red corpuscles. Pellani claims to have seen a few and so others. In passing we may recollect that Hitti seems to have succeeded with the blood test but in only two cases and those not on this coast; while Béranger-Jeaud's statement is strongly supported by Brecher's experiment of injection of bits into the blood (vid supra). Eyko and others advise us that the greatest danger in this condition is that of panic from the idea veritable blood is being passed; the inoculation of the opposed theory is therefore an important factor in the cure.

Glycosuria: Burdel (1859) and Vercueil (1881) have proved the
occurrence of glycosuria in malaria but it occurs especially in the intermittent form and is generally mild. It is hardly associated so much with the febrile stage as the agyretic and when the case becomes more severe it no longer continues.

Small Intestinal: Typho- Malarial Fever. About 1853 a great battle of books opened with Serres and Swart on the question of whether typhoid existed in India or not. Whatever it may be claimed as to its existence there previous to that date, on all hands typhoid is now admitted to be a common disease, specially among new-comers, both in India and elsewhere between the tropics. But a further question and one still to be definitely answered followed the first. Is there a fever which combines the features of typhoid and malarious fever that it constitutes a separate disease: typho-malaria, and the disease granted, is it a disease sui generis. This question has attracted wide attention both in America, India and other countries and the name has established itself as a received term in our nomenclature. The definition is however still very vague.

Berenger Sarraut has here also made important observations in Senegal; in Senegal, typhoid is noticed here specially in November, December, and January, that is at the time when most new arrivals come from Europe. But it is in November specially that a special form of malarial fever develops which hides itself under (qui revêt le masque de) typhoid fever within certain limits. This author decided (1875) by a number of autopsies that typhoid exists in Senegambia and attacks
European residents at all times of their sojourn. It adopts
the present classification into two varieties previously laid
down by Professor de'lin (Colin) (1) A subcontinuous arthral form
observed chiefly in those who have recently arrived from a tempe-
rat country and retain a somewhat sanguine condition i.e. in
the debent and full blooded. The effect is that the initial fever
phenomena are increased, more particularly does this form affect
a febrile gastric embarrassment. Hence a name given to this
form, the "ataxes" typhoid". The pulse is hard and full. There
are night wanderings, and disturbing dreams, sub- or even
continued delirium: there is delirium, a dry cracked red
language and gums, epistaxis, and other ordinary symptoms
of typhoid. In fatal cases the usual condition of the small
intestines in typhoid is found. Berengra- Andrau remarks on
the frequency of cases in which the lesions are advanced even
to gangrene of the intestines. With the absence of the latter fact
the statement of Norman Cheever that typhoid in India tends
to have a shorter course than in England. (2) is the subcontinuous
or autumnal form (autumn is the fresh season in Senegal)
and is that which attacks in preference persons who have been
for some time exposed to the action of malaria. In Colin this
characterizes this form as seen in Algeria and by him "The
mobial process conforms to the description of authors who hold its
continuity to be the expression of a fusion of accesses, the high temp-
rate persists during the intermission which tends to shorten the
gressively to a more or less complete absence, while at the same
time there develop grave symptoms: dyspnea, nocturnal de-
alveolar exudation, tenderness, hyperemic pneumonia, bed-
sores and sometimes parotitis. Despite similarity, the yellow
complexion, the splenic and hepatic enlargement, and sometimes
the general edema of malarial cachexia distinguish the term:
plant from typhoid. Often the paroxysms persist preceded by
shivering; there are times when the skin seems icy. The affection
is much longer continued than typhoid, possibly extending over
5 or 6 weeks, during which time the patient seems so ill that a
more violent paroxysm must terminate its existence. He drags out
a pitifully for a few 30 or 40 days or even for several months before he is
well; the condition is one of a long marasmus intermixed
with curves. The autopsy reveals integrity of the small intestine.
Deon Colin grouped both the autumnal and tertian varieties
under one class of malarial fevers, the Fever Scolaraceae. Benz.
gers Gerand insists that especially the first form is a case of
concurrent typhoid and malaria. Without resolving the second
form (and one receives the impression that he has not had so
much experience of it) he inclines to regard its nature as like that
of the other form adding that the intestinal lesions are not neces-
sarily in rapport with the gravity of the case. If however he ad-
mits the correctness of the final clause as stated above by
Colin Deon it is evident that he cannot hold with the rule
adopted by Chevres that where the pathological lesions generally
recognized as Typhoid are found, Typhoid Fever must be assumed, and not, an autopsy being made, otherwise. I may re-
mark that the Quinine test suggested by Chevère, is one held on all hands, to be peculiarly unreliable in this complication. The remarks of Dr. Chaplain (1835) on the fevers observed by him in Jerusalem are very interesting in this connection. He acknowledges as occurring a real Typhoid Fever—modified by Malaria—but from this he distinguishes another species of fever—"Typho-Malarial." The first condition he notes as characterized by excessive remissions and sweatings: the second as a peculiarly continued fever whose features are Typhoid at the commencement, but run on for a great length of time, displaying towards its termination (very often fatal) a great range of temperature. This form is, he states, exceedingly unamenable to treatment: in it we seem to have an approxi-
mation to the second variety of Cholera: the different classes of patients—in Syria they are principally poor Jews and natives—explain any difference. Dr. Chaplain also suspected that the Typhoid lesions of the intestine were absent in the second class. Mr. Haspel (1851) notes in Algeria the second variety referred to above agrees that intestinal lesions are absent. Such statements are interesting as affording an explanation of the absence of these lesions in cases examined post-mortem in India previous to 1852 by many who with Leeuwenhoek have denied all signs in the great mass of autopsies of typhoid lesions in cases with so-called, typhoid symptoms. Haspel probably put more trust
in the therapeutic test, then we should be inclined to do. At Bâlédé, a particularly malarious locality, in which we dwelt for some time, we were so used to this result that if after two or three days of (Jumine) medication, no amelioration of the symptoms was observed, we thereupon suspected a malarial origin of the trouble, or some abnormal obstacle to the action of the drug.

Most writers on other regions would have been glad for ground for such a trust: it must be noted however that his doses were large and the cases not so intense as the Indian or Intertropical African. He acknowledges that sometimes in the fumicious autumnal cases he found both Raja's and Brunn's glands affected and concomitantly the usual affection of the mesenteric glands; even in spring cases he found them rarely. To sum up: the clinical grouping is uncertain but pathologically there seem to be two really distinct forms: one in which lesions both of typhoid and of malaria are present; the other in which malarial lesions only are found. To the first the term "Malarial Typhoid" may be applied. To the second the term "Typhoido-malarial" is applied. The first is a combination of malaria and typhoid, but not exactly to the two great clinical varieties. Epidemiologically especially in districts where the condition may prevail, such as favour the usual existence of both diseases.
Horton (1874) does not mention in this book this condition but that typhoid-malarial disease as we may still call it does occur both at Sierra Leone and throughout the coast is certain. I have had under my own care a case of undoubted typhoid-malarial fever, in recovery, from Freetown where the bad hygienic much favours Typhoid. I believe that the season may here be very often Typhoid-Malarial. These may mention without dwelling on the preceous algid enteric form of fever; there are several varieties and all may be found recorded on that coast. Cholera is not endemic but has become epidemic; it will therefore be most easily detected in West Africa when in combination. Two forms however occur in which the Cholera symptoms are of purely malarial origin. One intesti colic suppression of urines and violent prostration says the patient: this is a penicillar "dry colic.
In other cases typical rice water stools may be passed. Such cases Chevres notes in India are apt to be followed by intes tense reaction. Large intestine is not subject to the action of the malarial poison. Dysentery is often associated with malarial fevers & convalescents from the latter should be on tire guard against it specially. The specific forms of both are favoured by the same circumstances. The congestion of the portal system specially during the cold stage frequently predisposes to hemorrhoids in those who are subjects of malaria.
Thoracic Cavity.

Lungs: A noticeable point in writings on malaria is the little space devoted to the effects of malarial fever on the lungs; these are generally at most a few remarks on some rare respiratory complications or on the commonness of hypostatic congestion. I must therefore explain how it is that I am about to dwell more than is usual on the relation of these organs to malarial disease. It was my object in writing the cases which are described in a later section merely to provide sufficient clinical justification for my assumption that the cases were such as would be ordinarily considered malarial. While this explains how it is that in many ways my notes are not so full as for more general purposes would require yet it will be understood that careful observations made at the time. In every case I made a thorough physical examination the rule. In the cases of Pavel Tarasco and Philip Waldock, the first two, it may be seen that for the first few days the temperature was not recorded; it was taken regularly at the time of course, but I did not diagnose malarial fever at first. I believed that some lung mischief was to blame. In both cases the respiratory tests were more prolonged, and the sounds mottle than in the normal lung; and specially at the bases, percussion did not yield any very clear result. There was no more than a suspicion of brightening of the note over particularly the left lung at the posterior and inferior margin. This was however never marked, but seemed to belong pulmonary in origin and not sinus, as it corresponded with the maximum abnormality of the long sounds. A further point and one I noticed
not only in these two but in nearly all the cases was the fact that there was a disproportionate increase of respiration compared with that of the pulse. I was, however, soon convinced of my error. The condition did not regularly run a course; it would seem a little better in the morning and worse again at night. Treatment seemed to make no impression, and the form of the temperature curve was not that of pneumonic but of malarial fever. I had under my notice and care also during the time I was on the coast 8 or 9 cases of pneumonic and other (particularly localized pleural) disease, and in nearly all of these cases, which were in natives of the Kroot Coast, the form taken, and the course, were irregular. Thus I give here the temperature charts of two natives, Jim Crow and Pea Soup.
In both of these specially in the case of Pec Soup the form taken by the temperature curve is suggestive of Tubercular complication. The history of Jim Crow is very interesting. He came in complaining of pain in the belly; he was very nervous and afraid of handling. He was very prostrate; but it was not till next day that the lung symptoms became prominent. In these cases in natives treatment of the lung symptoms did decide good, but quinine was of much service and they would actually ask for it. The reputation of the drug is not spread among natives of Africa as in India.

Chorera in India (under the heading Pneumonia) notes that "Pneumonia is likely to attack the victims of paludal cachexy, but I have never been able to trace any relationship more direct between malaria and pneumonia." After noting the fact that the native sick suddenly attacked in the "small hours" with fatal symptoms, frequently show congestion signs, he goes on "Possibly the many be pneumonia which never gets on to consolidation but kills in 3 or 4 hours. To me however it appears to be merely that hypostatic pneumonia."

Very different is the opinion of Moore. "Thoracic complications are most frequently seen among natives, particularly in the cool season, and in the Northern Provinces" (p. 310). "This is so too on the West Coast. Lung complications or simple pneumonia are commoner as we pass north and the stressometric variations increase, and in the cold season specially among natives. "Congestion of the lungs often passing on to emphysema. This is in my opinion experience the most common thoracic complication in
All stages of fever and especially in more decidedly paroxysmal phases. He notes the fact that patients frequently make little refer.
es to their chests even when the lungs are implicated: he remarks the hurried respiration. "In adynamia or perverso.
remittent the pneumonia may mask the fever. It is believed
that epidemics of fever have been regarded as epidemics of
pneumonia". Here I would make the suggestion that very pos.
sibly there is a much closer connection between fever and pneum.
monia in West Africa, and specially in natives, than is generally
believed. It is a common remark that the healthy reason
for Europeans is the reverse for natives and vice-versa; in most
books the reason is said to be that in the old season, so prone for
whitemen, the black race is specially subject to chest disease. The
natives in old Calabar however, consider this as their fever-
season: and so it probably is considered throughout the coast. It
is probable that as more observed among natives of India so
among the natives of West Africa Malaria and chest diseases
not unfrequently complicate one another. Professor Don (Colin)
has remarked on the frequency of lung congestion found first mat.
ism in perversious cases of Malaria: especially in the lower
lungs. The bronchi were often obstructed with mucous, often sang:
ulent. He mentions a very rare condition confined al:
most to the aglade (enteric) form, where there is a hemorrhag.
ic infarction with the appearance rather of a black marbling rather
than of distinct centres, and strongly resembling the lesion in
Indian Chorea. Herpes labialis is worth remarking as a frequent complication common, though by no means confined, to malarial fever and Pneumonia. A consideration of the etiology of Malaria would lead us to expect lung complications to be frequent. The effect of foreign particles on the delicate membrane from outside is obvious, that the large amount of foreign material brought to the lungs in malarious conditions, through the circulation, may have a deleterious effect on the same structure is at least possible. Were we able to accept as proved a frequent relation other important questions would require an answer. For instance Lander Brunton states that in acute pneumonia the pigment appears in the urine; a strictly limited pneumonia may produce no effect. Deficient oxidation is a cause of jaundice. Lung complications are more liable to occur in the cachexia than in other malarious conditions; so too Malaruria: is there then any connection between Malaruria and Pneumonia on the West coast of Africa does it?

Other lung complications may be mentioned. Bronchitis, sometimes very acute taking the place of interstitial myxomatous reaction; asthma; sudden pulmonary destruction, very apt to occur on excessive exertion in advanced cachectics (Cheever’s) etc. Tuberculosis of the lungs may occur (see case of Our Lady’s Hospital).

I omitted under the first part of this section to mention the 2 cases from Rome of Dr. Garson of (1) Quotidian intermitting Pneumonia, (2) trout intermitting Pneumonia. Both cases were easily cured by Quinine. Celli (see Doulet p. 12) records a curious case of recovery from a quartan fever after an attack of acute pneumonia.
Heart: Haspel notes that the pulse is intermittent, frequent but above all regular. But in remittent fever where it has endured some time and in chronic cases, especially in old cases, the only evident
motor is lost; indeed in old cases the only evident
manifestation, even when an enlarged spleen exists, is often a heart
of extreme irregularity in which auscultation reveals a frequent
regurgitation full blooded jet from the large aortie. The pulse
is apt to be
of a full regular, hearing character specially at first. In a
acute case as it is in typhoid. Haspel notes that detached clots
are not infrequent; he also sometimes met polyhedral concretions
occasionally nearly filling the right ventricle. In two such cases
the attachments was to the right auricle and valve which was thus
kept open. The vegetation extending into the ventricle; in one case the
vegetation was attached to the ventricular wall and extended back
as far as the origin of the inferior maxillary vein from the jugular.
Both Haspel and MacLeod incline to attribute the algæ (not
algae) form to a structurally weak heart. Ponsoldt noted
dilatation of the heart in 27 out of 61 autopsies. Out of 50 cases
of organic heart disease traced by MacLeod (hotter on
pericarditis and endocarditis, etc.) not one was traced to a malariad
pericarditis case. Permanent dilatation may however occur on a vessel if
of malariad cardiac dilatation which is completely
dealt with in its earlier existence.
Brain and Spinal Lesions: There are very many symptoms of the various brain lesions but rather than enter upon these individually and minutely, I suggest a more careful study of the one group of cases produced by the united action of the malarial poison and heat. The various results under malarial action of irritation and vascular obstruction on the cerebral and cranial centres we will not particularly discuss.

Heat apoplexy or Calenture: Complications: In most cases, divided into 3 groups: the forms of sun or heat stroke, the cardiacl, the cerebral, spinal, and the mixed. Heat just as its opposite, cold, is capable and in West Africa does frequently act so, of determining an attack of malaria; or worse to the direct rays of the sun without sufficient covering, or in the debilitated, even with such protection, is sufficient to bring on shortly an attack of fever. The same effect may be produced during the hot and exceedingly calm nights which prevail during the rainy season specially inland beyond the influence of the sea breezes. Berenger Fland, after remarking that but 14 cases were recorded of sunstroke at St. Louis and Goree in 30 years, states that it is not to be supposed that this includes by any means the complete number of cases but merely the most typical. "It is but in a very small proportion of intense cases (sunstroke) comparable to remittent fevers, and in which could be determined (or a said) in a manner exceptionally clear, the effective action of the sun's rays. All doctors at Senegal know, he says, that a great number of insulations correctly so called come into hospital as fevers or as
"Feverous access" cases. It considers that insolation is common during the rainy season, in the proportion of 120 to 80 cases: the proportion to the seasons of cases in which this factor will modify fever cases may be taken as somewhat similar. In his first work [Dagana] Boivis gives no the case of a soldier who stood bareheaded in the sun for 10 minutes and died thereafter of a febrile attack. Other cases resulted in a cutaneous algid's form: that is fever with symptoms of the mixed form of insolation. Hardly a year passes in fact, in which we do not see new arrivals persons from Europe and appearing in perfect health and never having suffered from fever, who are struck by the sun, and on the morrow. That is if the immediate result be not fatal, exhibit all the symptoms of a fever which goes on to anaemia and cerebral cases, via with a most uncommon rapidity. Dr. Boivis believes there is danger in exposure to the sun not only after alcohol drinking but even after food. He must remember that the European in tropical climates is always more neurotic than at home, and the irritability be increases with the heat and moisture of the air. So these factors, high temperature and hygrocity, not only sun stroke but acute mania, melancholia, insanity, &c. on are all due to a great extent. Gaydar notes that natives of India suffer most from Ardent Heat not in the rainy season but during the hot winds. The sun is hottest not at midday but in the afternoon. Mr. Boivis' account of the detachment at Dagana is classical. There went out from Dagana Fort 20
men under one officer at 1.25 p.m. to join another column. After one hour 5 of the party fell sunstroke: 2 only continued. The way 8 men out of the remaining 19 suffered from violent headaches only 10 others were less drunken men: one more fell into convulsion on his return and he and the officer had violent delirium. Out of the 19 returning to the fort only two escaped fever. Boeris says: We have known of very significant cases of the contrast there is between the dangers of isolation when striking at one time men of very different conditions of bodily energy: the sthenic (brave) escape and strong succumb, where the less en.

Sarcin optic and feebler escape: He dwells on the comparative harmlessness of the hot dry salt land. Sunstroke is scarcely ever uncomplic.

ated in this quarter of the globe. In Senegal at least the Cardiac variety is the commonest. The patient falls as if shot. Gagnard (Mlad. de Senegal 7 p.171) gives a most interesting case of the mixed form: The symptoms were first congestive but after eleven days duration became ataxic: The patient did not finally recover till after enormous doses of Quinine. More head was of opinion that the cerebral special was the commonest form in the Indian in India but this trachean affords and notes instances where the cardiac was the commonest among Zimeo and the cerebral special among mount soldiers.

We may remark here how frequently in repeated accesses for at least a short time the phenomena of isolation tend to re.

produce themselves. I may close this section by quoting
from Haspel to the proof that the superaddition of Insolation to Malaria Fever is only the expression of the general tendency of the Meteorological conditions to change the type of the disease (\textit{p. 154}). "In short, if you compare the fevers of this country (i.e. Algeria) with each of these four periods (the seasons) you cannot fail to recognize that these affections while always in the main identical and alike in constant general effects, are yet variable in their symptomatic expression according to the different Meteorological conditions." So impressed was he with this that he divides Malarial fevers in Algeria in Spring, with a special tendency to intermittence, Summer, whose forms are rather subcontinued and winter, whose salient forms are remittent and pernicious.

Other Central Nervous Symptoms or Complications: Dr. Gallieni has recorded an extraordinary case of tubular lesion with syphilitic reactions in a pernicious case from the West Coast. The lesion was preceded by occipital pain.

Epilepsy: Mami: Melancholia; Hemiplegia; Paraplegia; amaurosis; and particularly in cachexia, neuralgia, are among the ocularinal results of Malaria. Whether the causation of the neuralgia is central or due to irritation of the nerve sheath is not easy to tell.

Skin and Mucous Membranes: I have already remarked on the frequency of herpes labialis or facialis. Actiowicz found that in 2000 cases examined herpes facialis occurred in 20% mostly on the
...and more. Dr. Haspel notes that herpes on the lips and nose is not usually seen till the crisis of the fever has passed. Dr. Real considers that in benign cases it is indicative of a near recovery. Verrucaria may be a complication. Dr. Allan (1884) notes a case in Gambia of intermittent fever in the hot stage of which a transient patchy red rash appeared over the neck and upper part of the thorax. A more important condition of the integument is the yellow pigmentation resembling jaundice seen in cachexia, and in various forms of the fever as the "bilious" and the old "bilious haematuria" or melanuria. Much argument has raged around the nature of this pigmentation. It is a general opinion that whatever is the cause of the general pigmentation is also the cause of that of the skin. Many have thought this general pigmentation is due to retained bile; others to other products of destroyed haemoglobin. Darrow attributes it to the presence of the pigmented organism itself. Persids long ago drew attention to the accumulation of pigment in the minute cerebral vessels, and Darrow has shown it to be contained in amoeboid cells. We are not thus far in a position to state that the pigmentation of the skin is due to only one cause: there are various other factors to be considered, especially in the cachexia. Dr. Osborn describes a peculiar condition of the tongue as characteristic of Malarial Disease: the under surface seems to have its mucoa membrane extended round to the margins of the upper surface.
Thyroid: is there any connection between Bronchitis and Malaria? Many still consider there is some connection between the former and the presence of lime salts in the drinking water. A perusal of Macnamera's book on the relation of the soil to Goitre in India will I believe completely overthrow any absolute attempt to connect them. Mr. Billieu, Archbishop of Chambery (1850) was the first who suggested, I believe, the con: nection of Goitre with Malaria. Macnamera brings striking facts in support of this theory. We should expect if there is any connection that Goitre should be common in West Africa. Burton states it is pretty common among the Foutah Djallon. Hinton says it is endemic in McCartney's Island on the Gambia. I myself record a case on the Cross River. We have not very much evidence however about the disease. None that would justify us in considering it very common. I quote a case of Hinton occurring in a lad aged 18 years who had recently arrived in a district where the disease was prevalent and had remained 3 months. He had been previously well but in the morning complained of severe fever; the thyroid began to swell and was so much enlarged that choking seemed imminent; the eyes were prominent. The breathing difficult, there was running at the nostrils; the voice was crackly. The tumor was soft and fluctuating and extended to the lower part of the neck from the chin: it was rapidly formed but under treatment be: came gradually reduced. 6 months afterwards there remained
a tolerably large swelling involving all the gland. Horton notes that it is commonest in females beginning between 10 and 14 and increases rapidly after puberty. It is interesting here to note that in the female there is some unknown relation to the reproductive function: the gland swelling normally during gestation and coitus. We cannot claim that any clear proof can be brought from West Africa for a combined origin of Malaria fever and Goitre.

Malarial cachexia: We may say with Darwin that with the nature of the organism of Malaria in view "One can say that there is no anaemia that following haemorrhages excepted, which explains itself better than that of Malarial Anaemia." The condition is the best known in England of all the malarial forms of disease. I need not therefore enter upon it.

Dysentery, Suppurative hepatitis, spondylosis, sloughing of the corneal ulcer and muscular rheumatism, pneumonia, diarrhea, thrombosis, gangrene, phagedenism, sloughing of the scrotum, cancrum oris, embolism, abscess, boils, urethral fever (sometimes so very severe when an instrument is passed) congestion of the sphenoid sinus, spermatic cords, occasionally of the prostate, menorrhagia, chronic abortion, post partum haemorrhage, furious pelvic fever, tetanus. Here are some of the conditions that may occur in malarial cachexia.

Parotitis is an occasional complication but is more frequent in acute febrile forms of fever, specially in natives during the cold season.
Etiology of Malaria.

There is now no longer any excuse for those who would add to the literature descriptive of the modern history of theory and research on the Etiology of Malaria. The works of Professor E. Klebs and C. Tommasi Crudeli & translated by the New Sydenham Society give us a good deal of history concerning their speculations and those of their predecessors. Those of Professor A. Lavraz and M. Doutfet (1891) bring us nearly up to today. Dr. Hens in his paper gives a most concise historical summary. I shall not therefore attempt to imitate these authors but propose to deal specially with the facts that press for attention to-day. We shall not deal with Heyn's etiological or Oldham's "chill" theories etc. but only with those which have sought an explanation in a microorganismal hypothesis.

The first of importance was that of Professor Salisbury put out by him in 1864, and again sustained by him in 1885. The second was that of the Italian observers Klebs and Crudeli published about 1878-79. The one that now holds the field is that of Professor Lavraz, put forward in 1880 and around which theory an extensive, elaborate, and critical history is growing. We will briefly examine each theory.

Salisbury's theory is best defended in his work of 1885. To him the active agent is a lower Alga, a Phormella of the genus Eugenemia and several species of it. These he found in the earth of malaeous districts; but he also claims that they may be found in the saliva, sweat, vomitus, even in the blood of persons...
infected. He even associates the species Gymnarcum Rubra, growing in calcareous soil with the conjunctive types which he adds are more difficult to treat because of the effect this species has on the eliminative organs. Other vegetable organisms are he says of accidental growth: thus Penicillium is present in all cases of intermittent: specially abundant are its spores in obstinate cases: it merely indicates fermentation of glycerinous matter. His observation on the crystalline deposits in the urine are very interesting: lethites of the alkaloids & hemo-decalcate of lime crystals & of lactic acid are present: also triple phosphates specially in more obstinate cases. He believes that the alkaline lethite crystals are really cells in which a filamentous process, represented by the radiation of acicular from the centre, has commenced. He seems to prove a vast number of cases in which organisms were actually found, corresponding to his description, in the swat urine & even blood. There are some very weak points in his hypothesis. In the first place his Gymnarcum are by no means confined to malignant districts: they have even been found on the snow of the highest Alps. In the second place his theory ought to have been more minutely proved as regards cases where the organism occurred in the blood or other organs. And lastly there should be some proof forthcoming relating the life history in the body of man with the disease. We cannot deny that the organisms have soms forms at least been seen in the blood (as by Hoppe's observations). Moreover though long neglected this theory of Salisbury gave the clue to the Italian observers who next made the attempt to adduce a micro-organismal causation of Malaria.
Watts and Ludlow following the example of Salisbury looked for the cause of malaria in the air and soil of malarious districts. They made various alterations of the theory of Salisbury — as that the organism became more diffused in the air at night not by concentration of the mist, but because it is drawn from the earth by an upward current of air resulting from the cooling of the earth's atmosphere temperature — and they substituted for the hitherto a "bacillus malariae" which they stated they found everywhere in malarious parts. They then proceeded to inject this bacillus into various animals in which they stated they produced a fever in all respects similar to that of malaria. Numerous observations by observers throughout the world seemed to confirm their experiments when Laveran's theory was put forth, soon after which (July 31) Dr. Stemberg in America made a striking attack on the theory. Its authors have since abandoned it and now the theory of Laveran holds the field. We are not called upon to pursue the course of the discussion of this theory so that it will be enough to review Laveran's position as stated in his last book. Neither he nor any other observer have been able to trace outside the body any organism which when injected into the blood produces the sequent of events characterising malarial fever. There has however been discovered in very constant association with malarial infection an organism inside the blood. It occurs under the following forms according to Laveran: Spherical bodies; Flagella; Crescentic bodies; and segmented or rosette bodies (in rosae).
(i) The spherical bodies are much the commonest and are nearly always present. They are amoboid bodies, colourless, hyaline, very transparent, varying in size from 1 μ to twice the diameter of a red corpuscle; their contours as a single very fine line. They may be non-pigmented, but usually even the least have a grain or two and as they increase the granulations do also in number. The pigment may be arranged either irregularly or in an ordered series near the circumference. They have no power of movement in the cell beyond the Protomonad-like but irregular motion in their location; agitation of the pigment grain precedes motion of the body. They may be free or attached, one to three or four to the same corpuscle on which they are parasitic so that as they grow the corpuscle pales, becomes a shell and finally breaks up. Attached corpuscles are frequently enlarged, pale, and swollen so as to lose their concavities and even their disciform. The parasite may leave a corpuscle to which they have attached themselves hence dangerous to think they do not pierce the red corpuscles but merely adhere. No nucleus has been observed. He describes two forms of generation (a) segmentation into 3 or 4 smaller bodies; (b) budding; a fleshy growth forming on the edge and becoming detached from the spherical body.

(ii) The flagellae are very fine, transparent, rapidly moving, standing whose length is 3 or 4 times the diameter of a blood corpuscle. They may be free or attached by one extremity to the borders of the spherical bodies. They impart by their motion rapid movement to neighbouring corpuscles. Their origin is from the interior of the spherical bodies to which several may be attached at the same time but the movement of
Each is independent of the others; at a given moment each loses its attachment and becomes independent of the "corps sphérique" so as to constitute in itself a free organism. The flagellae show little thickening at their free extremity and sometimes in their course and often at this point is seen a minute pigment spot which is continued as a thin line from the interior of the spherical body through the whole length of the flagellum. The flagellae disappear rapidly under Berzin's exhibition. It is not known what happens in the normal course to the free flagellae. Councilman states them to be common in blood taken from the spleen than in that from the periphery.

In that from the periphery, however, avataran saw them in 92 out of 132 Malayan patients. They are not easily detected in preserved specimens.

Crescent Shaped Bodies: These are cylindrical bodies pointed to a very varying degree or rounded at their extremities and crescentically curved; they are transparent and colorless except for some pigment grains about their central part. Their length slightly exceeds that of the diameter of a red corpuscle: their breadth about 2 μ at the thickest part; their size is little variable. Their contour is smooth in fresh but doubt in preserved specimens when stained. On the concave aspect of a line often connects the horns of the crescent from points at or near their extremity. They do not fix themselves to the corpuscles, nor with any force, at least. They are neither amoeboid nor flagellated but after some time may be seen to slowly assume the form of an oval. They are never, as similar in the lower animals may be found, to be seen in development as small crescents.
Segmented or Rosette forms have not been often met with by Laveran who gives it a secondary position. He considers it only a modification of the method of reproduction by division previously described. The form was observed in quarten and quotidian but rarely tertian cases. The segmentation is marked in his diagram as central; there is a clear margin of non-segmented matter.

Method of Growth and Multiplication: is traced by Laveran through the spherical bodies from small clear to large pigmented. The next stage is through the flagella: this has not been connected with the first stage yet by him. The Crescentic and Rosette forms are to him secondary in importance.

Various Authors have suggested Modification of Laveran's Theory. Marchiafava, Celli and San Felice (1891 Doulet) have proposed that for each form, the quarten, tertian, and quotidian, there corresponds a different form of parasite, which differ as they require one, two, or three days to develop in. In the quarten form the parasite is more sluggish. Multiplication takes place by division of all but forms into 6, 8, or 9 forms arranged circularly. The first form is of minor importance. The form is endoplasmic. The pigment granules coarse, and the capsule is preserved to the end of the process. The tertian form, according to Golgi has more lively amoeboid bodies & pigment particles; the latter are finer. The invaded blood cell takes on a coppery hue or is decolourised. Sporulation is rapid specially in the larger forms which occupy a whole corpuscle. According to this the circular speculation is to 5-10 or 10-20 x from this author's reduction there almost entirely covered the account of the theory from here to Hebra's inclusive.
shores. In the quotidian form according to Marchiafava & Catti the endoblastular parasites are very lively; sporulation corresponds to the approach of a new access. Similar bodies appear in the form at one aspect of a capsule the wall of which afterwards forms the line towards the concavity of the crescent. They never form fringes but may become other degenerate forms. There are other differences between deveran and the Italian observers but the latter chiefly differ in maintaining the endoblastular character of the spherical bodies and a minor importance only of the flagella. The life history of the organism after them is first the non-pigmented, and then the pigmented stages: then either sporulation or degeneration into large free flagellated forms or crescents and other forms which degenerate within the capsule. Gorgi whose view is only in part held by Marchiafava and Catti (as above) contends for two varieties only of organism the tritian and quartian: his view is not important as he allows that one form may pass into the other.

Saville has described in Algeria an organism of quite a different kind as the cause of malaria, and found by him in the blood. He describes brilliant rounded hyaline capsules (i.e. organisms) in the blood: sometimes as diplococci, more often borne on a stalk of greater density and so suspended below it in the plasma, and nodding like a buoy to left and right while the flagellated part moves in the contrary direction. The stalk is composed of 3 or 4 sections of 5 to 7 μ length; the spherical
part is hyaline; the central part black. The central stage or lens are broken up by transverse clear spaces showing that development is by division of the stalk. The clear outside portion being a caducous covering. Thus increasing, the toulca gains a length of 18 to 25 μ usually in a vertical direction. Mobile, and appearing to have a black eye in its centre. Once this observer saw these micro-organisms take monstrous forms. "The primitive form of these minute is then a coccus with a central sheath, and multiply by division. The toulca, when mature, separate. Each segment constitutes separately a sheath, and this altona immediately to gain for itself a footing in the infected system, and thus inoculation causes the fever." Micro-bacillus allium is the name suggested. Professor Rofwca states that he has seen in malacal blood organisms similar to those of Yersin.

In. Rofwca has brought me theory and some startling facts into the field. We may enumerate after doubt the different forms of organism found by him.

A. Algae and schizomyctes. (Vegetable kingdom).
2. The micro-bacillus of Yersin of 20-3 μ: in the intestinal ulcers.
3. The bacillin in bluits seen by Socci and others. Its length is 20-3 μ and in profile it is much like a red corpuscle being constructed at the middle; it is very mobile.
4. Algae of variable length, both rounded extremities and a gradually constructed middle portion have often been seen in
His forces of malarial subjects.

5. Flood-like Bacteria: brilliant-spherical bodies with rigid rods from two opposite sides.

6. An alga of spherical form 2 μ diameter: from some part of which goes out a narrow stalk from which are two spherical structures hanging in a straight line and after these two oval diverging bodies.

7. Very fine undulating spirilla have been seen in a venous access, presented on red corpuscles or their debis: They recall "the flagellated spherical bodies of levan".

8. Streptococci: forming a fine chain with minute vesicles at its extremity. These recall the Streptococci of sepsis and occur in diverse cases.

9. In another variety the chain ends at one extremity in an oblique flattened vesicle, at the other in a bifid tail.

10. A hooked bacillus with a large belly and a rectilinear back and perpendicularly at either extremity a long whip. It moves very rapidly and sticks sometimes to the red corpuscles which then become crescentic bodies. The globular mass is grasped by the crescent: it becomes, over nearly, the half of the visible contour, a cushion relatively thick to the rest of the globule.

11. A bacterium showing slight signs of division on its upper surface and moving by cilia on its sides.

B. Infusoria with flagella: and Sparocea (Animal Kingdom).

1. Sporules and spheres: found as by levan in on the corpuscles,
but very numerous in the cells of the intestinal villi. They may be of various forms as spherical or ovoid and may be either vesicles, actiated or granulata. They may remain a long time actively free or on the conjugates and then suddenly develop. He has not seen the cosacs form.

2. Amoebae or Amoeboides arise often from the spores. He describes however two new varieties, a 4-branched star form with or without a nucleus and a second with also 4 branches but of unequal length and much more delicate.

3. A vesicular form derived from altered spores. This bears several aspects:

a) Oval forms terminated by a fine caudal appendage.

b) Spherical forms with an appendage inserted laterally and at an acute angle.

c) Nail-like bodies.

d) Spherical gourd-like bodies.

e) The same form elongated.

f) Horned bodies the neck being inserted at an obtuse angle. This was seen in the milk of two suckling women.

4. Falciform or crescentic bodies of 3 kinds.

a) Very large, 2 or 3 μ long, seen in chronic cases, differing from those of leukemia in being little narrower at the ends than the center.

b) Smaller with short lines within them.

c) Forms similar to the preceding but with verrucose prolongations from the concave border.
5. Cylindrical bodies - 12-28 µ, long and narrow, capable of elongating themselves and slowly crawling.

6. Flagellated bodies: (a) those of larvac
   (b) a sphere of 2 µ diameter with one flagellum ending in a tail.
   (c) Irregular bodies with a flagellum at each angle.

7. Flagella (a) of larvac, with a double contour (when stained)
   (b) with a single contour and a bifid or vesicular extremity.

Patrick Heber, Jr. D: by some very careful observations in India has confirmed the existence of an animal parasite of the Protozoa in the blood of malnourished individuals. He observed the following forms and facts:

1. Spores: These are minute, irregular amoeboid particles produced from both spherical and free flagellated bodies and from other forms. Their formation is as follows: A special spherical body enlarges slowly; the granules and spores increase it shrinks out processes and these other branches; it becomes very granular; then the outline undefined; the granules are extruded and acquire longer or shorter flagella; the parent cell disintegrates. A similar process occurs in free flagellated organisms and to a less extent in other products of large spherical cells. The freed spores which are of light pink colour attack the red corpuscles, whose protoplasm they seem to blend with. A hyaline body forms in the corpuscles; similar bodies appear throughout the infected cell; these approach, and encase the margin, join together to form a spherical body. The movements of the corpuscles are slow; often there is a dancing motion. These forms are
been observed with 3 to 6 spores round a central point. The spores are then of a darker hue and contained in vacuoles outside which a clear rim is visible. It would appear that segmentation, enlargement, & conjugation of the spores within the red blood cells are necessary for the development of higher forms.

2. Small ameboid bodies: 1/8 to 1/10 the diameter of a red corpuscle in size. These consist of very refractive ovoid a spherical bodies in a transparent protoplasmic envelope in varying forms (a) flagellated (b) the flagella uniting various bodies into a mucoid-tissue-like structure. Their protoplasm increases rapidly. They may be absent for days and reappear in vast numbers: they are at times present in all paroxysmal cases especially during pyrexia. They result from the spores. Quinins is very fatal to them. In the interval there goes on the maturation of spores and the formation of larger varieties. When within the capsules they are not flagellated. The flagella in free bodies may be seen to increase by generation. The more severe the fever the more numerous as a rule these bodies. The rule is not absolute however.

3. Simple spherical bodies: are the most constantly present. They are bright transparent and granular at first but soon pigmented particles form; they are developed in blood corpuscles (red) and有些 them when about 2½ to 3½ the diameter of the latter.

Besides the simple form there are other varieties e.g. Some with 4, 5, 9 filamentary cells and rapidly motile. Others rather larger ovoids. All these forms are flagellated or may be so. The simple form is generally met with during intermission.
(4) *Haemotomonas Malariae Distincta*: is a name given by Hehre to a spherical, hyaline, very refractive, and well defined organism with 3 to 5idea containing pigment of birefringent colour. It is a sphere producing form 43 is exceptionally absent.

(5) *Intra capillare* organisms of other forms: - Crescentic, pyriform, ovoid, lenticular, simple hyaline etc. The first four may be met also free in which case they acquire one or more flagella.

(6) Other flagellated organisms and free flagellae. Hehre describes two kinds of Filaria like bodies: under a section, apparently, of flagellated organisms (the long narrow) Hehre includes:

A) A form varying from a pyriform shape to 1/4 in. in length. It is provided with cells.

B) Sometimes another variety of Filaria-like organism of enormous size; it is frequently twisted upon itself. In some is a fairly well defined body cavity. Both forms are pervaded with spheres and ameboid bodies or more rarely stellar and cruciform shapes.

Theory of Development of Hehre for these organisms is shortly as follows: The oocytes enter the circulation through the alimentary or testary tract. They form in the manner described spheroidal bodies; these leave the corpuscles by disintegration of the latter and themselves disintegrate into other (1) Small ameboid bodies (2) *Haemotomonas Malariae Distincta* (3) Small free flagellated bodies (4) Filaria like forms (5) or large spheroidal or irregular flagellate forms, and at the
Same time the spores, granules, and pigment, are scattered. This
highest form only lives at most for 4 days when it again
disintegrates into spores amoeboid, particles. The pyriform, cres.
centie and other forms are produced in a similar manner but
perhaps from a different kind of spore.

Summary of Observations: The short account of the descrip-
tions and opinions of the most important authors just given
may lead us to the following conclusions. The existence in
the blood of malarious patients in distant parts of the globe
of certain bodies is agreed on by all. The organism is pos-
tible a parasite belonging to the lower animal kingdom. So
this Thiele dissent. Hepron has described vegetable as well
as animal forms, but does not assign to either group a place in
a theory. The organism is polymorphic. By all a spherical
form; fragmented or non fragmented, or both is acknowledged.
To some extent observers have coupled with the multiplication of
the organism the fatal access, and with the numbers present
the severity. No fixed association is upheld. Crescentic, oval,
rosette, and specially flagellated forms have been observed by
many, but there is no agreement as to the role they play.

Until the life history of the organisms determined be traced out we
shall not be justified in absolutely concluding that the organism
is entirely unique; much less shall we be able to accept as more
than a possible theory the conclusion of Danilewsky that the
organism found by him and others in the blood of birds is identical.
Lastly there is a general opinion that the organism is destroyed in some of its forms and perhaps only paralysed in others by Zincke.

My own observations: Having thus shortly dealt with the facts accumulated by observers in various parts of the globe I do not propose to enter into the interesting allied subject of the similar haematopoea of animals nor the many other questions that group themselves round the etiology of this disease but will go on immediately to my own observations. My observations on this disease and its etiology on the West Coast of Africa there naturally attaches a peculiar importance and for this reason. Malaria, which destroys more human life than any other disease in the world, attains here its maximum virulence and its widest prevalence. There must be the greatest local interest in it. Therefore. But also we shall expect that here the life history of the organism will reach its highest development, or the organism at least show remarkable productivity. But to a subject of such world wide interest, and to one of such particular importance on the parts where I made my observations, the latter must seem most absurdly insignificant and inadequate. So this I can only respond that such is the case but I can only hope that very soon some one with better opportunities will resolutely take up this subject of Malaria on the West Coast of Africa. This much I believe I have established, that in the blood of Malarial patients on this Coast the same organism is found to exist
which has been described in France, Italy, Algeria, England, Russia, America, India, Burma, etc.

My Method of Procedure: When a patient complained of symptoms that seemed referable to malarial fever I made as early as possible a careful physical examination to determine if there could be other cause. The temperature, pulse and respiration were always observed at the beginning of the sickness and every morning. The temperature was taken on two or three occasions during the day sometimes: generally once or twice. Being of the first importance it was recorded with more regularity than the pulse-beats or respirations. If the case was not urgent Quinine was not given till one or more examinations of the blood had been made. I was also able to examine casually the blood of a few malarious natives: if these of course there is no record on the case beyond what could be learned on the occasion. The cases were so recorded not so much with a view to illustrating peculiarities as to show the general nature of the disease.

To obtain blood for microscopical purposes the arm of the patient was well washed and then briskly dried with a rough towel. I preferred the arm because the fingers of the man were from their occupation hard and ingrained with tar & not so easily cleaned as to be desired. A quick prick was made with a sharp needle: a hot Coverglass cleaned previously in distilled water was applied to the blood drop: the coverglass
was then transferred to a similarly cleaned slide for immediate examination; or it was applied to another coverglass, the two were gently slid off each other: the films produced were heated as directed by Leveen over a spirit lamp; they were then packed in a thin foreign paper case, labelled and dated and put by carefully for further examination in Britain.

I regret that I should have had so little time to opportunity to carry on my observations on the preserved preparations.
The objective used was a 1½ in. (Parker, Birmingham.)

Most of my examinations of the blood were made on board the S.S. Nile River. I therefore could not order my own time, but avoided myself of moments when the propeller ceased rotating; at other times the fine vibrations prevented any delicate examination.
Records of Temperature, Pulse, Respiration and Stools, from 11th Day of September 1891

In the case of Roland Phillips, Aged 44, Occupation Sailor

| Day of Month | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 |
|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Pulse       | 64 | 71 | 72 | 64 | 62 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100| 102| 104| 106| 108| 110| 112| 114| 116| 118| 120| 122| 124| 126| 128| 130| 132| 134| 136| 138| 140| 142| 144| 146| 148| 150| 152| 154| 156|

Records of Temperature, Pulse, Respiration and Stools, from 12th Day of September 1891

In the case of Otto Astma, Aged 20, Occupation Sailor

<table>
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<th>Day of Month</th>
<th>17</th>
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<td>76</td>
<td>78</td>
<td>80</td>
<td>82</td>
<td>84</td>
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<tr>
<td>Resp*</td>
<td>24</td>
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Records of Temperature, Pulse, Respiration and Stools, from 17th Day of September 1891

In the case of John Cairns, Aged 38, Occupation Stoker
Cases observed clinically, with the microscope.

I. Perso Saraso: sailor, aged 20 years: born at least: he has been six years at sea but this is his first voyage to the West African Coast: he has been on previous voyages to Bombay, Calcutta, China, Japan, Algiers etc. No previous history of malaria or any important sickness.

August 31st. 1891. Monday: complained of a feeling of sickness, headache and of pain in the left side of the chest. These were slight lung symptoms: the breathing was hurried and rather short: respiration was prolonged about the painful area: temperature 105°.

I applied mustard leaves externally and gave a cough mixture and watched the effect (see section on "lungs").

November 6th. Friday: he seemed better this morning but the temperature was 102° F and rose higher towards night when I administered gr. 2 of antipyrin. He evacuations.

5th. Saturday: 8 a.m. Temperature 104°: pulse 112: very comparable: respirations 28. The patient feels stronger this morning: no doubt because of the satisfactory sleep that followed the antipyrin given at night. Spleenic dulness about 4½ ins. There is now pain on pressure at the lower border of the ribs over the spleen. 2 black evacuations. Temp. 10.15 p.m. 101.8.

6th. Sunday: 8 a.m.: Pulse 64: Temperature 97: Respirations 18:

I now concluded that there was no doubt of the malarial character of the fever and therefore gave at 10 a.m. Quinn's but only ½ grain: that I might satisfy myself by increasing the dose if necessary what was the least done if the drug that
would suffer. At 2.15 p.m. he was much better but at 10 p.m. his temperature was again at 102.9. I now gave gr. V of Quinine.

Today he has had stimulants as well as beef tea.

7th Monday: 8 a.m. pulse 100; temperature 100° F; Respiration 32. Quinine grs. x

Examination of fresh blood: 10 a.m. Some of the corpuscles are paler than the others: such pale corpuscles are pretty numerous. I believe I have seen many small spherical bodies; some few pigment granules, not numerous; and one or two semi-lunar bodies — specially one shaped thus — ( ) *

2 p.m. Temperature 101° F; Quinine grs. x.

9.30 p.m. Temperature 100° F; Antipyrin grs. x chart amis.

8th Tuesday: 8 a.m. pulse 84; temp. 98° F. Right 22; Quinine grs. V.

The antipyrin given last night was as before followed by sound sleep.

2 p.m. Temp. 98° F; Quinine grs. VIII; 9.30 p.m. Temp. 98° F; Quinine grs. V.

9th Wednesday 7 a.m. pulse 72; temp. 97° F; Respiration 20; Quinine grs. V.

1.30 p.m. Temp. 98° F; 9.30 p.m. Temp. 97° F.

10th Thursday: 8 a.m. Temp. 98° F; 2 p.m. 98° F; Quinine grs. V.

9.30 Temp. 97° F. Nearly full diet today.

* I do not suggest that too great confidence should be placed in the exactness of my first observations: fellows has gained a little experience it is easy to mistake a slanting red corpuscle for a crescentic body: or a merely pale central corpuscle for one with an ameboid body developing in it — indeed this latter point is individual cases impossible to always resolve.
11th Friday: 8 a.m. Temp 97°. 2 p.m. 96.4°. 10 p.m. 97.4°.
12th Saturday: 8 a.m. Temp 97°. 4. 2.30 p.m. 98°.
13th Sunday: 9.15 a.m. Temp 97.4°. 12.40 p.m. 98°3. 9.15 p.m. 97°.
14th Monday: 8 a.m. Temp 97.4°.
16th Wednesday: Temp 12 a.m. 96.6°. 7.30 p.m. 96°4. 12.30 p.m. 96.5°.
17th Thursday: 9.30 a.m. Temp 99°. 10 a.m. 98.5°. 2 p.m. Temp 99°. 10 p.m. 96.5°.
18th Friday 8 a.m. Temp 98.4°. 11.30 a.m. Dunnege X.

The patient did not seem to have nearly regained his former condition but resumed his work.

October 1st Thursday: 4 p.m. Pareel came in very ill and weak. At 5 p.m. a shiver began and lasted for 1/2 hour followed by perspiration. During the course of the evening. At 7.30 p.m. he was perspiring very freely. Perspiration 85. Temp 104.7°. Pulse 120. 10.30 p.m. Temp 100.7°.

2nd Friday: 8.30 a.m. Temp 97.8°. Pulse 70. Respiration 22.

Examination of blood (fresh) 10 a.m.: Numerous and very evident bodies adherent to the red corpuscles. These are vast numbers of fine spherical bodies small and large. A few semilunar wire, I think, not seen; but I was not convinced. I watched the division of an elongated body in the method indicated, but separation was not quite completed when I finally lost sight of the body behind some corpuscles.
5 p.m. 98.8° Temp. Quinine grs X. 10 p.m. Temp. 100.°

3rd Saturday: The patient had shivering between 11 and 1 a.m. last night: he then became hot and perspired. 8 a.m. Fever 32. Temp 101.7°, pulse 80. Quinine grs X 2 p.m. 101.6°, 9.30 p.m. 98.5°.

4th Sunday: 8 a.m. Resp 22, pulse 96. Temp 100.2°. Quinine grs X 4 drachms Arsenicus mith 2 p.m. 99.8°, 9 p.m. 97°.

5th Monday 8 a.m. 98°. 9.30 p.m. 96.8°.

29th Thursday: has made no complaint: a precautionary examination of temperature found his to be 98.6 at night.

30th Friday: the patient was vomiting & profuse in the evening but did not consult me.

31st Saturday, 4 p.m.: vomiting: shivering attacks, headache together with pains in the belly came on. Temperature 106°, 10 p.m. 100°. Very profuse sweating at night.

5 p.m.: made dried preparation of the blood.

November 1st Sunday: Temperature 98.4° Quinine grs XV

No relapse.

This patient was of a peculiarly melancholic mind under illness. Soon after he was seized he packed up his goods wrote his last will and testament and waited for the end. He strongly objected to the taste of Quinine and force had to be threatened before he would take it. A Resolution one of his mates had, he wished to obtain to shoot himself. He was not much delirious in spite of his peculiarity. His memory of language was much deteriorated.
when he had recovered so that out of a considerable stock of English he only retained a few words.

II. Philipp Waldsch from Oberwasser in Germany: Aged 38 years. He has been at sea for years and on this coast once before, when he had fever for two days - he could not tell what it was called.

August 31st Monday: taken sick and went to bed. He had headache, aches and weakness etc. The temperature was 102. A radiogram of the thorax showed signs of lung mischief as in the last case but the symptoms referable to the chest such as pain were not present or at least prominent. The history is the same as that of Jarasco till September 4th. Friday: his temperature rose to 104°: he wandered in his dreams. Antipyrin gr x.

5th.Saturday: 5.30 pulse 115: Respiration 22: temp 103.5°. His thirst is great. His bowels have been opened during the week with castor oil. He slept well last night after the antipyrine. Splenic dulness about 4½ inches.

3 p.m. Luminol gr x.

Examination of the fresh blood: numbers of small free spherical bodies of the size of a corpuscle. On many corpuscles were seen black points: on one especially 3 formed a kind of band.

10.15 p.m. Temp 100°.

7th Monday: 8 a.m. Temp 100.4°;Resp 24; Pulse 80; Quinine grs v.
3 p.m. 101.2°; Quinine grs v; 9.30 p.m. 104.5° Antipyrine grs v with
2 1/2 grs. morphia.
8th Tuesday: 8 a.m. Temp 100.9°; Pulse 80; Respiration 20; Quinine grs viii.
He slept well after his dose of Antipyrine. 2 p.m. Temp 99°; Quinine
grs vii; 9.30 p.m. 98.8° Quinine grs v.
9th Wednesday: 8.45 Antipyrine 22; Pulse 68; Temp 96.8°; Quinine grs v1/2.
1.30 p.m. Temp 99°; 9.30 p.m. 97.2°.
10th Thursday 8 a.m. Temp 97°; 2 p.m. Quinine grs ii Temp 97.4°.
Nearly on full diet now. 9.30 p.m. Temp 98.2°.
11th Friday: 8 a.m. 96°; 2 p.m. 96.9° 10 p.m. 97.4°
12th Saturday: 8 a.m. 97°; 2.30 p.m. 98°.
13th Sunday: 9.15 a.m. 97.3°; 12.40 p.m. 98°; 9.15 p.m. 98.4°.
14th Monday: 8 a.m. 98° Quinine grs v; 7.15 p.m. 98.4° 10.30 p.m. 97.8°.
17th Thursday: 10 p.m. 98°.
18th Friday 11.30 a.m. Quinine grs v; 2 p.m. Temp 98.9°.

21st Thursday: Phillip was sick and felt his appetite gone this morn-
ing; during the day he has chilly sensations over his body but has not left work. 9.30 p.m. he told me he feels better now: his temperature is 99.6°.
25th Friday: 8 a.m. Temperature 98°; he says he feels well. 8.30 p.m.
Temperature 100° yet he still says he feels quite well except that he
is a little dizzy and chilly.
Examination of fresh blood 9.30 p.m. by electric light. There are to
26th. Saturday. Examination of the fresh blood at 8 a.m. In placing the cover-glass with the drop of blood on the slide I did not put the former quite in the centre of the latter. I therefore pushed the cover-glass about 1/6 of an inch. I examined immediately. There was evidently no tendency to rouleaux formation: but very re mark able was it, that more than half of the bodies within the field had assumed an oval or rounded form tending to point at either pole from a sort of sucker-like projections - the direction of their axis being that direction in which I had pushed the slide.

Most were of the type of red corpuscles, some were smaller, a few were larger a degree. They showed no independent motion but as the surrounding corpuscles moved the sucker glands: generally remained firmly attached to the glass, the body seemed very pliant moved about in the fluid. When freed they tended to assume ordinary corpuscular forms but often they retained a sucker-like projection. Most notably however I saw to day without the shadow of a doubt clear adherent bodies on the corpuscles - hyaline refractive and clearly defined and seeming like a hole perforating the corpuscles on which at a time I did not see more than one.

Many corpuscles I saw also as I have roughly sketched - the outer part clear or nearly normal, the inner part darkened but having a distinct
I had no facts 3000 bodies or "rosettes". With my strongest suspicion I could see no pigment granules though sometimes towards their outer rather than inner part they seemed a little more opaque. I saw no pigmented bodies. (Examination one hour).

Quinine 11.30 a.m. qrs X: 9.30 p.m. qrs X.

27th Sunday: 9 a.m. Temple 97.0°F: stronger but yet he has a headache: 10.30 a.m. Quinine qrs X

28th Monday: Temperature 98°F morning & evening. Quinine qrs X.

29th Tuesday: Quinine qrs X. At work & says he feels well.

Mid October: Walsbeck came back for a few days for my treatment. The temperature did not run very high & soon completely recovered. He showed slight symptoms of acute arsenical poisoning: apparently from some slight perspiration of the arsenic from the Quinine Solution.

Roland Phillips of Dumpsie: a Quartermaster aged 44: has been at sea 30 years of which 14 have been spent on this coast. He has had Malarial fever 3 or 4 times. He came September 11th, Friday complaining that he felt sore all over in his legs, arms, shoulders and everywhere. He says he has had a cold for three or four days: he felt ill before rising but has been having the head for 4 hours this morning. Rain and sun. Bowels regular: no shiverings. Respiration 28: Pulse 92.
temp. 102°; when he came to me at 2 p.m. He was in a burning heat. [Name of patient] 10 p.m. temp 100.

12th Saturday 8 a.m. Temp 97.9.

Examination of fresh blood 9.30 a.m. I had a long time I could see nothing peculiar — not even any spherical bodies. But after ½ hour or so I noticed a light corpuscle of peculiar characters. It was a light-coloured corpuscle in margin appearing as a single fine line. While within was a slug-shaped seminulce and pigmented body of rather a thicker form than I have represented. The lower margin appearing to be complete whilst the concave was somewhat irregular towards one end as noted. But specially remarkable was the relation of the ends of the acrosomic body to the corpuscular wall. The latter seemed hardly to confine the body it contained: more particularly did one horn of the crescent seem to slightly protrude. The corpuscles were floating freely in the serum so that under observation nearly losing itself under a group I pressed my pencil firmly on the coverglass with the result that the body again came clearly into view but remarkably changed. The body within it was being slowly extruded from the corpuscles in which however one half of it was cyst enclosed. I thought I had noted slight changes in shape of the seminulce body
while it was yet completely, or nearly enclosed, but such chances of form if more than apparent were very slight, after its first escape I could not keep the body in view long enough to observe further changes.

About 11 a.m. I took a second specimen for examination while fresh; in this I noted among other forms some of the forms of crescentic body I have represented. The last one is peculiar in that in escaping it appears to have brought with it some debris of the cell on its concave side. Besides semblance I could at first see only free spherical bodies; but after more than 1/2 an hour, bodies adherent to the cilia; these some with pigment scattered finely throughout, some in which it was in fewer and larger granules were seen: whether these late appearances were due to my not seeing them, to their development, or to changes caused by death of certain corpuscles, I could not certainly tell. I was unable to make out any movements caused by attached flagella, nor could I see any loose ones. There is a disadvantage in observation on board ship as the continual movements, however slight as when at anchor in smooth water, of the ship from side to side never permits the corpuscles to lie long in one position.

2.30 p.m. Temp. 99.7: Phillips continues in looking today.
3.38 p.m. Quinine grs 7½
Examination of the fresh blood 20 minutes after he took this Quinine. There were present large numbers of large pale spherical bodies; some of the hedgehog like bodies often found in normal blood even when quickly examined after emission of which probably constituted the bodies seen in the last examination towards the end, were present. A few semilunar bodies of seric like large numbers of small bodies adherent to the corpuscles, some with small pigment spots, others rare as described above were noted.

13½ Sunday: 9.15 a.m. Temp 99°.9: No sleep last night.
12.40 Temps 101°.6: 6p.m. 104°.7. About 3 p.m. he had a cold stage of about 10 minutes duration and succeeded by a hot stage, there was no subsequent sweating.
9.15 p.m. Temp 102°.2: Antiphylun grs 5
14th Monday: 8 a.m. Respiration 16: Pulse 72: Temp 99°.4:
9.30 a.m. Quinine 1 grain: 7.15 a.m. Temp 98°.2
10.30 p.m. 97°.4

September 30th: Wednesday: 12 a.m. Taken with weakness & violent
rigors: 2 p.m. Resp 30: Pulse 72: Temp 104°.
9 p.m. Temp 98°: he feels much better.

October 1st: Thursday: 8 a.m. 97°.4: 10 a.m. Quinine grs 7½.
4 p.m. Respiration 22 / pulse 84 / temp 99° / 7.30 p.m. pulse 90.
10.30 p.m. Temp 103° 8.

Examination of fresh blood at 4 p.m. Semilunar bodies: oval clumping bodies described before; and a good many small feebly spherical bodies present.

October 2nd / Friday / 8.30 a.m. Respiration 20 / pulse 68 / temp 100° 5.

Examination of fresh blood / 10 a.m.: a good many of the oval clumping bodies were present. Nothing else noticeable is the seen.
5 p.m. temp 103° 4 / Gumina 9 x. At 10 p.m. he had a violent attack of retching; vomiting about ½ pint of bitter fluid.
Respiration 32 / pulse 84 / temp 103° 8 / Antipyrin 9 x.
(The vomited matter is little coloured & has little smell - I am that during the evening he has suffed at intervals about a quart of tea and less water: it has probably been rejected)

3rd Saturday: Early this morning patient had copious watery diarhea / Rectal at 8 a.m. Respiration 22 / pulse 68 / temp 98° 4.

Examination of fresh blood / 10 a.m.: Towards the centre of the cover glass were many corpuscles as if perforated by adherent bodies. These were probably pale corpuscles. Near the circumference however there were vast numbers of variously shaped small spherical bodies: after half an hour or more I noticed a great number of the corpuscles begin to take a peculiar appearance - while retaining their normal shape they showed a clear band seeming to cut them in two - the uniformity of the band seemed to indicate that they must be scooped out of their ordinary flattened shape. Most peculiar
however was the appearance in one case of a delicate filament, so fine as to afford only an occasional glimpse, extending from the one extremity of the band. The possibility that this might be one of M. dawsoni's flagella was strengthened by the view of another clear but somewhat less fine filament about twice the length of the diameter of a red corpuscle. After about 1½ hours some peculiarly shaped bodies appeared and rapidly increased in numbers (still shingly towards the periphery of the glass) — shapes minute under my highest power moving rapidly in a vibratile fashion among the corpuscles. One of them I followed among the corpuscles for 20 minutes to ½ an hour. After a time it slowed down by the edge of a corpuscle but afterwards again passed itself and soon afterwards I lost sight of it. Others, however, but slightly larger were to be seen on the corpuscles at one focus these little objects appear refractive at an acute angle on blackgrounds. In about 2 hours time I saw more towards the centre of the coverglass the two corpuscles 

(a) 4½ close together
(b) had an ordinary clear band such as I had before described

(b) was like it but was more of a short bacillary rod in the centre. It had a slight tail extending from it. (An appearance something like (b) sometimes appears in artificially dried normal blood. I do not know that it is produced in blood at the temperature of the atmosphere.)

2 p.m. temp. 98.4° Inven. grs. X leg. Arsenical. m = 9.30 p.m. temp. 98.8°: Artificial Luna + Arsenic solution.
4th Sunday: 8 a.m. Rec'd 20: Pulse 80: Temp. 97°8. Scurvy gr.x: b.g. arsenical m.t: 2 p.m. 97°4. 9 p.m. 97°7.
5th Monday: 8 a.m. Temp. 97°8. 6:30 p.m. 98°5. Scurvy gr.x b.g. arsenical m.t: 9:30 p.m. 97°5.
6th Tuesday: 8 a.m. 97°3.
7th Wednesday: 8 a.m. & 10 p.m. 98°.
Phillips recovered his usual condition rapidly. He was a patient who was very hard to persuade to be careful.

IV Otto Rohme: a sailor from Stokknaer, North Norway: aged 20. has been only 2 years at sea on voyages to the East Indies & China. He was never sick before. This is his first voyage to the West coast of Africa. He has suffered on several occasions beginning soon after leaving Germany from gastritis, on this voyage. I have noticed him take jagg for a week or two back: but when questioned he denied all ill health.

September 12th Saturday: 6 p.m. He was taken with sickness again in the head & felt as if drunk: he also felt hot. He states he got wet in the rain at 12 a.m. He felt well this night.
13th Sunday is better: Temperature 100°. It is noticeable that he looks and feels this morning in spite of his fever, just as he has done for a long time back. He says he feels well and ate a good breakfast.
Examination of fresh blood at 10 a.m. When I first began the examination I could see nothing peculiar except an occasional small refractive body on a corpuscle that very rarely I prolonged..
my observations over an hour during which time the capsules retained their shape moved freely in the blood stream without rocking of the vessel. The are adherent forms which tend generally to the pseudopods and are more refractive than the capsules. Five amoeboid forms were also sometimes seen tending to adhere to capsules but in no case under my observation remaining so fixed. One was very peculiar being to all appearance, in color, contour and refractive power similar to a red capsule, yet there was a distinct pseudopode passing from it to some neighboring capsules. The pseudopode remained even when the capsules separated from it. This was yet more peculiar. After a half hour or so the capsules became more freely visible. Under the field there were at once two such oval bodies as A1 a floating body as A2 and another body as B1. As I was looking at a field suddenly a fresh body forced in its way leading a stream of capsules in its track— but a head of it and firmly united to its extremity was a body of about the size of a capsule but so drawn out as to be pointed towards its attachment and towards the opposite side. Suddenly the bodies parted and while the larger retained its shape the smaller heading one elongated in the course of one or two seconds its rounded shape. The oval body then secured a capsule sometimes two thus united moved together and again parted. This body was sometimes assisted by the side but more
usually by one of its extremities & when it adhered I noted a fine, but distinct line form at the point of junction. I could perceive no flags. I noted also some semilunar bodies but their form was not the usual - Their concavities were straightened out and their extremities irregular.

12.40 Temp. 101.5° 9.15 p.m. 102.2

Monday 14th 8 a.m. pulse 104 : Resp. 40 : Temp. 103° 9 a.m. Quinine gr K
7.15 p.m. 103° 5° 10.30 103.8°

Tuesday 15th 6.30 a.m. Temp. 91°4° Resp. 24 : Pulse ~ : Quinine gr K
12. a.m. 100° : Quininae grs VII : 6 p.m. 92° 6°

16th Wednesday 12 a.m. Temp. 103° : Quinine grs VII
7.30 p.m. 102°8° 10.30 p.m. 101.2

17th Thursday 9.30 a.m. 99° : Quinine grs K : 2 a.m. 98°

Examination of the lungs showed hypostatic congestion. The vertical measurement of silence dulness 30¼ inches. 10 p.m. 97° 1°

18th Friday 8.30 a.m. 97°4° 2 p.m. 96°5° 10.30 p.m. 96.8°

19th Saturday Quinine gr 7 at 10 a.m. The patient returned to work.

October 1st Thursday: Oft was taken with a rigor about 2.45 p.m. the sweat proceeding very copiously : 7.30 p.m. Sweating still though less than before : Pulse 104 : Resp. 31 : Temp. 103°6° 10.30 p.m. 100.6°

2nd Friday 8.30 a.m. Resp. 24 : Pulse 94 : Temp. 97° : 5 p.m. 98° 6°

Quinine gr K : 10 p.m. Temp. 100.6° : Directly after I left at 5 p.m. he had a short cold fit followed by a moderate sweat.

3rd Saturday 8 a.m. Pulse 92 : Resp. 25 : Temp. 98° 6° He has returned
of his own accord to work: 2 p.m. 97.5: government gas & dip arsenic.
also Mr. M. 9:30 p.m. temp 98.5. Same dose of Drunum & dip arsenic.
4th Sunday: 8 a.m. respiration 24: pulse 88: temp 98.4: Same dose
of Drunum & dip arsenic: 2 p.m. 98.5. Respet: Drun. 6th dip arsenic.
9 p.m. 96.8.
5th Monday: morning temp 97°: 9.30 p.m. 96.8.

October 26th Monday: Complained of sickness in the evening: temp 102°.
27th Tuesday: morning temp 100°.
Preparation of the blood made and preserved.
Drunum & arsenic easily subdued this attack.

James Fiscrill: sailor: aged 32 years: is a quarter master: has been at
sea 18 years. He has sailed to the East Indies, China, Australia, America,
the West Indies, Black Sea &c. He has been going to the West Coast of
Africa during 4 years: he was laid up with fever for a week on his
first voyage & and 2 ½ months with fever on the voyage last.
September 16th Wednesday: 12 noon I saw him: He had been suffering
since 1.30 a.m. from faintness, headache, heat, & occasional grip:
Nausea. Here for his appetite has been normal today it is completely
lost. His tongue is a little brown towards outer margin.
His bowels are regular: temp 98°. 8.
2.30 p.m. Examination of fresh blood: I could find nothing certain
there were perhaps a few large clear bodies the 1/5 of corpuscles
but more probably there are pale or empty red corpuscles.
7.30 p.m. temp 98.8 10.30 p.m. 97.4.

17th Thursday: Is today quiet well and of normal temperature. He had no diarrhoea. The symptoms were no more than could be accounted for by mere climatic fever.

VI John Cairns: aged 33 is a seaman. He has been ten years at sea: he has been to Russia, the East and West Indies, New Orleans to but never before on this coast nor was there any previous history of fever. He had never suffered from rheumatism.

A casual precautionary examination of his temperatures at 9.30 p.m. of Sunday 16th gave 98.4.

September 17th Thursday: Cairns came to me at 9.30 a.m. complaining of pains all over especially at the flexures of the knees and elbows and at the back of the neck and head. He accounts for his illness by his exposure at work on the 14th and 15th to a very high temperature while cleaning the boiler and to subsequent chills.


Examination of the feces. 10.30 - 12-15 p.m. I was struck immediately with the enormous number of Crescentic bodies present. All were provided with cell remains of the cave-cave aspects: some appeared still capable of approximation and degradation of their horns. After ½ hours they mysteriously lessened in a very few in number. Careful focussing showed that the light space normally present in the red corpuscles was more defined larger than usual so that many appeared more rings.
I did not remain at all close at the end of this examination about the crescents. They disappeared so suddenly that I was inclined to think myself mistaken; that some at least might have been red corpuscles with pale centres, which for some reason kept their edgeway position longer than usual.

3 p.m. 100°. 6 10 p.m. 102°. 5.

18th Friday: 8.30 a.m. 100°: 11.30 a.m. Quinine gr x.
2 p.m. 100°. 6: 10.30 p.m. 100°.

19th Saturday: 8.30 a.m. 100°. 5: 10.30 a.m. Quinine gr x.
Examination of Urine: Blood: at 12 noon: small spherical bodies & one or two small red: later on many corpuscles appeared to have a white band of irregular form. I do not know that this appearance is found ever in normal blood after withdrawal. I saw such banded corpuscles in other cases.

The patient has been lately complaining much of the bad pain at the back of his head and neck and of lumbar pain: that in the joints is gone. There is pain on pressure over the kidneys. He says his water is red. I could not obtain a specimen while this coloured. It may have been some form of haemoglobinuria (paroxysmal?) but (see section on kidneys) one does not know much about the real effect of Malaria on the pathology of the kidneys.

4.30 p.m. Temp. 5 99°. 8.

20th Sunday: 9.30 a.m. 98°. 8: 10.30 p.m. 98°. 4.

21st Monday: The patient went to his work of his own accord.

22nd Tuesday: 9 p.m. 99°. 1. He is now better he says did not come again.
VII. Matthew Robert Cockerlin: aged 26: has been at sea since he was 7 years of age: has been to the East Indies, Australia, South Pacific, States etc. but never before on this Coast. He never has had from nor any serious sickness except accidents. He is remarkably strong, healthy & of a very cheerful, cheerful temperament.

September 22nd Thursday: When he went on watch about 2 a.m. he felt inclined to vomit: at 8 a.m. he was worse: from 8 a.m. till noon he was again on watch: below from 12 to 4 p.m. & got much better. At 5 p.m. he was again worse: came to me complaining also of pain over the eyes.

Examination of fresh blood at 5 p.m. I saw some small spongelike bodies but they were not characteristic & were scarce - one was of a peculiar scooped or leaf-like form. The corpuscles were generally healthy. I saw however an oval shaped body with sucker-like extremities adhering to a neighbouring corpuscle and again separating. The appearance was not convincing.

23rd Wednesday: 3.30 p.m. 98.4

24th Thursday: General health and appetite good: no medicine given. No relapse.

VIII. Robert: aged 18: has been out to this coast several times as under-steward aboard: has had various feverous attacks. He is a very short, but stout built: apparently hardly a lad but he took very little care of his health. Besides the attack here recorded he also had attacks on leaving & on returning to
Cold weather. The last was the result of wearing a very thin cotton vest only in sharp weather.

September 26th. Saturday: about 12 noon when about to do some work the lad was suddenly taken faint and came to me. As I took his temperature (97° s) he nearly fainted again & a marked rigor came over him.

4 p.m. Quinine gr xv.

Examination of fresh blood taken before the Quinine could act: A good many adherent suckers, oval or rounded bodies were to be seen & I felt pretty sure I distinguished small bodies adherent to the trophozoites, though not to plain as in Waldschmidt's case.

He felt better & returned to work in the evening.

27th Sunday. 10.30 a.m. Quin. gr xv.

Mr. John Clark: 35 years old. had been long on the coast: had had bad fever 5 times before. Was now suffering from intermittent.

September 14th. Monday:

Examination of fresh blood 9 a.m. Semilunar bodies: Adherent amoeboid bodies: One large oval body adherent to a corpuscle. The red corpuscles are reduced in number.

F. Ekansom Eyo: brought to me in the morning before I left Creek town. September 16th. Wednesday. Is aged 3 to 4 years. is suffering from Whooping cough & morning fever. Specimen of blood preserved.
Esoin Ockypong: 17: Old Calabar: He came on Monday 14th September to Dr. Rose of Old Calabar complaining that his belly was sore. There was no fever; he was given Castor Oil & Chlorodyne. He returned at 8.30 p.m. Shivering; there was pain in his right side. His temperature was 105.2. He has had 4 motions today.

Examination of fresh blood at 10 p.m.: The contour of the red corpuscles seems ill defined & their centres are displaced. The white corpuscles are more granular than normal. The black granules looking like pigment grains.

A.M. Bonice: came on Tuesday 15th September to Dr. Rose Dispensary at Creek Town 12 a.m. She complained of frequent bloody menstruation; pain over the whole body, specially in the supramammary region on the right side. She is a slave girl brought from up stream. It is usually the case with those brought into new localities. She is very subject to fever; she is thin & poor looking. Her spleen is enlarged. Temp. 50.5°; pulse 150; Resh 36.

Examination of fresh blood: This woman's blood is filled with semilunar bodies in every stage of development. I had never before seen them extending so round the corpuscle as in (a).
(b) is apparently a small clear adherent body. Some of the similar bodies must have increased in size after leaving the corpuscles. I see an oval body of clear consistence than the surrounding corpuscles pointed at either end and of a rather smaller size than I saw in a previous case. At a little distance from either end was a group of red corpuscles in irregular roulcaux & sometime one group sometimes the other is forcibly drawn towards the body which seems to cling to them; then it will leave its hold and they are repelled: or sometimes the roulcaux would be bent as a caterpillar: all these movements were independent in form & direction of the surrounding corpuscles. The body is pointed towards either end & is darker towards the centre.

The spleen I should have remarked could be palpated below the ribs: similar pressure on the right side showed pain in the liver. That this case was one of malaria, haemoglobinuria was very probable.

XIII. Ekperi Igbo: came to the Dispensary at Creek Town on the same day. Age 16. Complains of fever coming on about 5 pm for the last fortnight. He sweats very early at the feve. Temp. 100°: spleen much enlarged & swelled by pressure: right notion percussion prolonged expiration at right side of his right lung.

Examination of fresh blood: many small spherical bodies: adherent bodies; a few ill shaped semilunar bodies.
XIV. Olisa Okpo Okasi: aged 31, is a teacher at Creek Town. He looks very strong and healthy (September 15th, Tuesday) but syphilis was diagnosed a year ago. He had a small bony growth on the forehead; night: headaches, restlessness, loss of appetite, pain in the right shoulder. Gout with dyspnea or on pressure
Examination of chest: showed bronchial breathing in the supra- and infra-clavicular regions at the right apex; the condition was less marked at the left apex. I made careful hunt for remains of any syphilitic sore but could find neither trace nor history.
Examination of fresh blood: I saw 2 or 3 large oval sucker-celled bodies but not very active. There were some misshapen corpuscles and possibly adherent bodies; others appeared yellow and clear, a swelling of the corpuscles of the latter was noted while they were on edge, while they were flat they were lighter with a clear centre. Some were unaccountably active. The results were indefinite.
9.30 a.m. 1st specimen of blood preserved.

XV. Gotor of King Eyo Honesty viii of Creek Town. Was seen by Dr. Rae and myself at 8 p.m. Tuesday, September 15th. She is an old woman and suffered from a large goitre. She complains of fever every morning for the last 3 weeks: one morning at 4, the next at 5, then at 6 and on refusing to an earlier hour again. Her breathing was often embarrassed due probably to cardiac trouble. There was a rough systolic-diastolic murmur. The respiration was much more difficult during the fever.
Specimen of blood preserved.
Description of Microscopic Appearances in the Preserved Specimens.

Unfortunately since my action I have had little opportunity of carrying out as I should have wished my examination of those specimens. They have all too been attacked by an abundant branching organism, a spore-bearing mycelium, which seems to have been favoured by the saturated atmosphere of the Coast. I will forbear any remarks till I have described those examined by me.

All those mounted in Canada Balsam were examined with a 1/25 glycerine immersion lens of Parker of Birmingham. The power used for the others was an eyepiece of the same strength (a high power but not numbered) and an object glass enlarging not above 700 diameters. They were both stained with methy1-blue.

Parel Zaracon 10 a.m. 7th September. This specimen was very much destroyed and nothing could be made out.

Parel Zaracon 10th September: II.a. is a representation of organisms seen in one field: the branching mycelium: a straight or oval like form of the same: some corpuscles which tend to be pale towards their circumference: and irregular corpuscles.

II.b.: In this are various bodies sketched from another field. The branched mycelium is disarticulating at one point. Towards the centre & bottom are masses of its spores stained deeply blue. To the left is a large colourless body disintegrating and small spheres of a bright yellow colour are being set free: one of these spheres especially is noted as provided with a minute flagella.

The vasculum was in that specimen very branched. The branches side if were not so numerous but sometimes the branches ended in groups as in the case of 2 terminal groups represented. I noted a light pinkish blue horse shoe shape (see below and to the right). Many of the blood corpusules had not taken up the colouring and appear transparently structureless. On one or two were un: segmental structures appearing like perforating holes: other such took on the carminine stain but not the blue. In them could be seen numbers of grains of brown pigment. The structures re: presented in III B are from one field in which every thing was tinted by the Carminic. One corpusule is vacuolated (appar: ently at least): others contain fine pigment: there were also to be seen large coarse granules of pigment some of the my dam. In other fields were ovasulated vacuolated corpusules + numerous pig: ment grains some at least probably extraneous. One cell had a very peculiar form being pale outside forming within a coloured ring thus O. Other corpusules are shown a little more: pigmented than normal in the centre but with a clear space of varying size in some part of their interior. There are two cells close together in one place each with 2 vacuoles. In one part specially both stains had taken there were 2 clear vacuoles and I think a crescent of blined form.

IV. Parel Tasacco 10th Spt: double stain: In this the forms already described or very similar were seen. In one case however the
mysticism passed directly from a branch into the straight corona form: in a few cases the free spores were arranged as a series of 4 parts, but this might have been accidental. But in one part of the field (see diagram, which however is not nearly so clear as the specimen was) there were very numerous small curved bodies. In one field they were still one within a capsule; in another they were still clear, though the capsules were losing their distinct outline. These bodies were unmistakable: they were very numerous in some fields at that part of the coverglass as it were back towards the centre not more than 15 containing capsules than which they were more deeply stained. They had a well-defined margin sometimes a vacuole about them. Their extremities were generally thicker than their middle. They stained with rose; in some fields as many as 50 such showed.

V. Phillips 12th September Methyl blue - Nothing noteworthy could be seen in this.

VII Phillips same date: double stain: Not much of this specimen is good but in one part the brown has stained fairly well. A semilunar, a pigment shoot off, a ruptured, and other forms of corpuscular body appeared in the field. In another field was seen the large pigment-granules-containing cell: also the oblong cell containing two large refractive particles pigment spots (diagram)
VIII. Phillips: Same date: 3.50 p.m. Methyl-blue stain. The mycelium is here very active & it is in parts filled with minute refractive spores. In the vicinity of its walls are the usual deeply stained spores; but also here & elsewhere were large pale cells with such an unusual crescentic body inside them. I thought at first these might be a form of the Streptococcus stage of the mycelium in which the articulations had not yet developed. Their consistence is rather granular or rather they appear as if in being curled on themselves, folds had formed. They are not as in the diagram close together but are sparsely scattered non-stained red corpuscles forming the general ground. They have certainly themselves no connection with the mycelium. I noted the 2 methods of multiplication of the mycelium indicated: also the 3 peculiar crescentic shaped bodies close together, which were pigmented & granular in their interior. The diagrams of crescentic bodies of the peculiar sort described are from all parts of the specimen. They are not so deeply stained as the fungous spores. The containing cells were perhaps hardly so plain as in some cases viewed further on. A somewhat similar body was seen in A.P. Bermie's blood.

VIII. Phillips: The same date: Methyl-blue. In this slide the staining was bad: the white corpuscles were however stained, as well as faintly, other smaller cells. In one part I noted a jointed oval body. I have drawn the surrounding cells to show how the corpuscles were deformed: the cell they surround contains a crescentic body; in a neighbouring cell was a spot of brown pigment.
I have also made a diagram of a large white cell in which was a densely stained thread elongated spore and another not yet enclosed. There is a good deal of minute brown pigment about both loose & enclosed in white cells. Very faint staining all about the preparation seemed to indicate that deeper staining would have shown more. The oval cell I have shown undergoing transverse dehiscence was with smaller cells enclosed in a mass representing cartilages run together.

The preparations so far as described were all mounted in Canada Balsam & examined under a 1/6.5 objective; the remainder unless otherwise specified were mounted dry & examined with a lower power.

Another of Syc. Honeys. Sept. 15th: In the stained blood I could distinguish hardly anything: all the cartilages appeared perforated but this was a mere optical delusion. In the unstained preparation it was easier to distinguish really parasitic cartilages from those pale in the centre. When due to paleness and transparencies only the perforation seemed to fade away towards the circumference when I focused up and down. When the appearance was really due to an adherent body the edge did not thus melt. This is by no means a distinction always so easy to make out.

In the unstained preparation I believe there were really a few adherent bodies to be seen on the cartilages, or within them. All were deficient in colouring material. Some cartilages were blotched in spots: others, more numerous were reduced below normal size.
X. Ekannem Eye Sept. 1645. In this preparation was capitate. There
watched the usual distinction between half circular corpuscles & those
with an adherent respective body attached. In one field there were
plenty of pale but very few infected. In another the latter abounded.
They were thus easy to compare. There was a great amount of the
mycelium. Some very large blue stained cells were scattered about.
Many of the corpuscles are small. Some irregular e.g. with a finger
like projection. The large cells mentioned were sometimes to the
number of 4 or 6 in a tile; the blue staining had coloured
within them large irregular crescent similar to those developed in
but the cells were easily stained seen in which they lay. The cells
themselves were unstained. It varied from the 1/8 of 1 to 2 or 6 corpuscles.

XI James Carris 19 September. If there are any there are but very
few spherical forms adherent to corpuscles but I am not even con-
vinced if them in this case. The blood corpuscles appeared well
coloured. The usual mycelium is present.

XII Philip Waldecker 26th September. a most peculiär change had
destroyed this preparation. All the corpuscles had run together
into a clear honeycombs mass between the meshes of which was
much debris. The diagram does not represent the condition very
well. Over a among the debris the blue stained mycelium &
its dark spheres are seen scattered.

XIII to XXIII are blood preparations taken from the following cases.
Phillips 10 a.m. 2nd October: Ekhori Iquo 15th September. Renin Oakpoon
14th September; Otto Rother 13th September; & John Clark 14th September.
They were unfortunately rather muddled by the fall of the box in which they were placed when stained. I have however recorded their appearance. The first two are the only ones mounted in Canada Balsam & they were examined with an immersion lens.

XIII. In this preparation there were on many of the corpuscles more punched-like appearances of perforation; sometimes there was more than one of these in a single corpuscle. Many present however a more empty border. In some cases the corpuscle seemed swollen & the little clear bodies seemed to lie in a vacuolated border or line within the corpuscle; the vacuole was of linear shape (see diagram). Some cells were pale throughout & one was pigmented in a transverse band. The myelium was not excessive in amount.

XIV. The red cells are not very uniform in size: a large number are so clear that amid the fuchsin-coloured they could hardly be seen at all. I saw one distinct crescent (see diagram) with sharp ends. Instead the 2 cells with shores or pigment & vacuoles or one in one case the edge of the corpuscle was lost. The large cell is apparently simply lysozymic not phagocytic. In this preparation also occurred some of the large stained crescents in clear cells; in one field 5 such could be seen near each other.

XV. The red corpuscles show little change but the white, or granular cells, are much in excess. Six such I had under the field at once; they all have one, some more, parts of their interior coloured light blue by the stain. The outer part is more granular contains pigment granules & is coloured by the carmine. There are also some of the
large clear cells described in other cases as containing irregular blue crescents. A white cell enclosing a red corpuscle or edge with a blue stained nucleus is sketched: also another cell dispersing into little spheres of very minute size: also a much larger sphere of the same bright yellow colour (due perhaps to the carmin) was seen giving rise to a long filament which developed directly into a mature mycelium.

Not this case I find as interesting because though the mycelium is absent nearly yet there are plenty of the large clear cells containing blue stained irregular crescents. This suggests that the mycelium has no connection with this body. The crescents as I call them might often better be described as worm-like. These cells vary from as small as a red corpuscle to 3 or 4 times the diameter of these. At the same time as they increase, by a sort of concentration, shadowy at first, gradually figures out in blue stain the enclosed organism, which at last becomes much more easy to see than the cell that encloses it. It does not show however unless pigmented blue. There were lots of evident adherent bodies on the corpuscles: some oval suckered corpuscles, perhaps only, some ordinary crescent forms.

The intra-cellular crescent is represented but not so numerous as in the preparation also. A good deal of the fungus at present. I think the preparation was dried a little too long as some normal corpuscles were deformed by minute hyaline bodies.
Conclusions: While admitting that my grounds are insufficient and my experience inadequate to form any theory or to properly discuss the value of my observations, except for myself, I draw the following conclusions. Of the 4 forms of the organisms described by Mr. Luschan, I found two—(1) the spherical, more frequently attached to the euglena; (2) the crescentic form but not so frequently as might have been anticipated. Also on one occasion (17 Oct.) in the fresh blood, and on others in the preserved (17 Nov.) either fine minute forms or similar spores being produced from out of a pale cell. The characters of these recall somewhat the description of spore formation in the malarial organism as written by Dr. Hkin in Hyderabad.

Two anomalous forms of crescent have been seen in the preserved preparations. The first is a minute form developing towards the centre of the cell, much similar to one described by Danilsky in lower animals. Its distinct intra-cellular position makes it very improbable that it assumed its position after extraction of the blood. The second form is less free from suspicion. It was observed in various cases and showed no connection with the mycelium. Moreover it did not appear as the mycelium did to be an infection. This however might easily be an optical delusion. I leave to others to discuss its real nature. In 17 Nov. it took in one case a spiral form + various other modifications of its position in the cell were seen. In one preparation of fresh blood (that of A.M. Bemiss see diagram) was a somewhat similar form seen but its outline in this case was more regular.