BERI-BERI; WITH SPECIAL REFERENCE TO ETIOLOGY AND DISTRIBUTION IN COUNTRIES OTHER THAN TROPICAL.

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B E R I - B E R I .

ETYMOLOGY OF THE WORD: SYNONYMS.

The etymology of the word "beri-beri" is variously explained. Its first nosological application is to be found in Jacobius Bontius's work "De Medicinia Indorum," 1629. He appears to have seen the disease in Java, and describes a disease "qui ab incolis beriberi vocatur". According to Bontius, the word is derived from "bharyee" which in Hindustani means sheep, and was so used from the sheep-like gait of the patient suffering from this disease. There can be no doubt that the word is not of Arabic origin as Carter supposes. In the Malay language "biribi" means, according to Platteenu (Geneesk.Tijdschr.voor Nederl.Indie,X,665), an "abrupt and tripping gait". Marshall refers its derivation to the Cingalese word "bhargee", meaning a"feeble gait", and this is now considered the most probable etymology. Littré and Robin consider point to a modification of "bahr-bari", another Cingalese word, which is used to designate a condition of "extreme weakness". Herklots, on the other hand derives it from the Hindustani "bharbari" - a "swelling" of oedemetous character.

The disease is designated "binas" or "apooi", "pantjakit niloe" and "siloe" in Banka; in Java it is known by the name "loempe"; in Japan as "Kak-ke", from the words "kiaku", a "leg", and "ka" or "ki", a"disease"

in combination, according to Scheube, therefore, meaning a "disease of the legs". Beri-Beri is known as "maladie de suceries" in the French Antilles; as "hinchazon"(or dropsy)"de los negros" in Cuba; as "perneiras"(disease of the feet) in the Brazilian Province of Matto Grosso; and as "inchacâo"(oedema) in Minas Geraes. The French use the term "barbiers", and it appears to be a corruption of the word "beri-beri". According to Vinson, however, another disease was designated as "barbiers", but we now know that the other malady was but ber-beri of a particularly malignant character. The word "barbiers" was used by Lind in 1777 in association with the disease known as beri-beri as occurring in India. In 1822 Marshall (Note on the Medical Topography of Ceylon, 1822) described "barbiers" and "beri-beri" as two distinct diseases. In the former he found paralysis and atrophy to predominate, but oedema, dropsy, and dyspnoea in the latter.

Among other synonyms for beri-beri are:- "Kaki lem but", or "weak legs", in Malay; "Ashite",or"disease of the legs", in Japan; "Hydrops asthmaticus" (Rogers); "Lynclonus Beri-beiria" (Mason Good); "Myelopathia tropica scorbutica" (van Overbeck de Meijer);"Paraplegia mephitica" (Swaving); "Sero-phthisis perniciosa endemica (Wernich); "Neuritis multiplex endemica"(Scheube) and"Panneuritis endemica"(Bälz).

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DEFINITION.

Beri-beri is an endemic and epidemic disease, prevailing especially in the tropical and subtropical regions of America, Asia, Africa, and Australia; whose chief symptoms consist of motor and sensory disturbances(said to be due to inflamatory lesions in many of the peripheral nerves); a certain amount of cardiac affection; & by a chronic course frequently interrupted by acute exacerbations during which a rapid aggravation of the existing symptoms or the appearance of new ones takes place,when death may occur from an asphyxial or syncopal seizure.

HISTORY.

The history of Beri-beri can be traced back to pre-Christian times. Sheube and others, searching to ancient medical writings of China and Japan,found the word Kak-ke in a Chinese work dated 200 B.C., and in another bearing the date of 24 B.C. Other Chinese referneces were discovered in the writings of the third, seventh, and eighth centuries of the Christian era; and one of the Chinese medical works of the tenth century distinguishes between a 'dry' or paralytic Kak-ke and a 'wet' or dropsical. A century before this, beri-beri receives its first mention in Japan, but in that, and in subsequent Japanese books, the disease is often confus-

ed with other diseases, such as affections of the heart dropsy, rheumatism, later still, with malaria and anchylostomiasis. Bontius appears to have been the first to write of beri-beri in the East Indies, during the seventeenth century, about which time, also, the Dutch physician Tulpius saw it on the Coromandel coast of India. Following this, we have the accounts of the disease by Paxmaun, Lind and Fontana - for the Malabar coast; and by Malcolmson for the East Coast of India. Since then beri-beri has been seen in various parts of the New World, but at dates not exactly known. It was certainly unknown in Brazil and Guiana before the year 1860.

The earliest account of beri-beri is that contained in Malcolmson's essay published in 1835, which though now almost forgotten is worth perusing. In spite of his accurate description of the disease, his monograph, on the history, pathology, symptoms, and treatment of the disease, failed to have any influence on existing theories; and the writers that followed him, maintaining the previous confusion, give such garbled accounts concerning the nature and origin of beri-beri, that it is with the greatest difficulty that one can gather a correct idea of the affection from a perusal of their works. A variety of maladies were described as beriberi, more especially those attended with dropsy and paralysis; apart from other affections such as alcohol-

ic neuritis, certain forms of diffuse myelitis, nephritis, malarial cachexia, scurvy, ankylostomiasis, etc. Further, beri-beri has often been referred to under the names of infectious polyneuritis, pernicious oedema, progressive anaemia, asthmatic dropsy, myelitis, malaria, etc. Little wonder, then, that the disease known under the name of "beri-beri", or other colloquial designation was till not very long ago a riddle in its etiology and pathology; the more so as the disease was, according to various authors who dealt with it, characterised sometimes by motor disturbances, and at other times day respiratory, cardiac, or vascular disturbances. Fonssagrives and Le Roy de Mericourt's division of beri-beri into two distinct, though somewhat similar, diseases, in 1861, made the then existing diversity of opinion even greater. Since then however, considerable revision and amplification of our knowledge of this interesting affection has taken place, and the unity and specificity of the malady established. The "maladie des lucreries" of the Antilles; the "bad sickness" of Ceylon; the "Kak-ke" of Japan; the "barbiers" of Mauritius island; the "morbus innominatus"; the "beri-beri" of the Dutch, East Indies, etc., are now regarded as one & the same affection, and in no way differing from the "pernicious oedema" and "asthmatic dropsy" of the older physicians; and the affection in its various phenomena

clearly understood, mainly from observations made in Japan, Brizil, and the Dutch East Indies.

GEOGRAPHICAL DISTRIBUTION.

For a long time beri-beri was supposed to have a peculiar territorial distribution. It is now known to be more or less prevalent over a large part of the tropical and subtropical zones of the Eastern and Western hemispheres; but the more important endemic centres are within somewhat narrow limits. It is to be found in or near the tropics; but, for the reason that the contagium can be carried great distances by human beings, it is at times seen in remote districts, and it seems to be becoming more and more distributed each year.

JAPAN.

Japan is one of the chief centres of beri-beri, where it is widely distributed over all its islands, but chiefly in the main island, Hondo, and especially in large, low-lying, damp, over-crowded, cities. The marked dissemination of beri-beri in Japan appears to date from the middle of the eighteenth century, prior to which it was mentioned in the reports as a very rare disease. According to Scheube the greater epidemics commenced in 1740, and were localised at first in the capitals Tokyo and Kioto, spreading then to numerous cities in the interior and on the coast. In Kioto, with a population of 229,000, the morbidity was 2273 from

1875 to 1879, and 1093 in 1878. In 1877 there were 2687 cases in the Japanese army of a total strength of 19,600 men (14 per cent.). According to Scheube, 38 per cent.(13,629 cases among 36,000 soldiers) were attacked in 1878. Yokohama and Osaka are now the two chief centres of beri-beri in Japan, where it is said to be endemic from Kodato in the north as far as Nagasaki in the south, and all along the western coast.

CHINA.

From the statistical returns of the disease in China it would appear that beri-beri, formerly so prevalent disappeared in the eighteenth century; but we know this not to be the case; for, although it is by no means so frequent in China as in Japan, it exists for all that, and, according to Manson, has been observed in Shanghai, Soochow, Wenchow, Foochow, Formosa, Amoy, Swatow, Fatshan, and Hongkong, where , in 1888-1889, an extensive epidemic raged; Another outbreak occurred in the last named island in 1899, and destroyed no less than 197 of the Chinese inhabitants, the highest mortality being in the months of October, November, and December. The year 1895 appears to have been marked by an epidemic of extraordinary severity in Swatow. Lynch,(China Med.Rep.,1894) mentions beri-beri breaks out every summer in Chinkiang, and with marked regularity. It follows, therefore, that the disease is no stranger to China: further, the Chinese seem special-

ly predisposed to it, for the Calcutta physicians state that the malady in their city is mainly confined to the Chinese population.

KOREA.

Beri-beri appears to prevail chiefly in the southern districts of Corea, when it visits that country at rare intervals.

FURTHER INDIA.

Beri-beri is endemic in Burmah and Siam, and ever since the outbreak among the British troops in 1824; also at Singapore, where, according to Russell, 1174 cases of the disease were reported among the goal population from May, 1875, to May 1880. It has been seen in Penang, and on the islands of the coast of Cochin China, particularly Pulo-Condor, and in Annam and Tongking. As it is not mentioned by recent Siamese writers the disease must be rarely seen in their country. But, in 1892, the goal population of Bangkok suffered severely from it and presented a high mortality. It occurs sporadically in Annam and Tongking, rarely as small epidemics.

MALAY ARCHIPELAGO.

Beri-beri is one of the commonest of diseases in the Malay Peninsula and the adjoining archipelago. Its prevalence from year to year exhibits considerable variation, and its endemic quantity in some years is strikingly great. It probably never entirely disappears

On the many islands of the archipelago the disease is widely spread, but it appears periodically in epidemic form, as in Sumatra where the Dutch troops suffered from it severely during the war in Acheen. In the Straits Settlements a severe outbreak prevailed in 1895 In 1896 the hospitals in the Settlements contained 2057 patients suffering from beri-beri; in 1897, 2058; but only 1329 in 1898. In the latter year a severe epidemic occurred among the prisoners of Singapore, which had contained no cases of beri-beri from 1885 to 1897, and only two cases during the previous thirteen years and two or three at the end of 1897: in 1898 there were no less than 124 cases.

From the Lampong districts and in the plantations of the East Coast of Sumatra, beri-beri is never absent; & the same may be said for the islands of Bintang, Banca, and Billiton. It is undoubtedly common on the coast of Sambas in Borneo, Sampit, and Bandjermassing, while it is more or less endemic in the interior at the mines of Sintang and on the island of Labuan. The disease has been introduced to Java within the last thirty or forty years, and it is now a much dreaded disease at Batavia, on the island of Onrusl, and in the district of Banjuwangi. It appears to be quite common in the Celebes, more especially in the Macassar district; in the Moluccas, especially in Amboina, Saparna, Banda, on the

southern coast of Ceram, and in New Guinea. Beri-beri seems here much less prevalent than formerly.

AFRICA.

On the African Continent beri-beri appears to be less common than in Brazil or south-eastern Asia, and to prevail in districts widely separated from one another. Nevertheless, it seems to be on the increase in African territory. Thus it has recently been seen at the following places:- In Natal at Pietermaritzburg; in West Africa on the Tanga Coast; in East Africa, according to Manson, at Zanzibar; at Senegal, Gorée, Sierra Leone, Belgian Congo(especially amongst the natives), Togo, Niger, Soudan, Cameroon, Gaboon, Loango, and Angola. Formerly the disease was known only at three places, viz., at Mauritius, where it was epidemic among the British troops; in Réunion, where it prevailed epidemically in 1805, 1821, 1838, and 1847; and on the island of Noissi-Bé, off the north-west coast of Madagascar. Beri-beri is, however, said to have been epidemic in Madagascar itself in 1866-67, at one of its northern villages - Diego Suarez. A peculiar malady of a dropsical character, attended with considerable anaemia was reported as prevalent in Mauritius in 1878 and 1879;and is said to have been imported from Assam and Lower Bengal where the same kind of malady happened to be then epidemic. It should be noted, however that it differed from beri-beri in the absence of paralysis, by its

marked infectivity, great morbidity, and low proportion -ate mortality.

ST. HELENA.

Beri-beri is certainly no stranger to this island, where 13 cases were seen in 1897 and 8 in 1898 - in the latter year there being one death.

ASCENSION.

This island was a scene of a wide-spread epidemic in 1898; prior to which it had probably existed, as this outbreak is spoken of as a "recrudescence". (Rep. on the Royal Navy for 1898).

AMERICA.

BRAZIL.

In Brazil, which appears now to be a considerable centre of the disease, beri-beri was first recognised as such by Patterson, an English physician, in 1866. It appears, however, to have prevailed in the city of Bahia in 1863; after which date the disease, which at first escaped diagnosis, aquired a remarkable epidemic expansion, awakening general attention and calling forth several works on its manifestations. Some of these state that beri-beri was seen in Brazil before 1863, but was not recognised; and existed epidemically in Marianna and Diamantia(state of Minas), from 1858 to 1873. Be that as it may, beri-beri was carried from Bahia to several cities on the northern coast of Brazil as fare as Pará, developing at first epidemically and

afterwards assuming a truly endemic character. It broke out in Espirito Sancto, Rio de Janeiro, San Paulo, Parano, and Santa Catherina. Limited at first to the coast towns, it afterwards spread in the interior, developing in Alto Amazons, in places very remote from the coast, in the interior of the states of Bahia, Rio de Janeiro, San Paulo, Minas, and Matto Grosso; During the war between Brazil and Paraguay, beri-beri, carried by recruits from Bahia, developed epidemically among the Brazilian troops encamped at Curuzú and Humaytá. In Brazil the area of the prevalence of beri-beri begins in Alto Amazonas and extends all along the coast of the Atlantic as far as Rio de Janeiro; the accidental beriberic zone spreads from Rio de Janeiro to Santa Catherina and embraces the interior of the central and northern states,with the exception of Amazonas, Pará, and Maranhâo, which belongs to the first area.

FRENCH ANTILLES.

Occasional cases are seen among the negros and Chinese here, the disease being termed "maladie des sucreries". It was prevalent on Gaudeloupe in 1859 among negroes imported from the Congo.

Beri-beri has also been observed in Cuba, especially in 1873, when it was extremely fatal to the negroes at Palmira, the cases of mortality being from 60 to 75 per cent.

The disease seems to have been unknown in Cayenne,

before 1865 when it prevailed epidemically among the imported coolies, and among them again twelve years later, but absent meanwhile.

In Jamaica and Trinidad beri-beri has been very rarely seen: at no time has it obtained a firm footing there.

SOUTH AMERICA.

So far as the writer has learnt, beri-beri is unknown in the South American countries bordering on the Pacific.

NORTH AMERICA.

Beri-beri is said sometimes to occur amongst the fishermen on the North American coast - at least a peculiar form of peripheral neuritis bearing a close resemblance to it.

BERI-BERI AND IMPORTATION.

It is by no means uncommon to find beri-beri among persons who have arrived from foreign parts; but it usually remains confined to them and shows no tendency to spread. Thus there are often cases of it in the Greenwich Seamen's Hospital removed either from the ships as they arrive in the Thames, or from the Asiatic vessels which have lain up the river for a few months, the disease developing meanwhile. That the disease can be carried thousands of miles by sea we know to be a fact:

indeed, it is its main method of transmission. No surprise, therefore, need be entertained at its occasional appearance at our ports, brought there by ships arriving from the tropics.

Thus, the disease broke out in Dublin in 1894(the epidemic comprising 174 cases - 127 males and 47 females) & continued to rage until the end of November, with a mortalaty of 14.3 per cent. that is to say the deaths were 18 and 7 among males and females respectively. The epidemic is said to have been of a severe character, the most troublesome symptoms being those of paralysis,cardiac disorder, and anasarca.

After the lapse of a year, the disease broke out in July 1896 and prevailed until the next year; in all 114 persons were attacked(31 males,83 females), of whom 2 men and 6 women died, giving a mortality of 7 per cent. This epedemic was, however, of a much milder character than the foregoing.

In 1897, beri-beri showed a marked increase: no less than 246 (47 males and 199 females) being attacked, but on the whole it was of an even milder nature than the 1896 epidemic and presented a mortality of only 4.4 per cent.(3 males,8 females).

Only a few mild cases occurred in 1898. A few relapses were under treatment from the previous year.

Besides these cases in the Dublin (Richmond) Asylum,

there were others seen at the same time , in institutions for the insane, etc, in both England and America, and elsewhere; in every instance their importation by ships was either clearly established, or resonably suspected.

The epidemic at the Singapore goal has already been referred to; and to it may be added that of the Rajahmandry goal, Madras, in 1898 (Vide Report on Sanitary Measures in India in 1898-99, p.21. Parliamentary Paper, Cd. 397).

Amongst epidemics at lunatic asylums, besides that of Dublin, may be mentioned that which visited the Suffolk County Asylum at Nelton in 1894-5, and 1896-7; the Arkansas State Asylum at Little Rock, Arkansas State in 1895; and small outbreaks in certain French and German asylums about the same time (vide, Conolly Norman: B.M.J., Sep. 24, 1898).

E T I O L O G Y .

Despite the great attention that has been given to the subject, the etiology of beri-beri has not yet been established with the requisite accuracy, and several obscure points await a satisfactory solution. On the other hand, the most conflicting opinions, many of which are nothing less than extravagant, have been propounded by writers upon the subject, and too much importance has been given to certain etiological factors

at the expense of others, all of which contributes to the already existing confusion in the minds of those seeking for a solution of the problem. A close criticism of the of the opinions held, and of the data furnished by observation in the several localities where the disease has been seen, is an indispensable condition for a proper comprehension of the subject. The best method to follow in the attainment of this end would be a minute study,as complete as possible, of the conditions that attend the commencement, devolopment, & permanency or disappearance of beri-beri in prisons, colleges, asylums, hospitals, barracks, famine dis - tricts, urban civil populations armies, and ships.To do full justice to such a vast subject is obviously impossible in an article of the nature of an essay,- volumes might be written upon it,- so that the writer must content himself by devoting his main efforts to the statement of certain indudible facts, such as: The specificity of the disease; its transmissibility, and its infectious character. Other less important points will receive attention in their proper place.

BERI-BERI AS A DISEASE OF TEMPERATE CLIMATES.

The evident concern of writers in the medical and lay press during recent years at the occasional occurrence of beri-beri in this country, justifies the advisabil-

ity of determining as to whether beri-beri promises to swell the already lengthy catalogue of infectious diseases in this and other temperate climes.

Beri-beri was at one time regarded as occurring endemically and epidemically in eastern tropical countries only; but as the limits of its prevalence during recent years appears to be constantly widening, the older idea that it was essentially a tropical disease no longer holds. Viewing the geographical distribution of the malady one observes that it has become endemic or epidemic in many subtropical regions, and to occur more indefinitely in some temperate and even cold regions (Scheube: Diseases of Warm Climates; Clemon: Geographical Pathology; Davidson: Diseases of Warm Climates).

In the course of this essay it will be necessary to determine whether the clinical phenomena of beri-beri as it exists in "new" countries are identical with those obtaining in "old" countries. This has been denied in some instances(e.g.,the Dutch physicians' report on the Richmond Asylum outbreak),but the writer believes that the evidence of the conditions being similar is overwhelming. Among useful references in this connection are:(1) the article by Norman in the Journal of Mental Science (XLV, p.503), on Beri-beri in Asylums, in the course of which he points out that the kak-ke of Japan and the Brazilian disease were for a considerable period

not recognised as identical with the beri-beri of Ceylon and China; (2) an article by the same writer in the Transactions of the Royal Acedemy of Medicine in Ireland(1899), describing the clinical features of beri-beri as seen in Dublin; (3) the reports of the Dutch physicians regarding the Richmond Asylum epidemic - pub-lished in the Dublin Journal of Mental Science, 1900.

One may next enquire WHY IS THE DISEASE SPREADING? Is it due to mechanical transmission of the disease through human intercourse with the increase of commerce? This would appear to be so in many cases, e.g., Java,Brazil, Sumatra, Penang, Tonquin, etc. Or has it for some unexplained reason, as in the case of cholera, left its normal habitation and settled in distant lands? From recent evidence as to the nature of the disease and the circumstances of its occurrence in various places, the writer thinks it can be said with some certainty that the former is the factor concerned.

The writer maintains that beri-beri is a PLACE DISEASE, the virus of which has been conveyed to various countries through the increase of commerce, and that an occasional outbreak or a permanent settling of the malady in such countries depends chiefly on the presence of certain predisposing factors. The latter will be found to be overcrowding, defects, or absence, of sanitation, and so forth. Race susceptibility and habits of life

are of some importance. The influence of soil is, at best, doubtful. It is remarkable that temperate equally with tropical and subtropical regions have been exposed to risk of invasion, whereas the disease has occurred occasionally in temperate regions, and has become fixedly endemic and epidemic in many subtropical & tropical regions.

The writer believes that careful examination of the various countries affected and the conditions of occurrence will reveal the fact that beri-beri has not and never will be a fixed disease of temperate climates, and for several reasons, thus: (a) the sanitary advances of the highly civilised countries which are mostly situated within the temperate latitudes; (b) the absence of climatic conditions which in the subtropical an tropical regions would seem to enhance the effects of even the less aggravating predisposing conditions.

The outbreak at the Richmond Asylum affords some idea of what has to be expected in temperate climates - viz, local relapses from time to time, but no extension of the disease to surrounding areas.

In spite of the numerous infected ships which have arrived at ports in this country, practically no instance of the disease having spread can be found. The Richmond Asylum outbreak is evidence, however, of the possibility of outbreaks if artificial conditions exist

favourable to an outbreak of the disease. Beri-beri does not originate spontaneously in any place; it can be acquired only in localities where it habitually exists, and is observed only in persons who live in these places or who have visited them. When it appears in a locality hitherto immune, it is because of the arrival of some beri-beri patient or because objects from a beri-beri centre have been brought there. When it attacks the inmates of a prison, asylum, college, etc., who have hitherto enjoyed immunity, without there being any change of climate, or diet, or manifest alteration in the condition of life, it is because the specific agent of beri-beri, its determining cause carried from a place where the disease already existed, has entered this building. When it breaks out among the crew of a vessel, it is because that vessel, having taken on board patients or infected materials.

The writer contends, therefore, that beri-beri cannot be referred to meteoric influences, nor yet to a defect-ive diet, as has often been stated; nor does he regard it as a clinical form of malaria, as was formerly held by Chinese and Japanese physicians, and as many Brazilian writers at first maintained. These opinions concerning the etiology of beri-beri are now almost entire-ly abandoned, and are, therefore, of historical interest only. The same, perhaps, may be said of the opin-

ion according to which beri-beri is a consequence of worms. It originated with James Walker, of Longside, who presented to the Congress of Budapest a report comprising 887 subjects of beri-beri examined at Sandakow (British North Borneo) from the point of view of the presence of intestinal parasites. Duodenal ankylostoma was found in 756 cases; tricocepholus in 284 cases; ascaris lumbricoides in 155; oxyuris vermicularis in 123; distoma in 2; and various other parasites in 24. The ankylostoma was chiefly blamed as the ultimate cause of the disease. A certain coincidence of geographical dis-tribution, and the frequency with which this parasite has been found in beri-beric patients in various localities, in some measure appeared to support that opinion. The geographical distribution, however, is not precisely the same as has been vaguely asserted; in many places where ankylostomiasis is found, beri-beri is not met with, and vice-versa. The dochmius ankylostomum has been found in several countries of Europe and Africa, as Italy, Switzerland, France, Germany, Egypt, Algiers, etc., where beri-beri does not occur. Ankylostomiasis is a very frequent disease in the country, in villages and small towns in the interior. The contrary happens with beri-beri. In Rio de Janeiro, ankylostomiasis, formerly frequent, is now observed almost exclusively in persons coming from the interior, or from the sub-

urbs. Beri-beri, on the contrary, known in Rio de Janeiro before 1886, has since that time become more and more prevalent in the city. Further, the symptomalology and pathogenesis of the two affections is vastly dis-similar, showing their independence of the same causative agent.

That beri-beri is not necessarily a tropical disease is pointed out by Dr F.Grimm(Klin.Beobacht.ueber Beri-beri Berlin,1897, p.117), who states that thousands of cases are recorded in Yezo, the most northern of the large Japanese islands, having a winter of six to seven months. He attributes the possibility of pursuing his studies of beri-beri to the interruptions of the epidemics of this disease in hard winters, by periods of settled equable weather, with deep snow, and a temperature of 15°C below 0°. In the Kurile Islands, where hardy cerials scarcely ripen, the fishermen suffer from epidemics, which may follow a very devastating course. Beri-beri, he adds, is likewise found in North China, which is not at all tropical; and that a case of beri-beri observed by him in Berlin in 1895 strengthens the idea that the disease is only incidentally more frequent in warm regions, and that there is also an assumption in favour of its being spread in temperate and cold regions.

Dr Grimm - writing under date 21st July,1898, in Deut-

sche medicinische Wochenschrift,Berlin - remarks that;- (1) Beri-beri is most feared and most common in Indian, Malayan, and East Asiatic countries; also in South America, and has been carried by the Chinese into Australia; (2) it is not due to tropical climate; (3) it occurs in the Kuriles where there is a short summer not sufficient for corn crops; (4) it is common in Yeso where the climate is at times very raw; the mystery of the disease is partly due to the fact that most observers have paid so scant attention, or none at all, to the moment of its development, and, therefore, the same cardinal appearances often find entirely contradictory explanations; (5) clearness of description is further harmed by neglecting the possibility of repeated infection by the beri-beri poison in the course of the disease, for beri-beri does not make its patient immune; (6) most of his malarial patients from outside came from villages free from beri-beri ,and many of his beri-beri sufferers came from parts where malaria was unusual - a beri-beri patient contracting malaria suffered no complications, no two diseases could be less a - like; (7) recent English reports from India give as causes of the illness: emotional feelings, lack of nitrogenous matter in their food, infection and intoxications, and even astronomical happenings - the aspect of the disease is, therefore, not a recognised matter of

common knowledge; (8) Europeans who have European cooking in Japan never contract the disease; (9) the Japanese navy was cleansed of beri-beri by the introduction of European diet; (10) Some suspected the poison of beri-beri to be connected with marine animals and doubt whether thoroughly cooking removes or destroys the virus; (11) there is no proof that any immunity exists for differences in race or position in life: only young children are immune which is the more astonishing as it is the youthful of grownups who are most liable to the disease.

DR de Schuttlaer(Arch de méd.militaire,1901, p.470) investigated an epidemic of beri-beri which occurred in 1900, and found himself convinced of the alimentary origin of the disease from the fact that the epidemic was put an end to by the complete elimination of rice from the diet: only the Chinese labourers who continued to use it were attacked by the malady.

Soon after this H.A.Littlefield, U.S.V., reported to the War Department that there were several cases of beri-beri in the military prison of Lingayen, Pangasinan, where the sanitary arrangements were perfect;whereas in the civil prison, about a quarter of a mile distant, where the sanitation was faulty, there was complete absence of the disease. It appeared that the only difference in food was in the rice, the civil prison

being supplied with native rice and the military prison with Chinese, white, decorticated rice. The use of the latter was discontinued in February 1902, with the result that forthwith no new cases developed, and no deaths occurred among those sick - a striking contrast to the previous morbidity of twelve a month and a mortality of five during each month (50 per cent.)

Sir Patrick Manson's Investigations.

At the Section of Tropical Medicine of the British Medical Association,1902 meeting, Manson explained fully his theory of the causative agent of beri-beri. In a preamble he points out that peripheral neuritis is a symptom - rather than a disease - of alcoholism, ptomaine poisoning, metallic poisoning, etc., and suggests that in many districts it must often happen that such cases are regarded as beri-beri (the Chinese frequently use arsenic in the arts, in agriculture, and very often in tobacco), thus explaining some of the various theories as to the cause of beri-beri, as, for instance that it is due to arsenical poisoning.

Manson's Theory: That beri-beri is a distinctive form of neuritis produced by a toxin, the product of a germ operating in some culture medium located outside the human body. Taking this step by step :-

(a) The immediate cause of beri-beri is a toxin: the analogy of most forms of peripheral neuritis favours this view. Removal of the patient from the place

in which he sickened is followed by recovery if the dis-ease is not too far advanced. Such a fact proves that the disease is not an infection by a bacterium or other germ proliferating in the tissues.

(b) The toxin of beri-beri is produced by a living organism. The proof of this lies in the fact that the disease can be introduced into virgin country and there spread, that is to say, the hypothetical cause ic capable of being transported and of multiplying. Spontaneous multiplication is a property peculiar to living things; therefore, the causative agent of the toxin of beri-beri is a living thing; in short, a germ. Manson here quotes two well-known instances of the introduction of beri-beri into virgin "soil", viz., by the Japanese into Fiji, by the Annamites into New Caledonia, and into Diego Garcia.

(c) The toxin-producing germ operates in some culture medium outside the human body. Given that beri-beri is produced by a toxin and that no germ has been discovered in the bodies of beri-berics, it follows that the culture medium also must be outside the human body. Manson now refers to the analogy of the yeast plant - alcohol - alcoholic neuritis. The yeast plant protiferates in a saccharine solution, but one may swallow the germ - the yeast plant - with impunity, and one may swallow the culture medium,- the saccharine solution,- but the product of the operation of the germ on the

culture medium - alcohol - the toxin produced outside the human body is a poison.

(d) The toxin does not enter the human body in food. Manson arrived at this conclusion long ago but only by a process of exclusion and on epidemiological grounds, and on experimental proofs furnished by Travers in connection with the 1895 outbreak in Kuala Lumpor.

(e) It is not conveyed in drinking water. Manson finds no difficulty in proving this by comparing two institutions adjoining each other, as for example the male and female prisons in Singapore, with identical piped water supplies; one, the male, is attacked with beri-beri, the other, the female, is exempt.

As both a predisposing and an exciting cause, defective diet for long was given great prominence. Amongst many Le Roy de Mericourt, Overbeeck de Meyer, and J.Rochard maintained that beri-beri was due to deficient and bad food. The same view is also held in Japan. Dr Kanahiro Takaki - at one time director-general of the Tokyo Naval Hospital, attributes the disease solely to errors in diet believing the cause to be an improper proportion of carbon and nitrogen in the dietary, which instead of being as 1 N to 15 C, he found invariably in all outbreaks he enquired into in civil life, in the army, in in goals, and in the navy, to be as 1 N to 22 C. This excess of carbon so alters the composition of the blood

as to induce or cause beri-beri, and so sure is he that his opinion is correct that he affirms that given hundred healthy individuals, he could by diet alone produce beri-beri in them in six months, or given a hundred recovered patients, he could prevent a relapse by diet alone. Dr C.Aoki also, attributes beri-beri to errors in diet, consisting of an excess of carbon. Acting according to these ideas the Japanese Government modified the rations of seamen in 1884, and after that date beri-beri, which had caused enormous ravages every year in the imperial navy disappeared almost entirely. In 1883, with an effective force of 5,349 seamen, there were 1,236 cases of beri-beri; in 1886, with an effective force of 8,475 seamen there were only three cases. It should, however, be remembered that when the Japanese Government modified the food of the sailors it improved at the same time the ventilation of the vessels, rendering them drier and cleaner, and instituted other hygienic improvements. As early as 1878, Van Leent and Gayet had found that improvement in the rations of the natives in prisons and board ships, either alone or combined with other hygienic measures, was sufficient to reduce greatly the proportion of patients in prisons and to stop the epidemics on board of ships. Notwithstanding these facts, which contribute to strengthen still more the opinion of the Japanese physicians, beri-beri cannot be admitted to be an intoxication of ali-

mentary origin, caused by nitrogen starvation. The Brazilian observers demonstrated that beri-beri attacks indifferently rich and poor, well-fed persons enjoying every comfort, as well as those who are subject to all sorts of privations. When beri-beri develops in a civil population it even shows a certain predilection for the higher classes of society. Brazilian sailors all receive equal rations of food; nevertheless beri-beri develops among the crews of some ships while it spares others, and the same may be said with regard to the Brazilian army. These facts should serve to disprove the theory of the alimentary origin of the disease.

METEOROLOGICAL CONDITIONS.

Apart from the influence of high temperature and moisture in favouring the multiplication of organisms, obviously meteorological conditions have no direct bear-ing on the production of beri-beri. These cannot be transplanted and are not so capricious and limited in details of their distribution as is beri-beri. The latter, which is manifestly a disease of the seasons in Japan and in all the subtropical zone, developing all the year but with summer and autumn paroxysms in localities lying between the tropics, appear, however, to be influenced at its outset to meteorological conditions. Little is positively known as to the manner in which these act, nor is it known which of the meteorological

elements exercise the greatest influence. It appears reasonable to suppose that humidity and high temperature are necessary for the disease to break out, as these two conditions are observed in all beri-beri cent-res. The following fact likewise confirms the etiological influence of heat and damp; in Brazil in localities lying very far from the coast and at a great altitude, and which, notwithstanding their situation between the tropics, have a relatively low mean annual temperature and well-marked seasons, beri-beri acquires a periodical character, the first cases appearing at the end of the summer, which is the time of the great heat and wet weather, disappearing in winter and spring.

QUESTION OF INFECTIVITY.

The infectivity of beri-beri would seem to be demonstrated by numerous and evident facts. Hardly anyone now entertains doubt regarding this important point. The same cannot be said, however, in relation to direct contagion, which is denied by all writers. It is very difficult, if not impossible to satisfactorily determine this question, not only because the period of incubation of the disease is relatively long, but also because the necessity of repeated introductions of germs in the system, in order that the disease shall develop and progress, seems demonstrated. Pekelharing and Winkler made two experiments on monkeys with negative re-

sults: in one they injected 25 c.c. of defibrinated blood taken from a beri-beric suffering with dyspnoea; in the other they introduced under the skin of the thigh a piece of the popliteal nerve taken from a beri-beric who had died a few hours before. It may be objected in this case that the disease did not develop in these animals for the reason that there was only one introduction of germs, in the same manner that it does not develop when one single inoculation of micrococcus is made into a laboratory animal.

Certain writers have stated against the direct contagion of beri-beri that the disease does not spread in hospitals among other patients, when cases of beri-beri are admitted, that it does not attack nurses, visitors, and members of the same family, and that it has not yet been observed in persons visiting localities where it prevails, unless they remain there for some time. As to visitors, that is persons who have been in transit at the infected places or who have approached a patient, it may be objected that the disease develops only after successive introductions of germs in the system. Nevertheless instances of the transmission of beri-beri to other patients in hospitals are not so rare and exceptional as has been affirmed. Grall, Porée, and Vincent (Beri-beri in New Caledonia: Arch.de Méd.Nav., 1894) state that in a patient affected with chronic gastritis under treatment in a hospital where there had been beri-beri

patients, the first symptoms of the disease appeared at the end of six weeks. Facts of this nature have often been demonstrated in Brazil. Thús, in Rio de Janeiro, the first persons who contracted beri-beri in the city were sailors and soldiers who had been in the military hospitals, where persons having come from the north of Brazil affected with beri-beri were under treatment. Instances of the development of beri-beri in goals, asylums, hospitals, barracks, ships, schools, etc, after the admission of contaminated persons are sufficiently numerous and well known to render useless any further citation. Dr Hagen (Rev.Méd.de l' Est,1896) relates several facts tending to demonstrate the evident contagion of beri-beri imported by a shipload of Indo-Chinese prisoners into New Caledonia,which until the arrival of the ship "Cheribon", in 1891, has always been immune. These cases, as well as those already referred to, are not of a nature to demonstrate the direct contagion of beri-beri, since a centre of infection may have been constituted by the introduction of the germ of the disease in the country by means of the patient's clothing.

Besides this, it is necessary to note other facts, as the permanence often observed of the disease in a collective dwelling, notwithstanding the removal of patients and rigorous disinfection. Beri-beri developed in Rio de Janeiro in the Blind Asylum, which is a new

building of excellent construction, with large and well ventilated accomodations, having all hygienic improvements, and with a capacity for ten times the number of inmates that it possesses. The director of the establishment - a physician of renown - used every effort to stamp out the epidemic; he improved the food, ordered all the patients to be withdrawn from the building, and had it thoroughly disinfected, but in spite of all this the disease continued, the director himself and members of his family falling ill of it. In 1893 the Brazilian Government appointed a committee of physicians to study the causes that determined the permanence of beri-beri in this institution and means of removing it. The committee recognised that the general hygienic conditions of the building were the best possible, that there was no excess of inmates, that the water could not be suspected of contamination, since it came direct from the pipes destined for the supply of the city; that the food was good; that irreproachable cleanliness prevailed in all the building and its dependencies; they proposed the withdrawal of all the patients, and advised a rigorous disinfection, according to modern methods, of clothes and other objects, and of the walls, floors, doors, etc., of the whole building and its dependencies. Notwithstanding the withdrawal of the patients and the disinfection, the disease continued to be observed, and almost exclusively limited to the female wards. It is

possible that some inmate, in whom the disease was in a state of incubation may have given the disease to others during his subsequent illness.

During the long voyage of the Brazilian cruiser "Benjamin Constant"- a new vessel of the most modern construction and completeness of sanitation - from Rio de Janeiro, along the southern coast of Brazil, and then north to her station at Pará, no case of beri-beri was observed. On leaving Pará, where the ship had been anchored about 30 days, and where beri-beri is endemic, the disease broke out on board and attacked more than 50 seamen one after the other. On arriving at Bahia the commander put all the patients ashore, and ordered a strict disinfection of the vessel; in spite of this, the disease continued to be observed, but on a smaller scale; from Bahia the vessel went to the Lazareto of Ilha Grande where the disease did not cease entirely in spite of a full and complete disinfection.

Beri-beri, on the other hand, after its epidemic paroxysm, often disappears from a place never to return, and this without any hygienic measures whatever being put into practice. This seems to show that the germ producing the disease did not find in the locality conditions so favourable as existed in endemic centres, unless one admits the possibility of its having lost its virulence and living there as a common saprophyte. In

the colleges of Caraca and Mariana, in the city of Diamantia, in the states of Santa Catherina and Paraná, in the city of São Paulo, and elsewhere, beri-beri,- without the employment of preventive measures,- after having developed epidemically, has disappeared and has never returned. Many Brazilian physicians have been attacked by beri-beri and died of it: Manson, however, says he has never heard of a medical man contracting the malady. The writer by no means affirms that the above facts prove direct contagion; that the same is very difficult, if not impossible to establish he has already stated. Evidently beri-beri is not a contagious disease in the same sense as syphilis, rabies, and variola and the acute exanthemata. True parasites, such as the germs of these diseases, are not accomodated to other surroundings and can complete the various stages of their existence only within the human body. Nor can beri-beri be compared to malaria, as has been done so often; Lavernan's haematozoon cannot live or multiply in the interior of houses, in floors or walls; it does not adhere to objects in daily use, to clothes, or to the human body, so as to be carried to immune places & there determine the eruption of the disease. A better and more substantial analogy seems to exist between beri-beri and the so-called infectio-contagious disease such as typhoid fever, yellow fever, dysentery, pneu-

monia, etc., which, having their origin usually in infection and only developing in individuals who frequent contaminated places, may under certain circumstances be propagated by contagion. In these diseases contagion is a contingent property, subordinated in its manifestations to variations in the energy of the virus and in the predisposition of the individual. That is why they are, like beri-beri, strongly influenced in their endemic character and in their epidemic expansion by atmospheric vicissitudes, by climate, by crowding, by improper food, and by other causes that weaken the system.

As regards the important question of transmissibility, either by infection of the soil, contamination of the air, water, or milk, or by indirect or direct contagion, the fact appears established that beri-beri is a transmissible disease, and is considered as such by the governments of Brazil, Uruguay, and the Argentine Republic, and in the sanitary regulations of this last country it is classed as a notifiable disease with cholera, etc.

So far no certain opinion has been formed regarding the beri-beri-producing germs, the circumstances that facilitate or render difficult its multiplication outside of the system, and the manner in which it enters the human body. Our knowledge is yat too rudimentary for that; but everything leads us to believe, however, that it lives in the soil and in the interior of

dwellings, being carried from one place to the other by the atmosphere. Observations made in several localities show that the poison of beri-beri is not introduced in the human body by food or water. The influence of soil on the constitution of endemic centres is prepondérant, since we see beri-beri fix itself with remarkable predilection in certain places, but disappear spontaneously from other subject to the same conditions of climate. We do not know what are the elements indispensable for the soil in order that it may constitute a ground favourable to the life and multiplication of the beri-beri germ. It has been held that it prefers swampy and damp lands, the neighbourhood of the sea-coast and the shores of rivers. Nothing is less true; for beri-beri has been seen in places where the soil is of a constitution and nature the most varied possible. In Brazil, for example, it is frequent on the shores of the rivers in the state of Amazones, and in the sea - coast towns; but it is likewise endemic in the cities in the western part of the state of São Paulo, many miles from the coast; and it has been observed in many places that are free of malaria and the soil of which, being of a volconic nature, is not apt to constitute a ground favourable to the development of malarial fevers. It is possible that the contamination of the soil by animal matters favours the life and multiplication of

the germs. It is very probable that this contamimation renders the soil and surroundings of prisons, colleges, etc., exceedingly liable to beri-beri inoculation. Impure air, determined by overcrowding in confined places must likewise favour the development of beri-beri, and, when once developed, contribute to its rapid spread.The mephitism of the soil only renders itself and surroundings favourable to the multiplication of the specific germs, but it cannot, however, of itself generate beri-beri.

Beri-beri in the Boer Camp at St. Helena.

Dr.W.A.Wheeler, Civil Surgeon in Charge of the Boer Camp in St.Helena describes (B.M.Jour.,Oct.18,1902 p.1258) his experiences of this disease which occurred among the Boers there, and he believes the facts to fully agree with Manson's theory as to the production of the malady by place infection.

It appears that from a few isolated cases in the camp the disease became epidemic (May,1902). Alcohol & rice as causes could be disregarded. Arsenic was not present in the drinking water, and if it had been present in the tinned foods the home troops would have suffered equally.

The following facts favoured the theory of place infection, resulting in the development of a toxin outside the body: The Boers had been confined to one camp

for two years; they led an inactive life, and were dirt-y in their habits. Conditions such as these, in conjunction with fouled ground would naturally bring about a state of affairs favourable to the production of a toxin. The mosquito could be eliminated owing to the high altitude. Place infection was further supported by the fact that removal of the patients to another site was followed by rapid improvement. The diet could not be the cause as it was identical with that of the home troops.

Travers's Observations.

These investigations made regarding an outbreak of beri-beri at Kuala Lumpor in 1895(Jour.Trop.Med.,1902,V 231), referred to by Manson in his address to the Section of Tropical Diseases at the Seventeenth of the British Medical Association,1902, though of a negative character, are suggestive (1) of a place infection, and (2) of the toxin not entering the body in the food.

It appears that in 1895 the prisoners were transferred to a new goal, and a few months after beri-beri broke out, all cases of the disease being then retransferred to the old goal. Immediately the case mortality began to fall. (In view of this it would seem that the cause of beri-beri could not be a germ living and multiplying in the body of the patient; for, if it were such the patient when he left the endemic spot would still

carry the germ with him, and the disease it produces would continue until immunity had been acquired. Analogous to this is the subsidence of alcoholic neuritis on withdrawal of the exciting agent). Later the removal of all the prisoners to the old goal was tried and no beri-beri occurred among them.

The report states that both goals (and several other collective buildings) were supplied with the same rice and other food, but no beri-beri occurred elsewhere than in the old goal. One fact in particular showed that the pathogenic nidus in the new goal was not in the food supply - viz., the healthy prisoners removed to the old goal were fed on rice cooked at the new goal in the same vessels and at the same time as that for the new goal inmates, that for the inmates of the old goal being conveyed there twice daily in a handcart. This disproves also any opinion of the rice being infected when it reached the new goal, for in such an event the prisoners removed to the old goal would have taken the disease.

Pekelharing and Winkler do not think that a toxin is the immediate cause but that there is an infection by a bacterium. They explain the improvement on removal from an endemic area on the hypothesis of the repeated introduction of the bacterium in the body.

Arthur Stanley (Jour.Trop.Med.,1902,II,p.369) reports a

series of experiments dealing with a search for a germ in the blood of beri-berics, but with negative results. From observations among the Chinese prisoners in Shanghai he concluded that "inasmuch as apart from rice, the food supplies of four prisoners were from different sources and a change of rice for all the prisons to one of recognised good quality produced no well-marked effect on the prevalence of the disease in two months, food infection would appear not to be a factor in the cause".

Beri-beri at Diégo Garcia.

Bolton (Jour.Trop.Med.,1902,V,248) conclusions from a study of this epidemic point to a germ being concerned in the cause of beri-beri, and, moreover,here differing from Manson,- that there is a germ-infection of the body.

Some Johannese landed from Mauritius at Diégo Garcia and some of them showed characteristic symptoms of beri-beri. Some months after, some of the residents fell sick of it: they had intermingled with the Johannese. Food supply could not be blamed, for the rice had been in store before the arrival of the Johanna men and was used before, during, and after their stay without untoward effect. Bolton thought that the history of the epidemic showed "that the germ of the disease, vegetable or animal, may remain latent in the human body

for months, until local conditions favourable to its development obtain. It then proliferates and gives rise to characteristic symptoms. The Johannese were loathsome in habit and had been lodged between docks; so that coming from one of the Comores Islands the germs were probably latent in them; conditions on board favoured development and they landed with a mild form of the disease. It would appear also that these men were the culture media on which successive crops of germs were produced and thus kept up the infection of the soil or air. The disease disappeared with the departure of these men".

Manson points out that Bolton does not explain satisfactorily why it ceased to spread, or why the islanders did not acquire infective properties, and thinks, moreover, that two important facts were: (1) The Johannese and their filth were departed; and (2) their huts burnt down. Three weeks after this, the epidemic, which seemed to be gaining strength, abruptly ceased. Manson thinks that this epidemic distinctly proves that the toxin of beri-beri can multiply and, therefore, that the generation of the toxin must be a living organism - a germ.

H.Lace (Arch.f.schiff.- und Trop.Hyg.,July,1902;B.M.J. Epit.,41,Sep.,1902) reports results of investigations as to etiology and epidemiology whilst in the China

expedition in 1901-2. He feels convinced that beri-beri is not infectious, and that there is no miasmatic contagion. He found that the disease in large towns is limited to certain localities. Often amongst neighbouring buildings, with the same hygienic conditions, he found the disease in one building only. The micro-organism not only picks out the place but its victims - men mostly.

De Schuttelare (ibid) writes concerning two epidemics at Diago-Suarez. The rations of the men attacked were wanting in fat: this observer at once gave 30 grains of fat in the diet and no new cases of beri-beri arose. In the second epidemic the rations of those affected contained rice deteriorated from age. This was replaced by fresh bread and fresh non-deteriorated rice, and an immediate arrest followed. At the same time no arrest occurred amongst those of the population who continued to eat the damaged rice. Thus the deteriorated rice would seem to have extended the disease; yet it could not have been the sole cause, for other bodies of the troops with the same peccant rations, but occupying habitations in a well ventilated spot, were not affected.

Dr.B.Ebbell (Janus, 1902, 661) brings some of the arguments used by Manson to support the rice theory. He points out that the disease is most common in the rice

producing countries; its symptomatology is that of poisoning rather than infection; the virus seems to require constant renewal from without; there is usually little or no fever; it is not infectious; it has a long incubation period; and it is almost hopeless to treat the disease during a bad epidemic in the place where it was acquired. Further, rice is not well borne by patients and often the substitution of wheat, barley, beans, or even animal food has a good effect in treatment. In many ways beri-beri resembles such a toxic condition as chronic alcoholism.

Captain E.R.Rost (Rep.in Indian Med.Gaz.,1900-01-02; Jour.Trop.Med.,1902;B.Med.Assoc.Section Meeting,1902) believes that there is an intimate connection between a disease in rice and beri-beri in man.

During an outbreak at Meikila Goal in 1898, pigeons, which lived under the roof, were effected by an epidemic disease, which caused paralysis of the wings and death. The jewari or staple food of the goal was stocked in the granary and the lower layers were mouldy and condemned.

Later, in Rangoon, Rost found in rice water liquor a diplococcus, and also observed this in the blood and cerebro-spinal fluid of beri-berics. Injection experiments with fowls caused death and a bacillus was found in the blood and cerebro-spinal fluid. Later experi-

ments with animals gave similar results. Fowls and pigeons were injected with rice water liquor or blood of beri-beri patients, and death occurred with paralytic symptoms, diarrhoea, etc.

Rost thinks that the latter experiments show that the disease must be caused by a micro-organism in the blood; that fowls fed on diseased rice die from a disease due to a micro-organism in the blood which on reinjection produces the same disease, and this, too, when injected with blood of beri-berics.

He also believes that there are some instances of outbreaks in lightships, schools, and in countries where it would appear difficult to look for the causation in rice liquor or in diseased rice. But it is probable that rice is not the only cereal in which the disease can grow; moreover, it is possible that the disease may be, in some instances, communicated by means of fowls suffering from the malady.

Littlefield (Causation of Beri-beri - Jour.Amer.Med.Ass. 1902,XXXVIII,1244) reports that Chinese rice was given to prisoners in Lingayen Hospital from February,1902, & that during this period beri-beri was markedly epidemic the monthly morbidity and mortality being 20 and 5 respectively. It appears that the rice was supplied by the Commissary and was Chinese white rice. On this being changed for native rice from the open market, beri-beri ceased forthwith.

Littlefield therefore concludes from these facts that the cause of beri-beri in this prison was the use of the Chinese white rice, especially as there were no cases in a neighbouring badly sanitated civil prison which received the open market supply of rice.

Sambon, at the Section meeting of the British Medical Association, 1902, gave as his opinion that rice may be related to beri-beri in the same way that pellagra is believed to be related to maize; in other words, that rice may become a vehicle of the beri-beri infection. Rice is a staple food over a far wider area than that in which beri-beri prevails; but the cause of the disease is not rice itself, but perhaps some micro-organism which in certain places and under certain conditions may be associated with rice and possibly with other grain.

Sambon believes that the specific agent of beri-beri exists within the patient's body and attacks the peropheral nerves; that beri-beri may remain latent for long periods within the system thus accounting for the numerous outbreaks amongst coolie gangs out at sea or landed in places in which beri-beri did not previously exist, and that this explains the strict limitation of the infection to such gangs which has been so frequently observed, the more so as undoubtedly beri-beri cannot spread any more than malaria in the absence of its

peculiar agent of propagation.

Sambon points out several epidemiological facts, such as its prevalence being favoured by high temperature & abundant rainfall. He admits, however, ignorance of the way in which beri-beri infection is carried from place to place and from person to person. Introduction of a case with a hospital does not infect other patients; but it was introduced into New Caledonia, in March,1891, by a shipload of prisoners and subsequently spread to the natives. Again, it is essentially a disease of collective dwellings, which at first sight might suggest contagion: this is so, even under the best hygienic and sanitary conditions. He does not think such a fact implies that beri-beri is a place disease; e.g., in 1894 Japanese coolies were infected in a colony in which beri-beri had never occurred before - dwelling houses were specially built for them - one month after beri-beri broke out. Many of the coolies had, previous to immigration, suffered from beri-beri. They were sent back to Japan, and their houses after disinfection were divided into separate compartments and occupied by Indians, yet no cases of beri-beri followed. He, therefore, maintains that whatever the cause of beri-beri it cannot be denied that the diet has some potent influence on the prevalence of the disease.

J.Cantlie (Section of Tropical Diseases, Seventeenth Annual Meeting of the British Medical association,1902) points out (1) that in the Japanese Navy the disease disappeared in the barracks in which the food was not changed: the only common factor was the improved hygien-ic condition; (2) the observation by Weinkauf, in the Dutch Indies, of improvement in diet not leading to a decrease of beri-beri; (3) that beri-beri is prevalent in countries where rice is not an article of diet, as for example, in such centres of beri-beri as Brazil, in the Moluccas, and the Linga Archipelago, the people there partaking of sago, fish, and game, but never rice.

With a view of proving the infectivity of the disease he points to the admission of three beri-berics to a mixed surgical and medical ward of sixteen beds, with the result that within a few weeks three other patients in the ward developed beri-beri. He considers it significant that all these patients suffered from open sores on the legs, but none of them were in adjacent beds but were separated from one another by medical cases.

Cantlie enquires: (a)Can the infection be carried by mosquitoes? (b)Has human inoculation of beri-beri been practised; if so, with what result? (c)How can the disease be carried to a new country by human beings if they have only a toxin and not a germ in their blood?

(d) If there was the toxin and culture medium, how was the active agent introduced?

He considers it possible (1) that persons harbouring a toxin in their blood could perhaps infect others by means of the mosquito, but this could not produce an epidemic; (2) that such persons may give rise to a few cases.

W.T.Prout (Ibid.) tells of an outbreak which occurred outside Sierra Leone, of which town and district beri-beri is not an endemic disease. He considers the cases in question to have been cases of neuritis, of alcoholic marlial or arsenical origin; and states in this connection that rice is the staple food of most of the population. The outbreak in question is said to have been introduced by a steamer of negroes - 25 of whom had beri-beri - from Panama. On landing, in all 250 cases were counted, some of a mild, others of a severe character. Isolation was at once practised and the patients gradually recovered. None of the uninfected on landing became infected, and none of the numerous attendants took the disease. Not a single case spread in the town, though the patients were scattered over the country.

Prout believes the above facts will support Manson's theory as to the disease being due to a toxin produced outside the body, though it does not actually support the suggestion that it must neceddarily be a place

disease.

Hamilton Wright (Studies from the Institute for Medical Research, Federated Malay States, vol.II,No.1) believes that beri-beri results from the introduction in the body of some specific organism by the mouth, probably in the food, its toxin being produced in the pylorus & duodenum. He strongly suspects rice.

Destefano (Sem.Med.,vol.X,No.18) believes, as do many others, that beri-beri is of the nature of an intoxication produced from the intestines.

Durham (Jour.of Hygiene,p.133,1904) relates his observations upon beri-beri in the Christmas Island and the Malay Peninsula. He failed, however, to discover the cause, but noticed that: (1) The well-fedd escaped the disease, but attacked by preference those in less fortunate circumstances(the ill-fed); (2) that beri-beri usually avoided the towns and was marked prevalent at the mining camps; (3) Cooks, etc., always escaped, even in the goals; (4) the disease occurred among the rice eaters, but sometimes among the wheat eating Chinese, (he believes, therefore, that beri-beri is associated with diet); (5) the disease seemed to be spread by contact, direct or indirect, the person attacked being in some way connected with the dissemination of the infection; (6) though all the rice-eaters on the Christmas Island partook of the same rice, yet beri-beri attacked the coolies only.

Mosse (Jour.R.A.M.C.,1904,p.243) comments upon the epidemic of beri-beri among the Boer prisoners at St.Helen-a: this has been discussed elsewhere.

ARSENIC IN RELATION TO BERI-BERI.

At the section Meeting of the British Medical Association,1902, Ronald Ross reported the discovery of arsenic in the hair of beri-beri patients in Penang, Singapore, etc. He points out, however, that his remarks apply only to cases under consideration, and that the observations do not entitle him to speak regarding other cases of tropical neuritis which may have a different origin.

Prior to this (B.M.J.,1901,II,p.979) Ross and Reynolds had drawn attention to the similarity of beri-beri to alcoholic neuritis; and as much of the so-called alcoholic neuritis was really due to arsenical poisoning, it seemed possible that some of the beri-beri cases might be due to arsenic. (A case seen by these writers, at Chester, of arsenical poisoning was so like cases of beri-beri observed in the East by Ross, that in the Lancet of 1901 the suggestion was made.) Thus, in August, 1901, a lady suffering with peripheral neuritis from Sierra Leone came to England. The symptoms though suggestive of beri-beri did not exclude arsenical poisoning. The hair contained a considerable quantity of arsenic. Ross and Reynolds point out that the

patient had lived largely on tinned foods and possibly, therefore, the case had no connection with beri-beri. They conclude, however, that some of the so-called beri-beri cases are due to arsenical poisoning, for tinned foods are commonly eaten in the tropics.

(The writer believes that the question of arsenical poisoning would appear to be important in throwing some light on the sporadic or solitary cases of so called beri-beri among sailors in English ports, and thus excluding reports of such cases as throwing any light on the etiology of beri-beri).

Leslie Roberts (Arsenic in the Hair of Beri-beri Patients, B.M.J., Feb.15, 1902, p.425) criticises Ross's arsenic theory, and points out that arsenic is found in the hair of healthy persons not taking it in the food or otherwise; and remarks that "if Major Ross were able to report the detection of arsenic in the liver or kidneys of individuals dying of beri-beri, or in the urine during the prevalence of the symptoms, that would be evidence of no little value".

The Lancet (1901, II, 1058) criticises the above observations of Ross and Reynolds. The suggestion is made that the peripheral neuritis in the case of sailors landing on our shores may not be due to the same cause as tropical beri-beri.

Simon (Jour.Trop.Med., 1901, IV, 285) points out that in poisoning by arsenic pigmentation and other affections

of the skin and eye occur, but he has never seen these phenomena in beri-berics. He notes that experiments made in the Straits Settlements tend to show that the serum of beri-beri blood possesses toxic properties and is capable of causing peripheral neuritis.

Van der Scheer (Letter to Dr Manson, Jour.Trop.Med., 1900 III, p.96) gives it as his opinion that beri-beri is caused by a parasite that lives in the intestinal canal, forming there a toxin which causes degeneration of nerves. A part of the life cycle of the parasite may take place in the blood of a blatta species (in its kidneys, intestines, or lymph glands) and the spread of the disease to them would be possible when: (a) There are patients suffering from beri-beri; (b) when the blatta species is present; (c) when it is possible that the blatta eat human faeces; (d) when man becomes infected by blatta excrement(faeces, urine, etc). This observer, recalling epidemics reported, thinks they can all without exception be explained on this hypothesis.

BERI-BERI ON BOARD SHIP.

The Lancet (1902,I,598) states that four cases of beri-beri came to Cardiff from Rangoon. The disease appeared six weeks out from the latter port. It was suggested that the outbreak was due to shutting ports & the heating of the forecastle when the ship came to cold climates. The symptoms resembled arsenical poison

ing, and that substance was found in the intestines in some cases, but it could not be discovered in the ship itself.

Van der Scheer (La direction à suivre dans la recherche dans causes der Beri-beri, Arch.de Med.Nav.,1902,LXXVII 473) states that beri-beri ought to be considered as a miamatic disease analogous to malaria. These two diseases have much in common; both are most frequently seen in hot climates and in the hot seasons; and endemic and non-contagious. It is a disease of the soil. The theory of intoxication by rice does not explain the epidemiology of the disease. Contrary to malaria,which is contracted from the air, beri-beri is contracted in dwellings. The cause of beri-beri is to be sought in a parasite which has two hosts; man in one, and the other the bug or the cockroach, which is found in ships as well as ashore.

Anderson. (Beri-beri on the R.I.M.Surveying Ships Investigation and Nancoury, Indian Med.Gaz.,1901, XXXVI, 330) reports that one month after leaving Bombay several cases of beri-beri occured. As an epidemic seemed imminent,the water tanks were emptied and refilled with fresh water, but without effect. Lime juice and extra fresh meat rations were tried, as, too, the separation of the sick from the healthy, but all without effect. finally, all food, including Bombay rice, was thrown

overboard: the disease at once ceased. There was no evidence of infection from person to person. Prompt separation of the sick did not diminish the number of attacks. It was found that the drinking water could not be blamed. The fact that the disease occurred in detached boat parties(where the food was not changed)at the time when no cases occurred on board, renders local -ity as a cause unlikely. Bad feeding, mouldy rice, heat, moisture, insanitary conditions, etc., were absent. Overcrowding there certainly was. It appeared highly probable that the disease was due to food for there was immediate cessation of cases when the food supply of the ship was changed and a continuance of the disease in boat parties who used the old supplies.There were other outbreaks subsequently in these ships after leaving Bombay. Cases have thus occurred in all classes of the crew, except officers whose food was obtained from a totally different source; it affected old and young, healthy and weak. It broke out in all climates and weather: One common feature was that the outbreaks all occurred within two months of leaving Bombay, and always while Bombay provisions were being used.

Dr B.Ebbell (Etiology of beri-beri,Janus,1902,VII,661) after criticising the former ideas of the above as to the disease being rheumatic, malarial, from rice feeding with consequent deficiency of nitrigen, etc., refers to Vanderman's experiments(1898) as disproving Eijkman's

assertion(Janus,1898,p.84)that shelled rice could play an important role in the etiology of beri-beri, and states that he believes beri-beri is not contagious but of the nature of a chronic intoxication; for it is not passed from person to person, occurs frequently in house epidemics with rest of community uninfected, has a very long period of incubation, the patients are quickly and completely healed if at once removed from the seat of the disease, and it is unaccompanied by fever.

Ebbell suspects rice, and Van Dieren (Janus,1897,p.493) is of the same opinion. But against this opinion must be adduced the fact that beri-beri exists in countries where rice is not eaten, e.g., the Molucca and the Lugg islands. Still, it seems as if the disease only attack-ed Europeans who have immigrated there, and it is easy to suppose that these persons eat rice, whereas the natives eat sago and are immune. The disease is said to have attacked some few who are not rice-eaters. This may be explained however, by saying that the meal used for their bread is mixed with rice. Further, beri-beri has decreased in some countries, especially China,where it was formerly very rife. But that is likewise the case with ergotismas, which years ago was common in West Europe, but now driven out. Beri-beri, it has been observed, fluctuates annually as do various con-tagious disorders. "But the same condition is observ-

able in intoxication illnesses. Ergotismus is commonest in the autumn and pellagra in the spring. Symptoms of the disease are enlargement of the spleen, fatty degeneration of the heart's muscle, liver, and kidneys". Saneyoski (On Beri-beri - Kak-ke of Japan - XIII Cong. Intern.de Med.de Paris,1900;Sec.de Med.Milit.sous Sec. de Med.Nav,Pt.17,p.72) remarks that beri-beri formerly only occurred in localised populous places in Japan; now it invades all parts of that country. He thinks that the cause lies in the food, and considers the disease should not be classed as infectious. He refers to the Japanese Navy outbreak in which the malady disappeared on the diet being changed from rice, to which the men were partial, to other articles. Similarly in Japanese prisons removal of rice from the dietary put an end to the disease. He concludes that the only persons attacked in Oriental countries are those who make rice their staple food. Beri-beri is more frequent in hot seasons, and this he attributes to want of appetite and rice water drinking. If such a diet is used in cold seasons beri-beri will break out. That it does so among crowds in prisons, etc., is owing to inferior diet and more rice; and such people will enjoy immunity in spite of the position and site of the dwelling if they are allowed to freely choose their own diet. Saneyoski further remarks that the introduction into virgin

country of disease is due to people from without who eat a large quantity of rice; that augmentation in Japan is due to greater rice dietary(he admits that an epidemic in Dublin Asylum was not produced by that cereal); that a proper diet will certainly prevent beriberi in all seasons and everywhere; the negligence of dietetic precautions will always be followed by the hatching of this disease.

Dr Rho, in a discussion on the above states that in spite of Saneyoski's opinion the infectious theory of beri-beri finds many supporters; he believes defective diet e.g., rice, to be a certain cause but not the only one. He points to possibility of the existence of other factors of etiological interpretation by way of predisposition.

Dr Jabe next remarks: "I believe beri-beri is an infectious disease, and that rice gives a predisposition to contract it. In Japan we have partisans of the two theories".

Finally, Dr Pulle pointed out that the morbidity of beri-beri diminished consequent upon the change of diet. In his opinion the malady attacks a great number all at once independent of rule.

BERI-BERI IN THE JAPANESE NAVY.

Baron Saneyoski, the Director-General of the Medical Department of the Japanese Navy, publishes in the Sei-

I-Kwai Medical Journal for April and May,1901.statistics bearing upon the prevalence of beri-beri(Kak-ke)in the Japanese Army, between the years 1884-1885. The report is of interest, because it was during the years in question that beri-beri broke out in the Japanese Navy; but until the present information was made public one was entirely ignorant of the fact that the disease had prevailed in both services.

Saneyoski's main conclusions are as follows; (1) That in the East rice-eaters are the only persons affected by beri-beri; (2) the improvement in diet in the Japanese Navy and Army since 1884 has extirpated the disease (3) that no other hygienic improvement has been recognised as having anything to do with the result; (4)Rice eaters transport beri-beri to places where no beri-beri had existed before their arrival; (5) beri-beri and rice are inseparably connected; (6) lack of nutritive substance is the cause of beri-beri. In the Japanese Army, and in the prisons, the introduction of barley into the diet, along with rice, caused a speedy diminution of beri-beri; which malady, moreover, is more apt to occur amongst communities who are supplied with "white Chinese rice" than amongst those who consume "red Chinese rice". In further support of the diet-theory of causation, Saneyoski points to the fact that the "red rice" yields, on analysis, a larger quantity of fat & albumen.

Fajardo (De l'hematozoaire due beri-beri,XIII.Cong.Int. de Med.,Paris,1900,Compt.Rend.,Sect de Bacterial.,p.116) states that he found a heinatozoän in the blood of beri berics. He likewise quotes a curious case of a man from the Amazon, diagnosed as a grave case of beri-beri and afterwards confirmed by several physicians. Though his symptoms presented the phenomenon of shiyõshin(dyspnoea, palpitation, vomiting, etc.) he lived several days, and his blood on examination was found to contain the malarial parasite thus accounting for the malady being mistaken for beri-beri.

H.Noble Joynt (Jour.of Trop.Med.,1901,IV,141) states that in April,1894, Japanese coolies were imported to a sugar plantation in Fiji. Previous to this no beri-beri had existed in the camp. The dwelling houses were specially built and freely open. The Japanese were very cleanly in their habits. One month after arrival the first cases of beri-beri occurred, and by the second week of November 219 out of the 250 had contracted the disease. The patients were removed to a plantation hospital four miles away until this hospital was full,after which the cases were treated in their own houses. It is noteworthy that not until the hot season and rains did the epidemic take hold of the Japanese. Some Indian coolies lived near and some Indian patients were in one of the hospital wards, but not a single Indian,or other nationality, took beri-beri. The Japanese were

sent home, their houses were cleaned, and occupied by Indians, whose habits soon created dirt, yet, no more beri-beri occurred.

Gibson (Beri-beri in Hong-Kong, with special reference to the records of the Alice Memorial and Nethersole Hospitals, and with notes on 2 years' experience of the disease, Jour.of Trop.Med.,1901,IV,p.96),in the course of a lengthy article mentions that beri-beri had existed in the colony since 1852, and that it had become more prevalent by the time a hospital was built. From 1888 to 1899, 1864 cases were treated at both hospitals. The ages of the patients were from 16 to 30, and they were chiefly of the male sex. The disease attacked coolies, sailors, tailors, cooks, and barbers: in that order of frequence. The coolies lived in covered lodging houses; the sailors in close bunks; the tailors in vitialed atmosphere; and the cooks in smoky kitchens. Furthermore, the disease was most prevalent when the rainfall was greatest and the temperature highest; and by the Chinese themselves damp was considered an etiological factor of supreme importance.

Simon (The known and unknown in beri-beri, Jour.Trop. Med.,1899,II,29) states that, in addition to defective hygiene and insanitary environment in endemic areas,the immediate cause of beri-beri has been referred to bacteria, deficiency in nitrigenous food, malaria, and to

parasitic disease of the rice. It is now generally believed that the immediate cause is a toxin - probably bacterial in origin and manufactured outside the body. Conditions of environment which favour are: Low-lying, damp, or marshy situations, with overcrowding, defective ventilation, absence of sanitation, and bad food. Beri-beri, however, occurs in situations with conditions opposite to those mentioned and where food could not be a cause. One constant condition is overcrowding, and yet it had not yet occurred among the thousands of Indian coolies who inhabit the estates in Province Wellesley. Simon frankly admits that he is at a loss how to account for the disease, for we do not feel sure, - taking into account the analogy of neuritis from alcohol, arsenic, lead, malarial intoxication, leprosy, and perhaps other causes,- the toxin of beri-beri is not always the same; or that, in dealing with different outbreaks of beri-beri we are always dealing (though symptoms may be identical) with the effects of the same poison, but feel inclined to doubt there is any such one, real, specific disease entity at all.

Speaking of communicability, he remarks that most outbreaks point to the disease being contracted from an infected place: many instances occur in which the possibility of contagion may be entertained. No definite bacteria have been found, nor have any definite inoculation experiments been conclusive. There is evidence

that beri-beri may be introduced into goals, etc., by the admission thereto of patients; so that it is probable that the poison, or means for its manufacture can be given off in some way from the body.

Gerrard (Influence of Rainfall on Beri-beri, Lancet, 1899 I, p.367) mentions that the highest rainfall does not correspond with the highest morbidity of beri-beri; and that the fact of a large proportion of men falling sick of the disease when mines are opened, points to its cause being in the soil, or perhaps to its requiring the presence of malarial conditions for its development.

Carpenter (Jour.Trop.Med., 1899-1900, II, 12) believes that the origin and meaning of beri-beri is obscure. It is certain that the name has been applied to more than one disease. Anything in the way of swollen legs or feet is dubbed "beri-beri" in countries where the disease is common. Different varieties, for the cases which he saw at Singapore were not quite the same as those which he had to deal with in North Borneo. The reason that it was deemed advisable to eschew rice in the dietary of beri-beri patients was principally on account of the dilatation of the stomach which it sometimes causes, and also from its not being a sufficiently nutritious or nitrogenous diet. Experience has taught that overcrowding is one of the chief causes of beri-beri. Probably anything which sufficiently lowered the vitality

would predispose to beri-beri,- prison life, for instance, in an Oriental goal. He believes in the miasma theory. It is the poor man, the common labourer,who is the principal victim of beri-beri,- the ill-housed, the poorly fed, and often the overworked coolie. He had never yet observed the supposed contagious element of the disease: hospital servants always mixed freely with the patients with impunity. Never has he known a child to contract the disease.

Haynes (Notes on Beri-beri in the Australian Pearling Fleet,1883-1887,Jour.Trop.Med.,1900,II,196) refers to Malay crews employed in diving for pearls, and concludes from his experience that: (1) Beri-beri is confined to a very great extent to rice-eating races and with proper care will not develop in less than seven months; (2) that the substitution of a mixed diet of wheat, flour, beans, potatoes, etc., to the exclusion of rice, mitigates, even if it does not prevent the disease; (3) lime juice does not appear to be of much service, but beer is most beneficial.

Montgomery Smith (Janus,1899,IV,p.38) of Bermuda reports that in December,1896, a ship laden with rice from Rangoon to Falmouth, had an outbreak among the crew, and with three deaths. Two years later, the same ship with sugar from Java to Bermuda, had all the crew, except one, ill with beri-beri. The disease appeared

after three months at sea. Six of the worst cases were put ashore, and recovered in a month after proper dietetic and medical treatment.

Drs Rump and Luce (Zur klin.und pathol.Anat.der Beriberi Krankheiten,Deut.Zeit.f.Nervant.-Kinde,18,1900,p.63) consider beri-beri of the nature of a miasmic-infectious malady, on accouut of its localisation, seasonable character, and its greater prevalence pari passu with the increase of commerce. They refer the condition to a polyneuritis with exacerbations.

Bullmore (Beri-beri,Lancet,1900,II,873) believes that the beri-beri which reaches them at Falmouth is not the same beri-beri of the Malay Peninsula and elsewhere. He excludes rice as a cause for the reasons that (a) very little rice is eaten, and (b) if eaten, it is seldom followed by an outbreak of the disease. As we know it, he does not consider beri-beri infectious or contagious but believes it to be due to an alkaloidal poison fanned into flame by disarranged infection due to improper diet, as witnessed by the improvement in the Japanese Navy consequent upon revision of the dietary.

We find in Janus(1899,IV,p.43)an account of a little epidemic of beri-beri that occurred on board a guardship at Cameran (Red Sea) in which it appears that the patients had typical beri-beri symptoms. The ship had had come from Genoa where it had been built. The crew

of Indian coolies had come from Bombay seven months before. The sanitary and dietetic arrangements were satisfactory. Italian and Egyptian rice was eaten. There was no suspicion of the existence of beri-beri in any part of the Red Sea, whence the disease might have been transported into the ship. Hence this was a small autocthonous epidemic which originated on the ship itself; and the cause of it remains unknown, unless one is prepared to suppose that the coolies had the germ of the disease upon them since their departure from Bombay seven months before.

The Indian Lancet (1900,XVI,p.385) contains a report on the Rangoon General Hospital cases, numbering 944 in three years. It is noted that there is little doubt that beri-beri is endemic in the Delta districts of Burma and only requires subjects living under suitable conditions for the disease to become prominent and wide spread. The coolies living in the town of Rangoon do not suffer from beri-beri to nearly the same extent as those living in the districts. Compared to the total population of the Delta districts the class from which the beri-beri patients are almost entirely recruited is a very small one indeed, so there is no evading the conclusion that it is owing to his better house and more generous diet that the Burman escapes the disease almost entirely, though he lives habitually in districts where it is endemic, while the coolies who come for a

time only suffer so severely.

The coolies usually arrive in Rangoon fit and well and go into the jungle to reap. They keep their health for periods varying from nine months to a year or more and then begin to suffer from fever. They soon get worse & unable to walk. The time from the commencement of the attack to their admission to the Rangoon hospital is from 4 to 6 months.

Clark (Beri-beri, An address delivered at a meeting of the Hong-Kong and China Branch,B.M.J.,May 12,1900,p. 1152) mentions that the etiology of beri-beri is a much debated point, and that, though said to be predisposed to by dirt, overcrowding, and damp, the disease can occur as a localised epidemic without any of these accompaniments, as is shown by the recent outbreak at the Berlin Foundling House. He found the converse of Manson's hot weather prevalence in Hong-Kong. He goes on to relate the outbreak which followed the admission of a child with beri-beri into the Blind Home, the children of which attended church at the Berlin Foundling House, and a European nurse from the latter visited the Blind Home daily. An outbreak occured in the Foundling House soon after. In all, 60 were attacked, and sent away with six older girls (free from the disease) to assist in looking after them. The remaining healthy ones in the House were kept on the same dietary: no

further outbreak occurred, and those removed improved. Only those sleeping on the ground floor were attacked. The diet was very liberal. There were not any of the predisposing causes.

Clark states that if we adopt Manson's theory, we must assume that the infection was conveyed from the Blind Home to the Foundling House, either in the clothing or in the earth or in the boots of the children or nurse going from the one establishment to the other; that it developed rapidly; that the children sleeping in certain of the ground floor rooms were rapidly poisoned by the toxin generated by the infective germ. The fact that two children who required surgical dressings were the first to develop the disease suggests rather that they were thus more susceptible to the disease than that they communicated it to others, for the interval between their attack and the outbreak among the rest of the children did not exceed two days at the most, so that it was believed that all the children derived infection from the same source.

Dr Jamagiva (Virchow's Arch., p.451, vol.156) after describing the post-mortem findings in beri-berics, and criticising the opinions of others regarding the origin and nature of the malady states that he believes the malady to be the direct result of an autointoxication.

Randall (B.M.J., 1900, T, p.1506) dealing with the out-

break of beri-beri at Ascension, says that "it is reasonable to suppose that the spread of this disease is due to the fact that the quarters have become infected." None of the conditions given by Manson as necessary for the development of beri-beri germ - dampness, temperature, and possibly soil contamination - existed, except perhaps the high temperature. The original quarters were stone and concrete with cement floors. After the outbreak the men were removed to a high healthy spot & the original quarters replaced by huts with galvanised walls and roof, and solid concrete floors, to which the men were taken back. At no time was the sanitation defective. The disease was hitherto unknown. It first occurred among the batch of Kroomen who had arrived in the island some months previously. One or two of the older residents also became infected. Since this outbreak there have been recrudescences, bearing relation to the arrival of new batches of men from Sierra Leone three times a year. It is on these grounds difficult to conceive how soil (or place) infection can obtain. In many cases the disease may be a long delayed reappearance of a very much postponed development of infection originally acquired in Sierra Leona - but this cannot be applied to all cases, for some must have become infected here, and place infection is at least improbable; so that one is forced to the conclusion that per-

sonal infection must take some part in the spread of the disease.

Laurent (Arch.de Méd.Nav.,No.3,1899,p.194) describes an outbreak of beri-beri among the Annamites forming part of the French troops in Chantaboun(Siam). Acting on Brémand's view, fat was included in diet and in 48hours the epidemic was arrested. Later, at Poulo-Condore, Laurent recommend fat, as there was an outbreak there, and with a remarkable result. In connection with this epidemic Laurent mentions that after the improved dietary a fresh batch of prisoners, who were anaemic and ill, were landed in the island, and the disease was warded off by the addition of fat to their food.

Brémand (ibid.,No.5,p.369) commenting on the above, refers to his experience of the Paulo-Condore Settlement in 1877-78 when the exclusion of fat from the dietary was followed by a severe outbreak of beri-beri. The disease ceased when fat was restored. In connection with this outbreak it should be noted that some men from another prison had previous to the epidemic been brought in suffering from beri-beri, which, however, disappeared rapidly under the general conditions of the place. This may perhaps place another construction on the cause of the epidemic.

Brémand mentions that, in 1879, he was serving on an English ship with a convoy of Indian coolies on board, bound to Martinique from Pondichery, and that,so far as

he could learn the outbreak of beri-beri amongst the Mahommedans, was due to their not partaking of fat, for the coolies who ate pork escaped the disease. It is impossible to say that in this case beri-beri was caused by lack of fat in the food, but it would appear that the absolute deprivation of fat is a necessary and a sufficient cause of the disease, or at least favours the condition necessary to develop it.

Norman (B.M.J.,1899,II,p.686) in connection with the above gives the dietary of the Richmond Asylum, Dublin, where several epidemics have occurred. There was no deficiency of fat. The dietary was improved after this epidemic, but epidemics occurred later. He does not think these epidemics support the dietetic theory of the causation of beri-beri, but that the affection seems to follow some obscure law of periodicity. He remarks that a recent epidenic occurred in anothe asylum in which there is evidence of the disease having occurred 50 years before: this would favour'place'infection. The same author discusses (ibid.,1898,II,p.872) the question of beri-beri in temperate climates, and points out that there are in the tropics peculiarities in the distribution of beri-beri. In Ceylon and China, where it was formerly prevalent it is now much less often seen; but in Japan it seems to be on the increase, & in Brazil the malady has assumed a much more severe

character than hitherto. Within recent years it has occurred as new epidemics in tropical and subtropical areas, and in several of them it appears to be spreading. In cold and temperate climates, until the year 1894, beri-beri was chiefly observed in sailors just returned from some infected tropical station. Manson records cases appearing in London amongst Asiatic crews of vessels lying up the Thames for several months. Jameson records Lascar outbreaks in outward bound vessels. For this and other reasons, possibly beri-beri is not a'tropical'disease. It occurs in cold climates, as witness the outbreaks at Richmond Asylum in 1894-96-97. As regards the Richmond epidemics, bacteriological investigations gave negative results. No member of the administrative staff were attacked in 1894. The disease increased in severity from June to September. Several nurses were attacked in 1896 and 1897. The epidemics present different characteristics: In 1894 there was marked cardiac disturbance; the same in 1896, but few motor symptoms; in 1897 painful formication. It has often been observed in the Straits Settlements that the first epidemic is the worst. As regards local causes, there was no reason to believe the disease personally imported. It did not break out in Dublin where the sanitary arrangements are not always satisfactory, and the floors damp. The food was the same as in Dublin generally, and rice was little used. The history of

the epidemics suggests that beri-beri can spread or may exist in hitherto unsuspected places. Apparently there is some predisposing condition in asylums, e.g., at the Suffolk Asylum the hygienic appointments were bad. Van der Burg (Janus,1898,III,83) reviews Vordermaun's enquiry into the connection between the kind of rice employed as food in the prisons of Java and Modoura and the appearance of beri-beri among the inmates. He states that he has never seen a case of beri-beri in prisons where red rice (with husk retained) was used, but many where white rice (with husk removed) was used. He does not think that the country in which the rice was grown had any influence, for the same percentage of cases occurred amongst Java prisoners fed on rice in different countries. When rice is stored in damp places it becomes yellowish, perhaps from micro-organisms; but beri-beri cannot be attributed to this as it is used in some prisons without causing the disease. On several occasions he found that the substitution of red for white(peeled)rice stopped the disease from increasing. He sums up by saying that he does not think that beri-beri is an intoxication from rice, but that it is an infectious disease in which alimentation plays an important role. He believes in the influence of micro-organisms, and found that his investigations favoured the results obtained by Eijkmaun upon polyneuritis in fowls.

A year later, Van der Burg gives an abstract (Janus, 1899,IV,p.271) of the criticism (Gen.Tijd.,5,u.I,28,709) of Van Gorkom on the above researches of Vodermann, and states that there is no connection between beri-beri & nutrition by means of rice from either the geographical or the etiological standpoint. He believes that there are errors in the pretended results of Vandermann's enquiry which precludes this connection, and also, therefore, any support which Vandermann's results may give to Eijkmann's evidence that in surroundings affected by beri-beri the kind of rice had some influence on the existence of the disease. He notes the fact that beri-beri was diminishing as much in the army as in the prisons, and that independently of a diet of rice whether decorticated or not; lastly, that the disease is spread through the villages of Java either endemically or epidemically.

Portayers (Sei-i-kwai.Med.Jour.,1898,XVII,537) points out that beri-beri in Java was not brought about by bad conservation of rice after peeling for it was consumed shortly after being deprived of its husk.

Van der Burg, in the former number of Janus, gives a review of Von Gorkom's work,"The question of beri-beri Intoxication or Infection," and gives it as his opinion that beri-beri is an infectious disease, and that alimentation, whilst an important factor, is not the es-

sential cause. Rice, he says, cannot be the true cause since the disease has broken out among persons who have never eaten it.

His reasons for subscribing to the infectious theory are ninefold;

(1) Beri-beri is only observed in countries or regions, and in well defined places within those regions, where the food differs not from that of the surrounding country.

(2) The disease has occurred several times when the soil has been disturbed.

(3) It has frequently shown itself in certain buildings, and there an intensity of the disease has been established.

(4) The disease has broken out in buildings a few days after the reception of a case in them.

(5) Beri-beri shows itself chiefly in the seasons when the daily variations of temperature are great and when colds are prevalent.

(6) It chiefly attacks middle aged persons.

(7) It shows great inclination to relapses under circumstances which preclude any influence of the food and which are typical of infection.

(8) There are cases of cure without the patients having changed their food or mode of living.

(9) Beri-beri shows many anatomical-pathological anom-

alies, and clinical symptoms which belong to infectious diseases, such as: inflammatory degeneration of the heart; fatty degeneration and other troubles of the liver and kidneys; splenic enlargement; onset of fever; anaemia; swelling of the lymphatic glands; digestive & urinary troubles; sometimes albuminuria; loss of hair; relapses.

Spencer (On Beri-beri as observed at the Seamen's Hospital, Greenwich. Lancet, 1897, I, 32) reports having had about 35 cases of beri-beri under his care in 1890-1. The diagnosis was in most of the cases "oedema of the legs" or "peropheral neuritis", but the description of them leaves little doubt as to their being cases of beri-beri. Very few died; and Spencer believes that the form of the disease seen in England is the subacute variety: for, in countries where the disease is endemic it is extremely fatal. The average duration of the treatment was about two months; the majority were Lascers,- a few were Chinamen.

All the symptoms are accounted for on the basis of the peripheral nervous system being affected; and this hypothesis has been confirmed by microscopical examination of the nerves in fatal cases. The symptoms arising from a diffuse peripheral nerve lesion are, of course, varied, and they are all seldom present in a given case.

There appears little doubt that beri-beri is a germ

disease and that the micro-organism which is the cause of it has a specially toxic influence upon the peripheral nerves. Europeans residing in endemic areas rarely suffer owing to their habits being different to those of the natives. It is increased in overcrowded spots, and is certainly more prevalent in some ships than others owing, no doubt, to the forecastles becoming infected. It may spring up at sea long after the ship has left port. The incubation period is a long one in some instances, and a slow poisoning may precede acute manifestations just as with alcoholic neuritis . Damp and heat seem to be predisposing causes.

Buchanan (Beri-beri and the Diseases confused with it, Dublin Jour.Med.Sciences,1897,CIV,475) believes that the endemic neuritis of Pekelharing and Winkler is alone the disease to which the term "beri-beri" is correctly applied.

Many years ago, Malcolmson, writing from Madras, described cases which it is clear had symptoms which Pekelharing and Winkler have since shown to be pathognomic of the disease. Unfortunately other cases were described of a cachexia in which oedema and dropsy of serous cavities were present, and these prominent symptoms as well as the concomitant anaemia, came to be regarded as characteristic of beri-beri. Then came the discovery of ankylostoma and a cachexia in Ceylon - to which

the name "beri-beri" was attached - shown by Kymey to be due to this parasite. The name "beri-beri" spread to Assam (where ankylostoma is found) and it was indiscrimmately applied to many cases of ankylostomiasis and kala-azar. In 1899 the Indian Government investigated this Assam pestilence and concluded that kala-azar is only an intensely severe form of malarial cachexia, attended by anaemia, dropsy, oedema, etc. Any argument against kala-azar being and infectious or communicable form of malaria applies with equal force to the historical epidemics of Lower Bengal and Mauritius in the sixties.

Owing to the confusion, therefore, statistical returns of endemic neuritis(beri-beri)make one sceptical as to the accuracy of the observations. It is probable that true beri-beri is far from being so prevalent in India as is commonly supposed. Anaemia is neither a prominent nor a necessary symptom of endemic neuritis, which condition, as stated, requires to be differentiated from ankylostomiasis (parasitic anaemia) and Kala azar (epidemic malarial fever).

The Semaine Médicale (1897,XVII,470) in discussing the question as to whether beri-beri can become epidemic in Europe by contagion, refers to the Dublin Asylum epidemics, and mentions that the physicians sent by the Dutch Government to investigate came to the conclusion

that the disease was a polyneuritis and not identical with the beri-beri of the Dutch colonies. They argued that in Holland the chances of contagion are infinitely greater than in Ireland as cases continually arrive, but no case due to contagion has yet occurred. At the outset, Europeans are refractory to beri-beri, but after several months of climatisation in the tropics they lose that immunity. They also noted that in the Indies the disease fell upon men of full age; at Dublin, on the contrary, in 1897, more women than men were attacked. A very great difference between the symptoms of the disease as it occurred in Dublin, compared with its occurrence elsewhere, was noticed. Drs. Veischur and Tysselstein concluded that in Dublin epidemic, as in beri-beri, there is a polyneuritis but between the two a great difference. The etiology of the disease that occurred in Dublin is as obscure as is the cause of beri-beri which occurs in the Indies and elsewhere.

Gilmore Ellis (Lancet, 1898, II, 985) writing of the disease at the Singapore Asylum affirms that the malady occurred principally in the damp, low-lying, ill ventilated wards, and that it was most diffused during the rainy season.

Many examinations of the blood from beri-beri patients have failed to show that the bacillus which Pekelharing and Winkler claim to have discovered; and unfortunately cultivations from the blood, and after death from the

spleen, stomach, nerves, and other organs, have as yet given no useful data.

It would seem that the degeneration of the peripheral nerves in paralytic cases and of the sympathetic, phrenic, and vaso-motor nerves, in the "moist" cases, is the cause of the obvious symptoms of beri-beri; that"mixed" cases are most numerous; that the disease is a most recoverable malady so long as the vagus, phrenic, and branches from the sympathetic ganglia in the neck are unaffected; but that when these nerves, all or any of them, once become attacked, death is imminebt.

Norton (Beri-beri,Cincin Lancet-Clinic,1898,n.s.,XL,359 Janus,1898,III,200) gives several synonyms for beri-beri:."Polyneuritis", "barbiers"(Indies), "loempoé" (Java), "Kak-ke"(Japan), "sugaries disease"(French Antillies), "bad sickness"(Ceylon), and states that the origin of beri-beri is obscure and was first so designnated by the Malabars.

Bondurant (Med.News,New York,Oct.3,1896;B.M.J.,1897,I, p.162) describes an outbreak of beri-beri at the Alabama Asylum, which had hitherto not been seen at that institution or in its neighbourhood. He suggests that it is not at all improbable that this disease may occasionally occur in other public institutions, also where overcrowding and similar insanitary conditions obtain but are overlooked, and that it is owing to the

special knowledge of, and attention to, nervous diseases in lunatic asylums that, so far, the occurrence of the malady has been observed only in them.

Macleod:(B.M.J.,1897,II,p.390) enters into the question of the possibility of the propagation of beri-beri by food supplies from endemic areas, and considers it especailly important in connection with asylum and ship epidemics. He mentions the case of the occurrence of the disease on board of a new ship on a voyage from New York. After the outbreak the captain and his son suffered but recovered on a milk diet, but the mate, who partook of the ordinary food, died. There were no symptoms of irritant poisoning. Suspicion was directed to certain articles of diet which must have been contaminated before loading, especially as the ship had not been to beri-beri centres and no other members of the ship's company were affected.

Outbreaks are common on boats from endemic centres and chiefly amongst Orientals whose food is drawn from beri-beri countries; it is not simply, therefore, limited to the forecastle.

The British Medical Journal (1897,II,p.415) in a leading article, points out that Tayler of Osaka promulgated a similar doctrine, and even discovered a coccus in rice. Macleod overlooked the question of the introduction of the disease into virgin soil, e.g., to Penang goal from Singapore and to New Caledonia from Tonquin;

Macleod erred in supposing overcrowding to be the direct cause: it only favoured proliferation of the germ. Morris (B.M.J.,Aug.21,1897,p.500) refuses to subscribe to the food-theory, and points to direct contagion as the cause of the dissemination of the infection. Corlette (ibid.p.680) deals with Macleod's observations, draws attention to the persistency of endemic foci, and declares himself in favour of the local miasma theory. Rees (ibid.,p.747) states that if, as Macleod suggests beri-beri depends upon contaminated food, similarly with many of the ships coming to London from beri-beri centres, the disease ought to be more common among the crews. He cites figures showing the predilection of the malady for particular ships, and opposes to the food theory the fact that a beri-beri ship will occasionally make a voyage without an outbreak. During the three months docking the native crew receive part rations from shore, at the end of which period the outbreak may occur. This points to the germ lying dormant in the forecastle.

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Among the predisposing causes, other than already mentioned, are the following:-

AGE.

Beri-beri is usually regarded as being extremely rare in infancy and childhood and in old age. Thus, in the epidemic that occurred on board the ship "Indien"

all persons under fifteen were spared, there being 56 on board. Fifty-five children took passage on board the "Jacques Coeur" and none of them presented the symptoms of beri-beri ,which decimated the crew of that vessel. In the college of Caraça, state of Minas,Brazil, beri-beri attacked the pupils over fifteen years of age, but spared their room-mates under that age. In the years 1889 and 1890 the number of deaths from beriberi in Rio de Janeiro was 830; of these, two were of persons between one and seven years of age; 11 between eight and fifteen years; 466 between fifteen and thirty five years; 285 between thirty-five and fifty years; 57 over fifty years of age; and in 9 the age was unknown. We may take it, therefore, that the most susceptible age is between sixteen and thirty-five.

SEX.

According to various reports, females are less predisposed than males. Corre states that, in Japan, the proportion of females to males is 1 to 27. The Japanese physicians think this difference is entirely a matter of diet. In 1889 and 1890 beri-beri caused 830 deaths in Rio de Janeiro, 720 being in men and 110 in women. This difference is explained by the fact that the disease develops in preference among sailors and soldiers. All Brazilian physicians are agreed that, in the civil population, beri-beri attacks males & females equally.

RACE.

It is a matter of common observation that in countries having a mixed population the disease principally attacks the natives and the immigrant coloured races, whereas those who do not come under either category enjoy an immunity which, though by no means absolute, is very striking. On the other hand some observers hold that no race enjoys immunity from beri-beri, and explain the fact that in Japan and the Dutch Indies the Europeans were spared many years (from which it was then inferred that the Caucassian race was immune) by the subsequent discovery that whenever they were exposed to the causes of the disease, they contracted it. Further, in Brazil, though the negroes appear to be less susceptible, the disease prevails irrespective of races and nationality.

OCCUPATION.

Specially predisposed to the action of the beri-beri poison are persons leading a sedentary life, inmates of goals, asylums, colleges, soldiers, sailors, & labourers working in damp and ill-ventilated places.

CONSTITUTION.

The state of nutrition would seem according to some observers to have a marked influence in beri-beri. Overbeeck de Meyer states that in the Batavia prison the disease showed a morked preference for muscular and

robust persons. Manson remarks:"It is a singular fact, and one contrary to what obtains in many other diseases that the robust and well-nourished seem to be more liable to beri-beri than the feeble and half-starved". Again:"My own impression is that beri-beri attacks anyone irrespective of his physical condition, just as measles and smallpox do". In the face of contradictory ideas on this question it is difficult to dogmatize, but the writer believes that most observations would confirm his belief that beri-beri attacks indifferently persons of all temperaments and constitutions.

PREGNANCY AND THE PUERPERAL STATE.

The susceptibility of pregnant women to beri-beri has been frequently observed, as, too, the facility with which the disease develops during the puerperium. Thus, Bentley says:"A very peculiar fact, and one which I am quite unable to account for, is the susceptibility of women after childbirth to be attacked with beri-beri." Silva Lima in 51 cases of beri-beri found 23 women, of whom ten were passing through the puerperium. He somewhat aptly remarks:"The most remarkable inference to be drawn from this statistical data is that the puerperal state is one of the most frequent predispositions to the paralytic form of the disease". Cases confirming these observations could be multiplied.

OTHER CONDITIONS. In tuberculous and syphilitic pat-

ients, beri-beri is observed with relative frequency, as also in convalescents from smallpox, measles, scarlatina scurvy, enterica, and dysentery. Corre believes inveterate drinkers to exhibit a marked predisposition to the disease. This remarkable predilection of beri-beri for the stage of convalescence in infectious diseases cannot be explained merely by the weakening of the system, anaemia, and disturbance of general nutrition then observed, for beri-beri is rare in chlorosis, leucocythaemia and anaemia, and in those weakened by other causes. Nina Rodrigues, of Bahia, as a result of careful study, admits that the existence of a latent neuritis, similar of that which Pitres and Vaillard found in tuberculosis and typhoid fever, excites a real predisposition to the intercurrent manifestation of beri-beri. In support of this opinion he presents statistics, which agree perfectly with those collected by Scheube, relating to the most frequent complications of this disease. The stage of convalescence from acute infectious diseases being precisely the period of polyneuritis, one can readily understand how beri-beri is frequent at this time, since owing to the existence of a local neuritis, the nervous system becomes more vulnerable. Furthermore, the hypothesis of a latent neuritis explains satisfactorily the frequency of beri-beri in inebriates, in women in the puerperal stste, and even persons who have formerly suffered from beri-beri. That previous attacks render

a person predisposed to a relapse after a fresh exposure, of even brief duration, to the influences of a beri-beric centre, is a matter of general observation.

BACTERIOLOGY.

In the present state of our knowledge it cannot be doubted that beri-beri is due to a specific organism. This theory as to the nature of beri-beri was first advanced in 1881 by Pacifico Periera, of Bahia, who examining the blood of beri-berics, found micrococci of uniform shape and characteristics, leading him to affirm a correlation between the presence of these parasites and the pathological process. On multiplying his observations, however, he ascertained the presence of micrococci, in small number, but exactly similar, in the blood of apparently healthy persons, and in those of patients suffering from other infectious diseases such as typhoid fever, puerperal fever, etc. In 1883, Lacerda, of Rio de Janeiro, asserted more positively the microbic nature of beri-beri. The germ, discovered in the blood and tissues of beri-beri by Lacerda, presents varied forms according to the circumstances in which it is observed: its adult final shape in fresh cultures is that of a bacillus with spore formation. Under the influence of certain conditions, however, we find streptococci, diplococci, or monococci; it also presents itself encapsulated or encysted. The stains for which it

exhibits most affinity are methyl violet and saffron; it is not stained by methylene blue. It belongs to the aerobic class; it does not form spores at a temperature above 40°C. and grows badly under 25°C. Rabbits and monkeys inoculated with pure cultures of this bacterium presented symptoms and lesions very similar to those of beri-beri. Lacerda's discovery was confirmed by Ogata Masanori and Wallace Taylor in Japan, and by Cornelissen and Suguenoya in the Dutch Indies who observed a similiar microbe(independently)in the blood and tissues of persons suffering from beri-beri.

Somewhat different results were, in 1887, obtained by Pekelharing and Winkler. They examined the tissues, prepared in various ways, without being able to discover pathogenic bacteria in them. The examination of the blood made by them furnished more positive results:they always found two species of bacteria - cocci and rods. The latter were of a somewhat irregular shape and inconstant length and thickness; they sometimes took a stain - methylene blue and fuchsin - only at the ends. Besides perfectly spherical granules, some were found of an elongated shape and others united like diplococci. The number of these micro-organisms varied greatly even in the same individual. Sometimes the preparation was full of bacteria; at other times only after a prolonged examination was it possible to find a few well determin-

ed rods or diplococci. The Dutch observers found these bacteria not only in the blood of sufferers from beri-beri, but also in that of healthy persons residing in a beri-beric centre, as Atchin, for instance. Examination of the blood of healthy persons in Batavia was negative, the observers failed likewise to find bacteria in the blood of beri-beri subjects who had been carried from the place where they had contracted the disease to Batavia, and had been under treatment for some time. In two seamen, however, who had been landed fifteen days from the vessel on board of which they had been taken ill, bacteria were found. Pekelharing and Winkler concluded that at places where beri-beri is endemic, bacteria are found not only in the blood of sick but in that of healthy individuals also, and that these bacteria disappear from the blood when the sick or healthy individuals withdraw from the beri-beric centre to an uncontaminated district. They remarked that in residents of Atchin, even among the apparently healthy, complaints of heaviness and pains in the legs, palpitation and slight oedema were common; they themselves and their assistants also felt these symptoms, which disappeared only some time after leaving Atchin. In order to ascertain which of the bacteria described acts as the ultimate factor of beri-beri, the Dutch observers undertook culture experiments; they inoculated 30 cul-

ture tubes with the blood of beri-beri patients in whom the presence of bacteria had been recognised. In only 15 tubes did they obtain a culture, that in 12 of them being micrococci, and in 3 of a bacillus. Of the cultures of micrococci 2 produced colonies of a yellow colour, and 10 of a brilliant white. Of these last, 6 liquefied gelatin; with these 6 cultures they made 9 inoculation experiments on rabbits and dogs with positive results, the autopsy of the animals showing more or less extensive lesions of the nerves. One single inoculation was never followed by a satisfactory result: it was necessary to repeat the operation daily for many days to get an effect. Pekelharing and Winkler concluded that the white micrococcus, liquefying gelatin, which they obtained from the blood, was the cause of beri-beri. This bacterium by the form and grouping of its cells, as well as by the aspect of its cultures on agar-agar, presented a great similarity to the staphylococcus pyogenes albus; the culture on agar-agar was of a milky white colour, forming a thick coat with a shiny surface, and very often with indented edges; it stained readily with aniline colours in alkaline mixture, and when treated by Gram's method it was not easily decolourised. Its growth was most exhuberant at the temperature of the body; at 68°F. it was weak, ceasing at 59°F. The air of barracks and places infected with beri-beri contains a great quantity of bacteria. They

saw symptoms and lesions of the peripheral nerves analogous to those of beri-beri on passing this air through a neutral saline solution and inoculating this solution loaded with atmospheric germs, in animals.

The above observations would seem to show that:-

(1) Bacteria of different shapes, sizes, and properties are always found in the blood of beri-beri patients examined at the place where they contracted the disease; (2) that cultures obtained with one of these bacteria, when inoculated in the lower animals, determined a distinct degeneration of the peripheral nerves with more or less paresis; (3) that these inoculations afford positive results only when repeated daily during many days; (4) that these pathogenic bacteria live in the soil and are carried about in the atmosphere; a salt solution, loaded with microbes contained in the air of barracks or infected places, is found to produce, when inoculated in animals, characteristic lesions. Another general conclusion results from the studies and experiments of Pekelharing and Winkler, namely, that the infection in beri-beri takes place in a very different manner from that observed in all other infectious diseases. In these, as soon as the pathogenic germs enter the system and determine the disease, the latter follows its natural course independently of any new introduction of germs. In beri-beri the producing germs, after living and multiplying for a certain time in the organ-

ism, die and disappear from the blood, essential to the progress of the disease being the new introductions and successive reinfections.

Certainly the researches of these savants are the best known, important, and most often quoted, in the etiology of beri-beri; and their ingenious theory, although subject to a few objections and not based upon sufficiently numerous experiments, explains satisfactorily, nevertheless, the clinical facts, and affords a good explanation of the complete disappearance of all the symptoms in many beri-beri subjects who have left the district where they contracted the disease.

The observations of Pekelharing and Winkler appear to have been confirmed by Van Eecke, who found in the blood in beri-beri two kinds of cocci, the one white, the other yellow. Rebourgeon described a micrococcus occupying the lower part of the medulla, cultures of which, inoculated in animals, produced the symptoms of beri-beri. Musso and Morelli obtained from the blood in cases of beri-beri, four species of micro-organisms, one of which, injected in thirteen animals, produced oedema and multiple degenerative neuritis with muscular atrophy. The cardiac muscle showed groups of cocci. Besides these observers others claim to have discovered peculiar micro-organisms in beri-beri. Glogner found a haemoeba like that of malaeia in the blood corpuscles in beri-beri, but he now no longer regards it as

pathognomonic. A spore-bearing diplococcus has been found by Captain Ross, I.M.S.(Indian Med.Gaz.,Dec.1900) in the rice sold in bazaars in an infected district,and also in the blood of thirty-two beri-berics.
Other observations and objections thereto have already been detailed in the etiological section. It seems somewhat premature to accept as definite the results of the investigations thus far made concerning the ultimate cause of beri-beri, for it would then be necessary to admit the germ that produces the disease is polymorphous, and that some of the organisms found are dead & degenerate forms. Although, therefore, in the present state of our knowledge it is not possible to indicate in a positive manner and isolate the germ that apparently produces beri-beri, we must consider the disease as determined by a micro organism, which ever it be,and admit the infectious character of the malady, which was proven inductively by clinicians and epidemiologists, even before any bacteriological investigations were made.

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SYMPTOMS.

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INCUBATION PERIOD.

The length of the incubation period is not yet definitely fixed. It was long believed that the residence of several months and even of two years in a contaminated place was necessary for the disease to de-

clare itself. Since then observations in the Dutch Ind-ies and Brazil have shown that beri-beri may develop in individuals coming from an uninfected locality, four or five weeks after their arrival in a beri-beric centre. It is difficult to establish the duration of the incubation period, as the beginning of the disease often passes without being noticed by the patient himself. It seems certain, however, that the time elapsing from the first exposure to the beri-beri poison to the development of the disease will depend on the degree of virulence of the germs, the continuousness with which they are absorbed, and the idiosyncrasy of the person attacked.

CLINICAL HISTORY.

Beri-beri may be divided into two stages - the prodromal stage and the stage of attack. From the insiduous nature of the approach of the disease, sometimes extending over a period of several weeks, it is often very difficult, or even impossible to determine the exact time of its invasion. As in many other diseases of slow development the symptoms of the prodromal stage are certainly not easily defined; feelings of indisposition, such as an occasional sense of chilliness, inaptitude for mental exertion, and especially a tired feeling in the lower extremities. A period of uncertain length now intervenes, during which the characteristic symptoms appear and constitute the stage of at-

tack. The first of these symptoms is, generally, anaesthesia of the skin over the anterior tibial muscles, in the tips of the fingers, and around the mouth in the order given. Paralysis in varying degrees next declares itself in certain groups of muscles, usually those immediately underlying the regions of anaesthesia. One of the consequences of this is a drooping of the toes, causing the patient while walking to lift the feet high so as to clear the ground, thus occasioning the peculiar gait noticed by many observers as characteristic of the disease. A sense of constriction in the muscles of the calves is experienced at the same time arising from a veritable contraction which causes their apparent enlargement and hardening with tension of the tendo Achillis. A feeling of tightness in the chest usually accompanies this condition, due, no doubt, to partial paralysis of the muscles of respiration. If firm pressure be now made upon the muscles in various parts of the body, a greater or less degree of tenderness will be found to exist in many of them, and especially those occupying the posterior part of the leg, back of the forearm, inside of the arm, and upper part of the chest. Tenderness of the periosteum of the long bones and a peculiar roughness of their surfaces often exists also. Palpitation of the heart, especially on making any considerable exertion, is a frequent and troublesome symptom, even at this stage of the disease.

The above symptoms up to this point are common to both the wet and the dry forms of the malady and to them the characteristic features either of the beri-beri hydrops or atrophia are now added. The first manifestation of anasarca, the pathognomonic symptom of wet beri-beri, is an oedematous condition of the anterior part of the legs. This, in reality is more or less general even at an early stage of the disease, as is evident from the plump appearance of the patient and a certain sallow-white colour of the skin, especially of that of the face. In uncomplicated cases the temperature is normal or it may be at times a little below the normal point. There is little or no increase in the frequency of the pulse. Its quality, however, is changed, and somewhat characteristic for both forms of the disease. Thus in the wet form it is full, large, and easily compressible indicating a great diminution of arterial tone, while in the dry form there is nearly an opposite condition. If the heart be now examined, a decided systolic murmur will be heard, most distinctly over the pulmonary valves; and in most cases of wet beri-beri it exists in all the arterial trunks. The heart furnishes the usual signs of dilitation and want of tone. In the dry form the cardiac murmurs are either slight or wanting altogether, and the area of cardiac dulness is variable, and as the disease advances it often diminishes.

The appetite is little impaired in the earlier stages

of both wet and dry beri-beri, but if in the former the stomach is over-distended, there is increased precordial oppression, and sometimes sudden death. The bowels in the wet form are sluggish, and urine scanty; in the other there is but little deviation from the normal in these respects.

By far the most numerous are the cases of the subacute type. From this it is evident that the acute or pernicious type of the malady is, in most cases, only an exaggeration of the sub-acute, as observed in some other diseases; The term pernicious is, strictly speaking, applicable to the wet form of the disease only, as the dry form is rarely, if ever, rapidly fatal. A marked case of wet beri-beri is always to be regarded as dangerous, from the suddenness with which pernicious symptoms often declare themselves. In these anasarca (which as has been stated, constitutes the leading clinical difference between the two forms of the malady) plays an important rôle. It often happens that in the course of a few hours the local oedema in the extremities and the slight puffiness of the face become general and extreme and the neck is enormously swollen by the distension of the veins, both superficial and deep. The pleural and pericardial sacs are more or less distended with serum, thus mechanically embarrassing the action of the organs they contain. The action of the heart now becomes lab-

orious, the lungs oedematous and filled with coarse rolls, and a terrible sense of suffocation overcomes the patient, causing him to seek relief by constant change of position. The stomach is irritable, a greenish yellow fluid is vomited, and death closes the scene. The acute stage of dry beri-beri, on the contrary, is characterised by a rapid diminution of the fluids of the body and atrophy of the muscles. The chronic type of the disease consists of the annual appearance in the same individual of either wet or dey beri-beri and its long continuance.

CLASSIFICATION.

In view of the great variety of form various classifications have been attempted. The symptoms, besides being numerous, vary a great deal as to greater or less frequency in patients. Even the most constant symptoms, such as depend on paresis, atrophy, numbness, and oedema, may be present in very variable combinations; and by way of facilitating the diagnosis it is usual for authors to study them from the point of view of their grouping and succession, classifying the cases according to the relative predominence of certain symptoms, and describing special clinical forms.

The older writers described two clinical forms, namely, the oedematous, or wet, and the atrophic, or dry, while some, finding great differences between the two

forms, considered them as distinct nosological entities. Others took exception to such classifications, believing that they did not meet the exigencies of the diagnosis, being rather a cause of embarrassment, because the paralysis, atrophy, and oedema are often associated in varied proportion, it being exceptional to meet with a case of dry beri-beri without oedema, or one of wet beri-beri without sensory, motor, and amyotrophic disorders. The classification of Silva Lima, on account of its facilitating the diagnosis, is accepted by most authors. He recognises a paralytic, an oedematous, and mixed form of beri-beri - the latter being the most frequent of the three.

Other clinical varieties have been described by certain authors: Oudenhoven, and he alone, recognise a polysarcous or adipose form. This he observed to be characterised by hypertrophy of the adipose tissue, increase in bulk of the muscles, hypertrophy of the heart, the sudden appearance of oedema and serous effusions with some motor and sensory disturbances. Thurm thinks it is probably a question of naturally fat persons in this form; and Le Roy de Mericourt holds Oudenhoven has mistaken solid oedema for fat. Oveerbeck de Meyer and Vinson have described a convulsive form. Scheube considers it practical to differentiate the four following forms: (1) The incompletely developed or rudimentary

form; (2) the atrophic form; (3) the dropsical form; or moist, or hydro-atrophic form; (4) the acute, pernicious, or cardiac form. Corre is still more confusing in describing the hyperacute, acute, subacute, chronic and abnormal forms, either simple, associated or complicated. Wernich, in addition to the galloping form of beri-beri terminated by death within a few hours or days, recognises subacute and chronic varieties. After the investigations of Pekelharing and Winkler, confirmed in Brazil and Japan by many other observers, it is no longer permissible to admit without discussion the so-called hyperacute and acute forms. Indeed, the Dutch savants have shown most clearly that beri-beri is a chronic disease, developing at first slowly and exhibiting at a later period of its evolution acute aggravations. Under these circumstances, the greater or less rapidity of development may constitute at most a clinical variety and not a special form, since in all stages of the disease may be observed the hyperacute or acute aggravation, now limited to a group of symptoms, now general throughout the course of the disease. As regards the convulsive form of Overbeeck de Meyer, the writer considers it a mere variety, since the symptoms that characterise it are observed during a limited stage of the evolution of the malady, lasting generally a short time, and do not, therefore, combine the indis-

pensable requisites in nosology to constitute a special clinical form. The same may be said in relation to the so-called gastric, cardiac, pulmonary, uraemic, and other forms mentioned in the literature and the polysarcous or adipose form of Oudenhoven. Grimm describes two forms on the hypothesis that the exacerbations and relapses of beri-beri taking place during the attack are always fresh illnesses induced by a repeated infection of the virus, while an uncomplicated case is caused by a single infection when it runs its course with final recovery and without any aggravation of the symptoms: (1) Beri-beri simplex, a simple attack of beri-beri induced by one introduction of the poison; (2)Beri-beri multiplicatum s. accumalatum, arising from a fresh infection of the virus repeated several times. Yamagiwa considers that the symptoms of beri-beri susceptible of grouping in three different ways, constituting three clinical forms: (1) The cardiac form - the most acute form; (2) the nervous-muscular form, which is generally subacute or chronic, and accompanied by motor and sensory disturbances; (3) the renal form(cardiac form), which varies according as the finer arterial branches of the lungs(cardiac form), or the arteries of the peripheral nerves and muscles(nervous muscular form), or the branches of the arteries of the kidneys(renal form)are particularly attacked. This ob-

server refers ℓø beri-beri to a poison, ingested with rice, which produces contraction of the finer arterioles in the circulation.

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ANALYSIS OF THE SYMPTOMS.

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NERVOUS SYSTEM.

There is no certain evidence of a direction attack upon the higher nerve centres. The mental faculties are not markedly affected until perhaps the patient is dying. Again it is exceptional to find any impliaction of the centres or nerves of sight, hearing, smell, or taste. With the exception of wasting of the subcutaneous fat in certain cases, there are none of the trophic lesions of the integument such as characterise spinal diseases. Thus bed-sores are seldom seen in beriberi running an ordinary uncomplicated course.Scheube's case of what he thought was a trophic joint lesion is a clinical curiosity on account of its great rarity.These lesions of beri-beri point to implication of the peripheral nervous system, and are practically identical with those seen in diphtheritic, alcoholic, and other varieties of neuritis. The neuritis of beri-beri, whilst it presents many features in common with other forms of peripheral neuritis, presents special features more or less distinctive and peculiar to itself, in the same way that there is a tendency for each of the special forms of peripheral nerve inflamation to display a

more or less characteristic grouping of symptoms peculiar to itself, and just as the poison of each of these diseases shows a predilection for particular sets of nerves.

Motor Disturbances.

Usually the prodromal stages pass into that of the declared attack slowly and gradually; to the vague and ill-defined symptoms of the former are added others, which denote that the nerves of voluntary motion and those of general sensibility are affected. The weakness of the legs, which at first the patient felt only when walking fast or going upstairs, becomes more accentuated and constant, and is accompanied by a feeling of heaviness; the patient walks slowly and often feels that his legs are about to fail him, bending and not obeying the action of the will. These troubles are soon followed by other graver ones which constitute the beri-beric akinesia. There is more or less intense paresis, always beginning in the lower limbs and choosing the extensor of the great toe, and the common extensor of the toes are sometimes almost entirely paralysed. At first incomplete and limited, the paresis becomes more and more pronounced, acquiring greater intensity and invading a greater number of muscles; it usually travels progressively upwards; after the muscles of the legs, those of the thighs are affected, and then those

of the forearms, arms, and hands, abdomen, and thorax. In the upper extremities there is also a certain predilection for the extensor muscles, so that we sometimes see the peculiar distribution noted in the various types of lead palsy. As the disease progresses, all the muscles of the extremities become affected, including those of the fingers and between the radius and ulna(the interossei). Paralysis of the sterno-mastoid and the trapezius has not yet been observed; Pekelharing believes that the biceps and the pectoratis major are among the last to be attacked; the facial muscles & the extrinsic muscles of the eye are sometimes, though rarely, involved. Those of the larynx are more frequently implicated; hoarseness is observed in many cases, and this, according to Van Eecke, is due not to the paralysis of a definite muscle or physiological group of muscles, but to paresis of all the muscles. Laryngeal paralysis may be the cause of sudden death (Pekelharing and Winkler). Seldom is complete motor paralysis seen; in a sitting or reclining posture, even in the advanced stages of the disease, the patient is still able to move the paralysed limbs. When the disease, after having reached a certain period, tends towards a cure, the akinesia retrogrades also in a gradual manner, following a descending course. It first abandons the muscles of the thorax, then those of the

abdomen and those of the upper extremities, and finally those of the legs. This fact, as well as the ascending progressive evolution at the beginning of the disease, although constituting a general rule, is open to some exceptions. In the majority of cases only the legs and forearms are affected, and that in a symmetrical way; the other muscles may be involved more or less capriciously. The weakness at first, and afterwards the weakness of the extensor muscles of the leg and the flexors of the foot, and the disturbance of sensibility, determining from the outset an imperfect perception of the ground, impart to the gait of the beri-beric a characteristic feature. The first modifications in the gait may be observed as early as the end of the initial phase; they become, however, more accentuated as the disease progresses. At first the patients increase the distance between their feet in order to widen the basis of support; at the same time they are very cautious, fixing their eyes on their feet and on the ground, fearing a fall or that their legs will not obey exactly the influence of the will. The gait may then be compared to that of a feeble person wading through a sheet of water reaching to his knees. Later on the gait becomes more irregular; the patient raises his heals very high, walks on the outer edges of his feet, the toes dragging on the ground, and keeps the inner edges lifted high so

that they do not touch the ground; hence often result irregular movements of the ankles, twisting of the foot, falls and sprains. If the patient insists on continuing to go about, he drags his toes more and more in a way that reminds one of the pawing of a horse and there is great flexion of the thigh exerted on the pelvis. After a few steps the patient feels fatigued, seeks for support, and can no longer walk unless helped by a stick or attendant. The patient has great difficulty in standing on one foot with his eyes shut, and even sometimes with them open; this difficulty which may be observed from the outset of the disease, becomes more & more pronounced during its course. Romberg's symptoms often exist. The sign of being unable to march properly in obedience to orders may also be seen at an early stage of the disease; the patient has difficulty in rising suddenly, in turning round rapidly, and in halting suddenly to command.

SENSORY DISTURBANCES.

These are constantly present in beri-beri. Among the first symptoms there is always a numbness of the skin, which develops symmetrically, beginning in the legs and extending to the feet, and afterwards to the thighs. Frequently t he numbness that the patient complains of in his feet and legs passes without transition to the hands, fingers, and tips of the latter; the

patient has difficulty in taking hold of surrounding objects and in buttoning his clothes. In some cases there is a certain regularity in the distribution of the anaesthesia; beginning in the legs, it descends, spreading over the instep, and ascends over the inner surface of the thighs; then the soles of the feet and outer surfaces of the thighs are attacked. At the same time, or a little while after, it appears on the inner surfaces of the wrists, spreading over the backs of the hands, along the fingers to the finger tips and palms of the hands; it afterwards spreads to the forearm, elbow and shoulder. The skin of the chest and abdomen is more rarely affected. Pekelharing believes that the anaesthesia always spares the groin and neighbourhood. According to Simmons, numbness around the mouth is a frequent sensory disturbance of beri-beri. This is denied by others. The temperature sense to either heat or cold, or both, may be diminished or even suppressed in various parts, and there is often considerable loss of faradic sensibility. The diminution in the sense of perception of heat and cold accompanies that of the sense of touch, and is localised in the same way. The sensibility to pain disappears more gradually; at first there is retardation in the transmission of painful impressions in regions where the numbness exists, and afterwards complete anaesthesia. Usually there are

alternate areas of more or less pronounced anaesthesia, paraesthesia, and hyperaesthesia, that is to say, the disorders of cutaneous sensibility are irregularly and capriciously distributed.

Various other disturbances of sensation are complained of, e.g., formication, tingling, prickling. Some patients state that the ground often feels elastic as if it were covered with thick layers of cotton, or unequal or stuck full of needles which prick their feet; others when they touch the roof of the mouth with the tongue feel a sensation like that produced by hairs or threads (Costa Alvarenga). Hyperaesthesia is frequently observed, not only in the skin, but in the muscles, when it constitutes real myalgia, causing spontaneous or provoked pains; this hyperaesthesia is commonly observed in the calf muscles, and in those of the thighs and forearms. Tenderness of the nerve trunks may be observed, but in far less degree than in most forms of polyneuritis. The pains may assume a neuralgic character. Visceral crises, like those of locomotor atoxia, are sometimes seen; they are chiefly gastric, laryngeal and urethral. What is termed "anaesthesia dolorosa" may be observed when anaesthesia and hyperaesthesia coincide in the same patient. Patients suffering from beri-beri often complain, at the beginning of the disease and even during its course, of a feeling of constriction,

heaviness, and rigidity of the muscles, and painful cramps, especially in the muscles of the calf and thigh. Cramps involving most of the muscles of the body, and preceded and followed by fibrillary contractions, were observed by Pekelharing and Winkler. A frequent symptom complained of by patients is the feeling of tightness, strong pressure, or constriction like that of a belt over the epigastrium, spreading a little towards the hypochondria; this is termed the "beri-beri belt", and the patient suffers from dyspnoea and a feeling of oppression when it becomes intensified.

The cutaneous and tendinous reflexes are exaggerated at the beginning of the disease and also in what are termed galloping cases; after some time, however, they become weakened, those of the lower limbs even disappearing in the advanced stages of beri-beri. Westphal's symptom exists almost always; indeed the knee-jerk is the one which is the most weakened, and is the first to disappear in the advanced stages. It may be diminished in the one knee and absent in the other.

More rarely do we find disorders of the special senses of sight, hearing, taste and smell; but one sometimes comes across descriptions of cases in the literature attended by more or less pronounced ocular disorders, comprising strabismus, diplopia, amblyopia, and amaurosis, as well as disturbance of taste, smell, and hear-

ing. Total blindness appears to be rarely encountered and then only in moribund patients.

Both motor and sensory disturbances are unstable in the -ir manifestations, for they may increase or diminish from one day to another, or remain stationary for several days.

FEVER.

Beri-beri for long was described as an apyretic disease, any fever present being referred to a cause foreign to it. All observers are now agreed that there is no fever in the advanced stages and that the temperature may be sub-normal; this last symptom always indicates a serious condition and the approach of a fatal termination. The same unanimity, however, does not exist in relation to the possibility of fever at the outset or during the first stages of the malady. Bentley says: "The temperature charts are of interest from their negative results. In no case could an onset of acute symptoms have been foretold by the observations of the temperature chart. It is essentially a non-febrile disease". Professor Saraiva of Bahia, has emphasised the existence of fever in beri-beri, and has given an accurate description of the acute febrile forms of the disease observed by him during the Paraguayan war. Later observations have shown the possibility of a febrile temperature independently of complications during the course of beri-beri.

According to Schutte, the temperature varies considerably; sometimes we observe cases free from fever;others exhibiting a frank febrile condition, chiefly in the acute forms of the disease; then the fever is continued attended with thirst, exaggerated palpitations,dyspnoea and prostration; sometimes the febrile temperature and apyrexia alternate. The fever in beri-beri is at most inconstant and very irregular as to appearance,duration and type. In some patients the disease runs its course from beginning to end without fever; in others there is fever whenever acute exacerbations of the symptoms occur during the first stages. The fever may or may not be preceded by chills; it may last one or more days,the temperature rising to about 103°1°F.; and the febrile type may be continuous, remittent or intermittent. In most cases the fever occurs during or just after the initial stage of beri-beri. Patients state that the numbness and other symptoms appeared after an attack of fever, or that a few days after the appearance of those symptoms they felt feverish. When it occurs during the initial phase, the fever is often supposed to be due to a cold or to gastric indisposition, and when beri-beri is confirmed and the patient demands medical attention, he often forgets to refer to that fever. Manson, in Hong Kong, had the opportunity of watching, in a small number of attacks, the development of beri-beri from

its commencement. The patients had been admitted to the hospital for various non-febrile surgical diseases. As a matter of routine the temperature was regularly taken night and morning for some time before beri-beri declared itself. These were quite free from fever on admission, and for a considerable period thereafter showed no signs of beri-beri. Seven of the hospital patients were affected by this disease, and in each of them, soon after the appearance of the premonitory numbness more or less marked, sometimes severe, pyrexia, preceded by rigors, occurred.

URINE AND GENITO-URINARY ORGANS.

The secretion of urine in beri-beri is often diminished; in some patients in the oedematous forms of the disease, it may be reduced to ten ounces a day, and may be even completely suppressed, constituting true anuria. Whenever this happens, the patient exhibits symptoms of uraemia, which will be the more intense and rapid the greater the decrease of uropoiesis. The occurrence of beri-beri uraemia without preceding albuminuria was first described by Francisco de Castro. The diminution of the urinary secretion and anuria in beri-beri may be due to a great venous congestion of the kidneys determining a compression of the urinary tubules and afferent arteries; this venous congestion is in its turn caused by the low arterial tension. But the

arterial tension is not always so low as to be able to provoke a venous congestion of the kidneys sufficient to produce anuria. Nina Rodrigues believes that beri-beri anuria is due to an oedema, of vaso-motor origin, of the cortical portion of the kidneys, and since the tissues at this point are inextensible, the oedema exercises compression on the afferent vessels, determining an exudation in the ducts. This explanation, which was proposed by Rénaut, of Lyons, to account for the false renal impermeabilities of interstitial nephritis seems worthy of acceptance in relation to beri-beri anuria. The polyuric crises that often succeed the complete suppression of the urine, the elimination during them of great quantities of urea, and the constant implication of the sympathetic nerve in mixed and oedematous forms of beri-beri favour renal oedema. The urine in beri-beri is usually acid, its density varying according to the greater or less amount secreted; it deposits sediment, is slightly coloured, and contains always a smaller percentage of urea. The quantity of urine is often enormously increased with the disappearance of the oedema. In the majority of cases albumin is absent; when found it is due to some accidental complication or to vascular stagnation towards the close of grave cases.

A diminished sensibility of the mucous membrane of the bladder is seen in some cases; there is a desire to

pass water only when the bladder is full to distension; others find some difficulty in urinating owing to a slight paresis of the bladder, or to weakness of the abdominal muscles; others complain of a burning sensation and even sharp cutting pains along the entire course of the urethra, whilst micturating; usually no such disturbance is felt.

Women attacked by beri-beri usually have menstrual troubles, the flow being sometimes suppressed, sometimes delayed, and sometimes less abundant. The beri-beric patient loses all sexual desire and may become quite impotent.

OEDEMA.

The oedema forms a constituent part of the symptomatology of beri-beri and it may appear in all forms of the disease. It has a marked predilection for the legs and usually appears over the antero-internal surface of the tibia or on the instep. It usually varies in intensity and is most marked in dropsical form of the disease, in which the dropsy spreads more or less to other parts of the body, the face, the arms, the trunk, the genitals, and in which the serous sacs contain fluid. Moderate oedema, besides on the shins, is usually best marked about the flanks, the root of the neck, and over the sternum. The degree of swelling may vary from day to day. It feels rather firmer than the oedema associated with Bright's disease, for it pits

less readily and does not involve the genitals to any great extent. In the hands and arms a peculiar localised oedema may be met with, causing a limited and sharply-defined area of the skin, some five inches in diameter, to be puffed out to a great extent. Such swellings may develop in a few hours and disappear quite as suddenly.

MUSCLES.

In beri-beri the muscles exhibit a constantly altered condition; they are sometimes atrophied and sometimes enlarged; and both atrophied and swollen muscles are sometimes found in the same patient. The muscular atrophy may be found in some muscles only or in groups of muscles, and may also invade all the striated muscles of the whole body. In relation to its intensity, the atrophy assumes various degrees; for instance, in dry beri-beri the legs, in the last period of the disease, appear to consist entirely of skin and bones. In the hands the thenar and hypothenar regions are depressed, the interossei and lumbricoid muscles become thinner. The atrophy may in some cases be disguised by the infiltration of fluid between the muscular bundles. The apparent muscular hypertrophy that is often observed, & which, when it assumes a great intensity, constitutes what is called the "polysarcous beri-beri" of Oudenhoven, is due to the swelling of the muscles, and may also

be dependent in some cases, as is shown by the autopsy, on an exaggerated development of the muscular fibres, attended with degeneration. The swollen muscles feel hard and firm to the touch, and when contracting may present circumscribed areas of enlargement. Anderson says that indurations in the calf muscles, symmetrical and apparently confined to the inner belly, are often observed in chronic cases. Both the atrophied and hypertrophied muscles may be in a state of hyperaesthesia so that the patient resents pressure being made upon them. In subacute cases, there is often an increase of mechanical irritability, which coincides almost always with the increase of galvanic irritability. When examined electrically the affected muscles and nerves exhibit a more or less pronounced diminution of the irritability for both the galvanic and the faradic currents, and a partial or complete reaction of degeneration. There may be a very short period of increase of irritability in some muscles and nerves at the beginning of the attack of beri-beri or coincident with the acute exacerbations.

BLOOD.

The blood is not always found altered in beri-beri sometimes, indeed, it shows no peculiarity. In mild cases the number of red corpuscles is not diminished; but in severe illnesses they are decreased throughout, the haemoglobin still more so. The white cells are

relatively increased in severe cases. Däubler says that in three beri-beri convalescents he observed an increase of the particles of fat in the blood, due to absorption from the diseased nerves. Schneider, Scharlee, and Scheube found partly a decrease of the solids of the blood,- especially of the cells and albumin,- & an increas of the watery and mineral constituents, and partly a normal composition. As this was observed in moribund acute cases only such vascular changes, though occurring, are by no means necessary concomitants of the beri-beric seizure. The same may be said for anaemia which some observers have made much of.

PULSE.

The pulse in beri-beri is usually accelerated, and remarkably sensitive to finger-pressure and varying with change of posture. Scheube says that in grave cases the pulse slows down before death, and mentions two cases, in one of which the pulse fell in five days from 104 to 20, in the other from 120 to 54. The finger or a pulse-tracing show that diminished cardiac power and lowered arterial pressure are present.

HEART.

Most cases of beri-beri have present bruits. They are usually systolic. Sometimes the second pulmonary sound may be found accentuated; rarely it is reduplicated as the first sound at the apex of the heart is occasionally said to be. One frequently observes a puls-

ation in the veins of the neck, and it is due, no doubt, to cardiac dilatation with consequent tricospid regurgitation.

Most, if not all, patients complain of palpitations of the heart from the very earliest stages of the disease. At first they occur in consequence of some effort or exercise, but later they appear spontaneously, in more or less lasting troublesome paroxysms. In some patients they are attended with a feeling of precordial oppression, which may turn into an attack of angina pectoris, with a piercing and constricting pain behind the sternum spreading to the shoulder and left arm, with dyspnoea. Sometimes the pain may be in the nature of a severe fulness in the epigastric region.

The right ventricle is often found on percussion to be more or less dilated and hypertrophied, less often is this the case with the left ventricle. Miura has observed that, in consequence of the high position of the paretic or paralysed diaphragm, the cardiac impulse in many grave cases was to be found outside the nipple line at the fourth intercostal space.

DIGESTIVE ORGANS.

Digestion is frequently disordered, but by no means always, in beri-beri. The distension of the feeble stomach occasioned by a full meal induces cardiac pressure and pain, so that such substances as rice are ill borne.

From the beginning of the disease, however, there may be loss of appetite, a furred tongue, nausea, vomiting, and diarrhoea or constipation, the two last sometimes alternating.

The liver and spleen may remain normal, or be enlarged in the acute form of the disease and slightly painful on pressure. Some foreign complication may occasion these phenomena.

RESPIRATORY ORGANS.

Together with palpitation beri-berics often suffer from shortness of breath, especially in severe attacks; and aphonia is a common phenomenon in cases approaching a fatal termination.

Occasionally one may observe colds in the head, inflamation of the throat, and mild laryngeal, tracheal, and bronchial catarrhs; these may occur during the prodromal stage or after the disease has fully developed.

Oedema of the lungs is very apt to occur in the dropsicaal form of the malady and generally the finale in such cases. It is recognised by the occurrence of increasing dyspnoea, with cough and frothy expectoration, and later, if the patient survives, by the presence of moist crepitations of a fine character.

DURATION.

Beri-beri has a variable duration of from five weeks to two years when chronic. The disease usually lasts a considerable period and is subject perhaps to

acute paroxysms during one of which the patient may succomb, or he may be cured by change of residence. Again, the ilness may remain stationary for a great time or grow worse very slowly when he remains in an endemic centre. Cases lasting as long as one or two years are probably real relapses of the disease. Certainly such are very common in beri-beri; sometimes three, four, or five occur in the same patient. Finally, there are persons who, taking the disease every time they go there, are forced eventually to stay away.

SEQUELAE.

From the description given it one can readily understand why serious deformities are so often seen in beri-beri convalescents,- when the muscles are imperfectly restored after the attack. The commonest sequela is that of talipes equinus. Heart disease may remain after the illness; the arms and legs may be weakened; oedema of the same, together with anaesthesia of the skin in various situations are frequent findings in beri-beri countries and elsewhere.

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MODE OF DEATH IN BERI-BERI.

As regards the symptoms that often precede death during one of the acute paroxysms of this disease it is noteworthy that the grave symptoms may appear without warning, nearly always developing in the course of a subacute or chronic attack. The patient may come under

treatment, say, for beri-beri of an apparently ordinary character; he is usually strong and well-nourished, has no sign of anaemia, and little or no oedema; the disease progresses in the usual manner, and no evil is anticipated, when suddenly rapid action of the heart, strong pulsation in the neck, and difficulty of breathing appear, with a distressing pain in the abdomen. Soon afterwards the patient vomits; and while an observer unaccustomed to see the disease still apprehends no danger those familiar with beri-beri know that the fatal ending is near. During the next few hours the breathing becomes more embarrassed, the pulsation of the heart more and more accelerated, and vomiting occurs from time to time. The patient can lie down no longer; he sits up in bed or tosses restlessly from one position to another, and with wrinkled brow, staring, anxious eyes, dusky skin, blue, parted lips, dilated nostrils, throbbing neck, and labouring chest, presents a picture of the most terrible distress that the worst of diseases can occasion. There is no intermission even for a moment, and unless active treatment be at once resorted to the pulse fails, the temperature becomes subnormal, and at length the patient passes away in a state of profound coma.

MORTALITY.

According to time and place so does the mortality

of beri-beri vary. On the whole the disease carries off few patients now than formerly. It is in the three principal centres of its prevalence, Japan, the Dutch Indies, and Brazil, mildest in the first, marked and most malignant in the last. Scheube gives the average mortality in Japan as averaging 3.7 per cent., & Balz, a maximum of 2.5 per cent. In the Dutch Indian army, from 1884 to 1894, van de Burg observed a variation in the death rate from 2.83 per cent., in 1891, to 6.12 per cent, in 1885, the average being 4.43 per cent. Da Silva Lima states that the Brazilian mortality fluctuates between 50.8 per cent. and 74.5 per cent. Further it varies from year to year, and from one place to another.

PATHOLOGICAL ANATOMY.

The beri-beri cadaver presents an appearance in accordance with predominant clinical forms and the lesions that produced death. When the paralytic and atrophic form predominated during life, the body may appear as destitute of fat as in progressive muscular atrophy. When during life, the dropsical form predominated, the body presents an appearance similar to that which is observed in persons who have died from Bright's disease. If an incision be made in the skin, the presence of serous fluid in greater or less abundance may be recognised in the subcutaneous cellular tissue, and in and

between the muscles. If death was violent, owing for instance, to the sudden arrest of the heart's action, or to paralysis of the respiratory muscles, the agony remains stamped upon the features. The face is swollen, cyanosed, the mouth remains half open, the lips are covered with a frothy saliva, the eyes appear to start from their sockets, ecchymoses are seen upon the conjunctiva, and the jugular veins resemble thick blue cords under the skin. Post-mortem lividity appears early, and rigor mortis is usually slight and of short duration.

With or without oedema elsewhere the autopsy reveals the presence of effusions in the serous cavities. Dropsy of the pericardium is constant; according to van Leent, it may amount to 2c. Hydrothorax may also be observed. The heart is seldom found in a normal condition: it is usually enlarged, the right ventricle in particular is nearly always dilated, sometimes hypertrophied, and occasionally, too, the left ventricle. Ellis reports the average weight of the beri-beri heart in 125 autopsies was 13.37 ounces, and less than 9 ounces in other 204 cases.

The myocardium is nearly always fatty. Fatty degeneration and opacity of the muscular fibres were seen by Yamagiwa in 50 per cent. of his autopsies.

Pekelharing and Winkler, Balz, and others report the

finding of small myocarditic foci such as are seen in diphtheria and certain infectious diseases. Cellular infiltrations into the subpericardial tissues, and tiny myocardial haemorrhages have also been described.

The blood of the beri-beri cadaver on exposure to the air is very slow in its formation of clot: it is dark red and remarkably fluid - said by Miura to be due to the large amount of C 02 which it contains.

The lungs are generally distended with blood, and may be oedematous, with emphysema of the apices and anterior edges.

The mucous membrane of the intestines usually exhibits punctiform venous haemorrhages and appears often to be the seat of oedematous swelling. The same may be said for the stomach in many cases.

The liver and spleen appear sometimes normal, at other times congested or altered by fatty degeneration.

Hyperaemia and cloudy swelling of the kidneys are common findings, and may be accompanied by granular degeneration of the renal cells. Miura reports glomerular nephritis; others have seen haemorrhage into the renal pelves.

The most important morbid changes are seen in the nervous system, and it is the peripheral nerves which in beri-beri constitute the principal seat of the disease. The changes in the peripheral nerves were first described by Bälz, and by him shown to be constant. His

description has been confirmed by Pekelharing and Winkler, Scheube, and others. On examination, the peripheral nerves, besides some normal or almost normal fibres, present many degenerated ones, showing various alterations according to the degree of the pathological process. Now the nerve fibre appears thicker, the myolin sheath loses its regular form of a double outline cylinder, and appears segmented; the medullary substance is wanting at the level of the nodes of Ranvier, where may still be seen the axis cylinder; again the myolin presents itself broken up, all changed into granulations; at the level of the interannular nuclei are found two or three coloured nuclei; the myelin then disappears entirely, and with it the axis cylinder, leaving the nerve tube reduced to the empty sheath of Schwann. The nerve fibres may, moreover, appear thin with swellings at certain places; un the swollen places are found small black or yellow coloured globules, perfectly mixed with a frothy mass, which takes a light pink hue by the addition of carmine; by reason of the absence of the myelin, the sheath of Schwann collapses; on the inside may be seen very fine fibrils; a colourless cone limits the frothy mass, and at its level may be observed the fibrillary structure of the contents of the nerve tube. In many cases there is an increase in the number of the nuclei of the endoneurium, and pronounced inflammatory alterations of the blood-vessels.

The known lesions of the periaxial segmental neuritis of Gombautt are sometimes found in the nerves. In chronic cases there is hyperplasia of the endoneurium of a gelatinous nature. The increased connective tissue crosses in the interior of the nerve bundles, forming thick septa which frequently divide a few nerve fibres into a great number of distinct parts. The nerve lesions of beri-beri are not regularly distributed; in the same nerve trunk certain of the tubes are found almost normal, if not entirely so, and others the the myelin of which is broken up in large pieces; fine fibres ,empty sheaths of Schwann, fibres presenting alterations of periaxial neuritis, and finally proliferation of the interfascicular connective tissue; dilatation of the vessels, and extravasation of blood are also met with. As a rule the anterior and posterior spinal roots are unaffected. The lesions are not uniformly distributed throughout all the nerves; even in the same nerve they are more accentuated at the periphery than in the centre.

As regards the rest of the nervous system, Balz, and others found more or less pronounced congestion or oedema of brain and the medulla; partial or total softening of the spinal cord; alterations of the cells of the anterior and posterior spinal nerve roots; amylaceous corpuscles in the spinal cord, cerebrum, cerebellum,and bulb.

In ten cases Pekelharing found the medulla perfectly normal six times; with probable but trifling modifications in the two radicular zones, three times; with distinct alterations in the posterior zone once. In one case Scheube found atrophy and partial disappearance of the ganglion cells of the anterior horn. In three cases Miura found vacuolation of the cells in the anterior horn. The vacuoles occur singly or in groups of various sizes, sharply differentiated from one another, and always in the neighbourhood of the nucleus; the body of the cells is often largely occupied with the vacuoles, while the nucleus is little altered. Bently found the spinal cord in all cases enormously congested softened, and oedematous in some, while the brain and dura mater were in others likewise congested.

MUSCLES.

Lesions of the muscles coincide with those of the nerves and are frequent, being chiefly seen in the paralytic form of beri-beri; atrophy and sometimes hypertrophy, or rather swelling, are constant findings in these cases. When the muscles are much atrophied they assume a yellow colour; when swollen yellow streaks and pinkish spots alternate, giving them a marbled appearance. According to Scheube, in most cases there are atrophy and fatty degeneration of the muscular fibres, with increase of nuclei. At the same time there is fre-quently a degeneration similar to colloid, by reason

of which the muscular fibres become thinner and homogeneous, and are reduced to fibrils; true colloid change is seldom seen; in place of the muscular fibres that are atrophied and that disappear completely or in part, connective tissue and newly formed nuclei are found, and peculiar alterations of the vessels show themselves. Pekelharing saw no loss of transverse striation, but finely granular muscular fibres, others with the appearance of wax, with indented border, others swollen and rounded, others merely atrophied with an increase of nuclei in certain cases.

KIDNEYS.

These organs are usually in a state of hyperaemia and cloudy swelling, and show granular changes in their cells. Miura states that he has often seen glomerular nephritis, and Bently testifies similarly. According to Scheube, the kidneys are generally engorged with blood; and in two cases he saw several haemorrhages in the renal pelves.

D I A G N O S I S.

Beri-beri is usually easily diagnosed in endemic centres; not so, however, in palces where it is unknown, at least the first cases. The following symptoms should serve for the recognition of the disease: The previous existence of a latent neuritis; the endemic or epidemic

development of the malady; the special symptoms of the prodromal stage, chiefly those revealed by electrical examination; the characteristic oedema of the anterior surface of the tibia and the puffiness of the face; the irregular peripheral distribution of the sensory and motor alterations, denoted by the respective symptoms; the exemption of the sphincters of the bladder and rectum; the amyotrophy; the existence of the so-called "beri-beri belt"; the peculiar gait known as "steppage"; the visceral symptoms, especially the cardio-vascular; the coexistence of oedemas and effusions of the serous cavities and disorders of the sensory and motor nerves; the progress of the disease with its stages of aggravation, pause, and retrogradation; and, finally, the abatement of all the phenomena, or their complete disappearance on the patient's departure to a district where beri-beri does not prevail.

The history of the case and the epidemic or endemic nature of the malady are factors of prime importance in differentiating beri-beri from diseases resembling it. Among the latter are: Spinal meningitis, locomotor ataxia, progressive muscular atrophy, ankylostomiasis, trichinosis, nephritis, polyneuritis and acute ascending paralysis. Should doubt exist, as, for example when the disease has been preceded for some time by indefinite symptoms common to beri-beri and other maladies or when serous effusions have been prelimary to the

attack, the diagnosis must be established by further ob-servation of the illness.

PROGNOSIS.

In the majority of cases beri-beri is favourable in temperate climates. In seasons of its epidemic prevalence, however, all cases of the oedematous form of the disease must be carefully watched, as it not infrequently happens that grave symptoms suddenly appear at a time when no danger has been anticipated. An unfavourable prognosis may be ventured when, in a case of oedematous beri-beri, relief is not obtained from the remedial measures employed or when vomiting sets in. In dry beri-beri the termination in death is exceedingly rare as a direct result of the action of the poison producing the disease, so that when death does occur it is chiefly from exhaustion.

The prognosis will also be determined by the presence or absence of disturbances of circulation: should these occur early in the disease the outlook may be taken as unfavourable, and whenever arising they constitute a cause for anxiety. Even severe oedematous cases eventually when they are either absent or not pronounced. Increase of urinary secretion and return of appetite are favourable signs; Complications or the existence of diseases or vices in connection with or prior to the

attack materially add to the gravity of the prognosis.

T R E A T M E N T .

The best form of treatment for beri-beri patient is his removal away from the place where the disease was contracted, and this is frequently the only treatment necessary if it can be done early. The effect of this change is often almost magical, especially if it be made to an elevated locality and among the mountains. When removal is impossible, care should be taken to place the patient in a well-ventilated room. He should be removed from the neighbourhood, from the house, or at least from the room, in which he was taken ill. He should be surrounded with all hygienic conditions; if he can go out in the fresh air without excessive fatigue he should be encouraged to do so as much as possible, but long walks and exposire to the sun or to the damp should be avoided.

Diet is an important element in the treatment of beri-beri. Coarsly prepared grains, such as wheat and barley, apparently because of more or less laxative properties are preferable as articles of food. A small red bean called adzuke, possessing both laxative and diuretic properties, is a favourite remedy with the Japanese for beri-beri. It is used alone or mixed with rice and is not infrequently the only means resorted to for

the cure of mild cases.

No drug has yet been discovered possessing specific properties in this disease. In the oedematous form many physicians are in favour of the administration of drugs calculated to draw off the excess of serum in the areolar tissues and in the serous sacs, using for this purpose such aperients as sulphate of soda, Carlsbad salts, and sulphate of magnesia in large doses. Marked relief from the urgent symptoms and in many cases a cure have been reported from the exhibition of such remedies. Others, however, deny that they are of any use, but rather that they have the effect of weakening the patient: they may be used with advantage in small doses, however, for the correction of digestive disorders and constipation, more especially Carlsbad salts: Anderson's treatment of beri-beri with a combination of crotan oil (2 drops) and calomel is too heroic for adoption by cautious practitioners.

Anderson has also advocated the use of copious blood-letting in those cases in which death is imminent, but the practice as likely to lead to disastrous conseqences should not be imitated.

Particular attention must be paid to the condition of the heart in the treatment of beri-beri, and as a reliable remedi⌀al agent digitalis stands supreme. Either as the tincture or digitalin it has a marked effect on

both the palpitation and the dropsy when present. In the latter condition it may advantageously be combined with other diuretics such as squills and acetate of potassium. Serious cases may require the exhibition also of ether, strychine, or other stimulants. Strophanthus, coffeme, diuretin and belladonna are amongst the other drugs advocated for palpitation and cardiac disturbances. Balz recommends cocains in acute beriberi with threatening paralysis of the heart, while Simon believes a better tonis effect can be obtained from doses of five to tem minims of a 1 per cent. solution of nitroglycerin every fifteen or thirty minutes. Other troublesome symptoms, such as pains, digestive difficulties, and the like, call for treatment on general principles. The systematic exhibition of nux vomica, strychnine, ergotin, potassium iodide, arsenic, and phosphide of zinc has been advocated by certain observers to overcome the paresis, as also have electricity, massage and hydrotherapy. The majority of clinicians regard these measures as more harmful than beneficial, especially at the commencement of the disease and during the progress of the paralytic condition. The exhibition of these physical agents, sea-bathing, electricity, massage, and the employment of general tonics are, however, of service in chronic cases, or in the retrogressive stages of the disease, after the acute

aggravations have passed away and the paralysis promises to be amenable to treatment.

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A D D E N D U M .

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The writer desires to intimate the fact that in 1897 he was resident in Dublin and was frequently in attendance at the Richmond Asylum during the famous outbreak of Beri-beri in that institution. Since then he has seen many cases of the disease at the Greenwich Seamen's Hospital. Consequently, his views upon the manifestations of the malady have been somewhat prominently displayed in the text in accordance with his personal experiences, while the observations of other workers in this interesting affection have not been disregarded.

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F I N I S .

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