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THREE SHIPS WITH BERIBERI OUTBREAKS SHOWN TO HAVE HAD EXTENSIVE FORMATION OF CARBONIC OXIDES DURING THE VOYAGE — ANALYSIS OF BERIBERI BLOOD — CONCLUSION THAT BERIBERI IS NOTHING BUT CARBONIC POISONING OF THE BLOOD.

BY ALBERT S. ASHMEAD, M D., NEW YORK, N.Y.

IN *Science*, Nov. 18, 1892, I contributed an account of the outbreak of beriberi on board the bark "H. B. Cann," from Ilo-ilo, Philippine Islands, with a cargo of raw sugar. That cargo fermented during the trip, stifling fumes filled the ship, and the beriberi outbreak was considered the consequence of this state of things.

In an article which will shortly appear in the *Medical News*, entitled "Investigation of the Outbreak of Beriberi on Board the Bark 'Pax' from Ceylon with a Cargo of Graphite," I show that, from the deficient packing of 1,200 tons of graphite, the cargo was exposed to the moist air encountered on a tropical voyage, all but six of a crew of nineteen were stricken with beriberi.

The bark "J. C. Warns," from Java and Macassar, with a cargo of green coffee, arrived in New York June 23, 1890. The captain and three men had died of beriberi. The coffee had been picked and shipped too green. Mr. Tobias, consignee of the cargo, showed me a sample of it; it was charred, carbonized, and almost destroyed. The coffee had fermented. The outbreak of beriberi on a ship from Java, where the coffee has been carbonized, is a regular occurrence. Java coffee owes its value in our market to its color; in order to obtain this color, the captains take their cargoes quite green, which favors a slight fermentation during the trip. Sometimes they go too far; the coffee is too green, and the fermentation too violent; in such cases there is always carbonization; the grains stick together in great masses, and abundant fumes (carbonic gases) fill the ship.

The iron ship "Glenmorag," Captain Currie, 133 days from Colombo, Ceylon, with 1,100 tons of graphite on board, 800 tons of cocoa-nut oil, etc., arrived July 17 in New York. This ship, loaded in Colombo alongside the "Pax" (mentioned above), travelled the same course, at an interval of two weeks. She lies now at the Atlantic dock, in Brooklyn, again alongside the "Pax." She had no beriberi outbreak. From her first mate I have the following information:—

Crew, 28 men; captain's wife and two children on board; or all, 31.

She is a Scotch Glasgow boat, and the crew is English and Scotch. Before taking this cargo, this ship had carried from Barry Dock, near Cardiff, a cargo of coal to Buenos Ayres, South America, and taken a ballast of sand to Colombo, Ceylon. Before these trips she had been in the wheat trade from Tacoma, Washington, to Havre, France. She is remarkably dry, and the cleanest ship one would wish to see. I went down her hold and examined every part of it; there is not a smut nor a stain anywhere about it. The iron part is especially clean: no trace of incrustation of carburetted iron, which might have indicated the action of hot moist air on the carbon. None of the barrels containing the graphite was broken. The packing was exceedingly good, the dunnage consisted of sticks and cocoa-nut hulls, so that it was impossible for the barrels to roll and break, and thus expose their contents to the action of the air.

The diet bill was about the same, or even poorer, than that of the "Pax." Nine casks of salted beef and seven barrels of pork were consumed during the trip. Fresh beef (tinned) three times a week, one-half pound to a man, and a half pound of salt meat on the same days; other days a full pound of salt meat a day. One-half pound of rice for each man on Saturdays; no vegetables except onions with the soup three times a week. The ship being Scotch, oatmeal made part of its fare for two and a half months after starting, when it ran out. No sickness whatever during the voyage. One death by accident. The captain attributes the good condition of his cargo and his crew to the change of winds and cooler weather which he enjoyed from the Cape of Good Hope to the North Atlantic. His log is indeed very different from that of the "Pax."

In *Science*., vol. xxii., No. 545, p. 16, Venable states that "the metallic carbides are usually formed by the action of intense heat upon the metal in the presence of carbon. The form of this carbon is capable of being greatly varied. Graphite, amorphous carbon, and many hydrocarbons, may be used. The heat of the ordinary furnace is sufficient to form the carbides of the metals already mentioned, zinc, copper, and notably iron. All of these carbides, under certain conditions, give off their carbon in the form of hydrocarbons. The same smell can be detected in all during their decomposition. In some cases, as iron and zinc, the decomposition is caused by the action of an acid. The carbides of the earths (*of which graphite is one, in conjunction with iron*) decompose in moist air, and more rapidly in water."

I may point again here to those broken barrels of the "Pax," which exposed the carbon to the influence of tropical air.

I have examined microscopically the blood of four of the sufferers of the "Pax," and obtained the following results: Captain Geeseicke, sick since May 16 with beriberi; 800 diameters, $\frac{1}{12}$ inch oil-immersion objective; red discs, irregular in outline, congregated in masses, with ragged edges, not inclined to form rouleaux; quite plastic; colored streaks or rays of pink and red, showing the presence of biliary matter, biliverdin crystals; black spores, not free but entangled in the hummocks of corpuscles. It may be noted that the oedema of this patient's legs only left him two days before this examination.

Henry Oelrichs (second mate), German, 27 years old. Has been fourteen days sick with beriberi. Examination of the blood: 500 diameters, $\frac{1}{8}$ inch objective; red corpuscles, very plastic, aggregated in hummocks. Many black spores are seen floating about, free in motion. Fibrine in excess, light in texture, and lumpy. Blood very thick, syrupy, and plastic. No motion, showing want of circulation. Excess in the coloring matter. This same case examined: 900 diameters, $\frac{1}{16}$ inch objective immersion lens, shows excess of fibrine in ropes, biliary matter in great excess; no crystalline formations; blood quickly oxidizes and forms a solid mass. The black spores above mentioned are quickly held by the fibrine; the red discs are distended, bladder-shaped, and have very ragged edges. The meniscus-shape is lacking, there being great irregularity in outline and color, some are even square-shaped. Some discs have an excess of color, some are very pale. On the edges of the corpuscular mass the color quickly disappears, in consequence of rapid coagulation.

Isaac Hegglund, a Swede, 27 years old, has had beriberi since crossing the equator, six weeks ago. Legs are now very thin, but still some soreness remains; knee reflexes still lost. First sound of heart prolonged. Microscopical examination of the blood, 900 diameters, $\frac{1}{16}$ inch objective, shows rouleaux well formed, no spores, no filaments, slight feverish condition shown by spiculated outlines of some of the red corpuscles. Fibrine is assuming a normal form, showing meshes very regular; no distension of red corpuscles.

Emil Jensen, a German, 19 years old, sixteen days sick with beriberi. Black spores in active motion and very plentiful; freely scattered in the field of observation; circulation very torpid; fibrine

very irregular, light in texture; biliary matter freely scattered; blood discs distended and with ragged edges; red corpuscles congregated in masses; fibrine forming in heavy clots; blood rapidly coagulating; black spores are quickly fastening in the fibrine.

We have here, in the 14th day sick and the 16th day sick cases, black spores in active motion and biliary matter in both cases, and the corpuscles distended bladder-shaped, in ragged-edged condition; the fibrine quickly clotting. And in the captain's case, which was the worst of all, we have still black spores, biliary matter, and ragged-edged corpuscles.

In the 6th week case, a much milder case, moreover, than any of the others, it is reasonable to assume that in some way the patient has quickly eliminated the poison. There is no biliary matter in his blood, no black spores, no abnormal fibrine, no distension of red corpuscles; the latter are perfectly formed in rouleaux.

Examinatian of urine of Henry Oelrichs (second mate, bark "Pax"), July 17th, 1893 (14th day of beriberi):—

Odor, light, aromatic, and feverish.
Color, light (yellow) amber.
Reaction, excessively acid.
Appearance, transparent.
Specific gravity, 1.032 +.
Weight of a fluid ounce, 470.27 grains.
Solids in a " " 35.06 "
Nature of deposit, mucus.
Quantity of deposit, trace.
Bile, coloring matter not present.
Salts, " "
Sugar, Fehling's solution, trace.
Chromate solution, "
Nylander's solution, "
Sacchrimeter grammes in a litre, 0.00 +.
Albumen, nitric acid, 1 fl. ℥, not present.
Picric solution, trace.
Touret's solution, "
Bichromate solution, not present.
Bichloride solution, trace.
Millard's solution, "
Polariscopic grammes in a litre, 0.00 +.
Microscopical appearances:—
Pus corpuscles, trace in quantity.
Epithelium, bladder, trace in quantity.

Quantitative examination:—

Urea, proportion per fluid ounce	6.605 grains.	
Percentage of	1.404	
Total, quantitative examination	66.050 grains.	
Chlorine	.960 grains.	
	204	
	9.600 grains.	
Sulphuric acid	.992 grains.	
	210	
	9.920 grains.	
Phosphoric acid	1.024 grains.	
	201	
	10.240 grains.	
Carbonic acid gas	1.120 grains.	
	237	
	11.200 grains.	

Results on a net basis:—

Urea	1.40
Water	95.00
Sugar	0.00 +
Foreign	2.76
Albumen	0.00 +
Chlorine	.20 +
Sulphuric acid	.21
Phosphoric acid	.20
Carbonic acid gas	.23
	100.00

Traces of sugar and carbonic acid gas are commonly observed in the urine of beriberi patients.

Dr. Wallace Taylor, Osaka, Japan, sends me three interesting tables, which he made from examinations of 134 cases of beriberi. These examinations were made with Hayem's hæmatometer and Gower's hæmacytometer. The average corpuscular richness for the 134 cases is 94 per cent. This, he says, corresponds to the clinical experience in cases of beriberi. Most of the cases of beriberi seen by the general practitioners are well-fed, well-nourished, full-blooded appearing men. The ill-fed, poorly-nourished, weak constitution cases are the exception. During the past few years he has kept a record of the physical condition of the beriberi patients, and he gives this record, together with another record, of a beriberi hospital in Tokio:—

	Taylor.	Beriberi Hospital.	Sum.
Of strong constitution,	323	593	916
" average "	15	27	42
" weak "	9	6	15

Thus, in a total of 973 beriberi patients, there were 94 per cent of strong constitution (a result almost identical with that given in his tables), and only 6 per cent of average and weak constitutions.

"These numbers," says Taylor, "are large enough to be conclusive, and anæmia is not one of the pathological conditions of beriberi."

In his table No. 3 there is shown a general diminution of the hæmoglobine. The average hæmoglobine in 101 cases is 81 per cent. In some of these cases the amount is very low, being below 65 per cent, and with but few exceptions the per cent of hæmoglobine is below the per cent of corpuscles, showing a deficiency of the individual corpuscles in hæmoglobine.

The appearance of biliary matters, which I have shown in my analyses of the four cases of the bark "Pax," would show by itself a deficiency of hæmoglobine.

In the *Tribune Mèdicale*, Sept. 10, 1891, Messrs. Bertin-Sans and Moitessier show that it is the presence of hydrogen and carbonic acid in oxicarbonized blood that prevents the total destruction of hæmoglobine.

By sweeping their solution of oxicarbonized blood and water, with a current of hydrogen and carbonic acid gas, and an addition of sulphide of ammonia, they obtained the spectrum of reduced hæmoglobine. They thus show that oxicarbonized hæmoglobine can be readily transformed into a mixture of methæmoglobine and oxide of carbon. It is therefore reasonable to suppose that in an outbreak of beriberi where we have the presence of oxides of carbon and a deficiency of hæmoglobine (observable in all cases of beriberi) the latter is the effect of the former.

In Japan, the universal burning of charcoal produces the oxides, which held down in the low places by the moist atmosphere of the beriberi season, there is produced on a large scale and continually during the moist season what happens on board of each of those ships which come to us from the East with carbonized cargoes and beriberi-sick crews.

THE STRUCTURE AND AFFINITY OF THE PUERCO UNGULATES.

BY CHARLES EARLE, B. SC. (PRINCETON).

The discovery in 1880 by Baldwin of the presence of mammalian remains in the Puerco beds of New Mexico, was one of the most important in the history of vertebrate paleontology in this country. This rich mammalian fauna has been wholly described by that able investigator, Professor E. D. Cope, and to him we are indebted for having made known to the scientific world the interesting mammals which are imbedded in this formation.

As I have lately been studying a collection in the American Museum of Natural History from the Puerco, I propose in this paper to sum up some of the results of my investigations as relating in particular to the primitive ungulates of this formation, and especially to attempt to place some of these forms in or near their proper phylogenetic positions in the system.