is a question of only a few years before all our great trunk lines, or, in fact, all lines running trains at high speed will be thus protected. The earlier forms of block systems comprised a semaphore for each track, controlled from a cabin or tower at the entrance to each block or section. Telegraphic communication was established between these towers, and the movement of trains thus pretty well controlled, of course always assuming proper vigilance and devotion to duty on the part of the tower men and engineers. Nevertheless, accidents have happened by reason of a signalman forgetting that a train has lately passed his tower, and allowing another to fol-

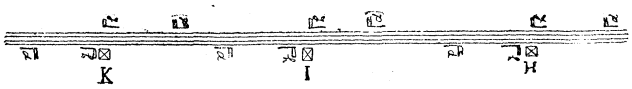

FIG. 3.

low it, without any information from the tower ahead. In the latest systems brought into use, the danger of such carelessness is largely, if not entirely, overcome, by interlocking the signal levers in two successive towers. By a combination of mechanical and electrical devices, each lever that moves a signal is locked in position by the man in the tower at the farther end of the block section, and can be unlocked only with the latter's consent and coöperation. For example, in fig. 3, a signalman at *H* cannot lower his signal to "safety," in order to admit a train to the block ahead, without asking the operator at the next tower, *I*, to unlock his (*H's*) lever. The man at *I* will not do this unless he knows that the block or section *H-I* is clear. A train having passed *I*, going towards *K*, and protected by a danger signal at *I*, the signalman there, on request of *H*, will unlock the latter's signal

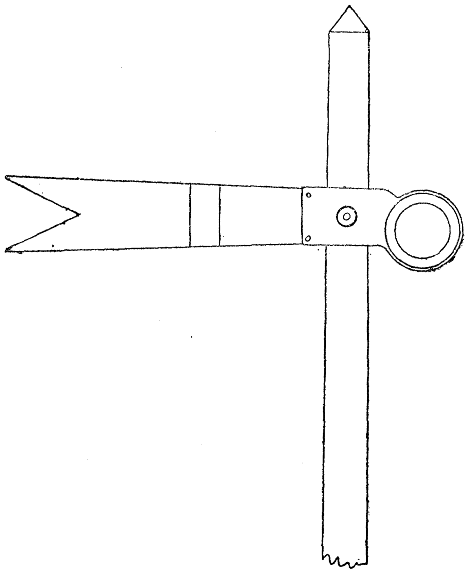

FIG. 4.

lever, so that he can lower his semaphore to safety, and admit a train to block *H-I*. It is usual, also, to have each signal in duplicate; that is, a semaphore placed from 1,200 to 1,600 feet in advance of the one at which an engineer must stop, if it stand at danger. The latter is called the "home" signal; the former, the "distant" signal. Home signals are almost invariably painted red, and of the form shown in fig. 1. At night they display a red light when the blade is raised to danger position. Distant signals are made of the "fish-tail" form, as shown in fig. 4, and painted green or, rarely, yellow, displaying a green light at night when raised to indicate "caution." A distant signal is for the purpose of informing an engineer whether he will find the home signal at danger or not. In moving the blades to indicate danger, the distant is first raised, then the home signal. In lowering them, however, the reverse order is used. If an engineer finds the distant signal lowered for him, he can go on confidently without slackening speed, knowing that he has a clear block ahead. If, however, it is against him, he then has time to bring the train under control and come to a dead stop on reaching the home signal, which, if at danger still, he must under no circumstances pass. In the Fourth Avenue tunnel, New York City, the signals are arranged so that the act of moving a signal to danger, places a torpedo on the rail over which the train must pass, and in addition to this, a gong is set loudly ringing if an engineer, neglecting the ordinary signal, runs beyond a certain point. Setting the signal to safety again removes the torpedo and throws off the gong mechanism. These extra safeguards have been found to be absolutely necessary in this place, where the traffic is so dense and the conditions of working are so trying.

ALTITUDE IN SPITE OF HUMIDITY AS A CURE OF BERI-BERI.*

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

THE Hakoné Mountain resorts, 836 metres above sea-level, Karuizawa, the new foreign resort, the religious stations (ten) disposed on each of the four roads up the sacred Fuji Mountain, and the Ikao Mountain and hot springs resort at Nikko, are the main beri-beri resorts of Japan. All these are in the neighborhood of volcanic centres. Karuizawa, at the head of the Usui Pass, is 3,000 feet above sea-level. Its mean temperature is 8° lower than that of Tokio, in the principal Kakké month, August; and there is a mean oscillation of 20° F. in the temperature of the day, as compared with the night. While at Tokio the variation is only 14°. It is this coolness of the nights, in all the mountain resorts of Japan, which makes the heat of the day tolerable. The August humidity, in all the mountains of Japan, although they have three times the rainfall of Tokio, is practically the same as in the latter city.

Yamanaka, another resort in the Hakoné Mountains, is higher even than Karuizawa, the same conditions as above.

Fuji, the peerless mountain of Japan, is 12,238 feet high. Its slopes are cultivated to an elevation of 2,000 feet. It can only be visited in the Kakké season, July and August. At other seasons, it is too cold. The highest temperature that has ever been recorded in August, on the summit of Fuji, was 70.5°, and the lowest 31.1°. The mean daily range of temperature is a little higher, 20.9°, than at Karuizawa; that is the variation between day and night. There are at the top of the mountain thirty-six inches of rainfall, and three-fourths of the whole quantity belong to the three or four days of the first storm of the month. The influence of Fuji in encouraging precipitation, is shown also at Karuizawa, the latest beri-beri resort, and in the other resorts.[1]

The comparison between the three, top of Fuji, Yamanaka on the Hakoné Mountains, and Karuizawa, gives the following figures:

	Bar.	Range.	Temp.	Range.	Vap.	Hum.	Rain-fall.	Rainy days.
Top of Fuji	490.7	13.1	7.7	11.6	5.5	71.2	888.1	18
Yamanaka (Hakone).	677.5	11.8	20.6	9.6	16.0	88.7	580.4	18
Karuizawa	679.13	10.	21.3	11.1	16.0	86.	212.0	17

*Communicated to the Sei-I-Kwai, or Society for the Advancement of Medical Science in Japan.

1Ashino-yu is at Ubago, near the base of Fuji. Hakone Lake is separated from Fuji by a ridge. Yamanaka Lake is seen from the top of Fuji. The same influence operates at Ikao; this is near Asama-yama, the second highest volcanic peak in Japan (Shinano.)

The meteorological station which is nearest these resorts is called Numadzu; it is at sea-level, about twenty miles west of the Hakoné Mountains, on Sugura Bay, Pacific side of Japan. The notations for August are:

Bar.	Range.	Temp.	Range.	Vap.	Hum.	Rainfall.	Rainy days
757.6	12.7	25.8	7.2	20.5	83,	187.2	23.

The average humidity at Tokio, sea-level, for the three Kakké months, June, July and August, as given in the meteorological summary, is 81.6. This figure is inferior to that shown by mountain resorts.[2]

It will be seen that recovery from beri-beri takes place in these noted places, in spite of their excess of humidity and rainfall, which makes it evident that the humidity and rainfall of the Kakké months, June, July and August, at sea-level, in the beri-beri centres, cannot be a direct cause of the outbreak.

Another cause must be looked for. The history of the following case shows that a high altitude is absolutely necessary for a real cure of Kakké.

A patient of mine, M. H., 23 years old, a ship builder and a powerful man, by no means anœmic, a native of Kochi (a city of 50,000 inhabitants, not a beri-beri centre, on the sea-level, island of Shikoku), contracted beri-beri in Tokio, June, 1885. He was a patient at that time of Dr. Ikeda, the emperor's physician. He was ordered to the mountain, but his father insisted on his returning home. He recovered and came back to Tokio in October. In June, 1886, the disease reappears; this attack is stronger than the last; for ten days he is unable to walk at all. He has this time the attendance of Dr. Sasaki. That eminent physician tells him that he must stay in the mountains near Tokio, and not return home, if he wants to be cured for good and all; should he go back, thinks the doctor, the cure would only be temporary. The patient disregards this advice, and goes again to Kochi, and recovers in September, as before. He arrives again in Tokio in November, spends there the winter and the following spring. In May, 1887, there comes upon him a third attack, not a strong one this time. As usual, he retreats to his native place, and recovers in August. He betakes himself to Yokohama, and in November sails for San Francisco, where he spends the winter. May, 1888, finds him again in Tokio, and this year he escapes beri-beri. He stays all summer in Tokio, and all winter, and in June, 1889, he has a fourth attack of beri-beri. This time again he flies to Kochi, and recovers only in October. After recovery he reappears in Tokio in November, and spends there the winter and the spring. In May, 1890, he goes back to his native place before the beri-beri season begins, and escapes. He spends the following winter in Kobe. In 1891 he returns to Kochi, and spends the summer. He again is spared. (It must be observed here that in Kochi, his native place, there is but little charcoal used as compared with Tokio, and that the city, situated at the head of a seven-miles bay, is not surrounded by hills or fells, which might coop up the deleterious products of combustion: it was really from this carbonic poisoning that he was escaping during his sojourn at Kochi). The winter he spends in Tokio. In April, 1892, he goes to Osaka, having heard of the improved climatic conditions for beri-beri patients of that place, for the purpose of getting out of the range of the disease, but does not succeed. He is visited by it there and recovers in September, having been only one month sick this time. He spends the winter in Tokio, and in May comes to the United States.

He has neglected the only remedy which can have any real and lasting effect on his case; that is, in his own country, the mountain air. He is not cured, though his diet has been irreproachable, at least for years.

Dr. Toyama, who has charge of the beri-beri hospital at Usigomi, Tokio, has in his hospital, in the beri-beri season, from 100 to 200 patients. This establishment is situated on the highest ground of Tokio. A vegetable diet is imposed upon the patients; they get no milk, no meat, no fat fish. If they decline to remain in the hospital or do not improve, he orders them to the Hakoné Mountains, about eighty miles southwest of Tokio, or to the hot springs Mountain of Ikao at Nikko, eighty miles north of the capital.

An albuminous diet is not considered by this eminent physician as of signal importance for the cure of beri-beri: it is the altitude, even the moderate one of his own establishment, that does it. If one high place has no effect, he sends his patients to a still higher one. Does this suggest, in any human mind, the idea of rice and anœmia as the causes of a disease which disappears, almost at once, when the air is pure, rich in oxygen, comparatively free from carbonic emanations? If the cure takes place (and even in the Kakké season) where the degree of humidity is the same as, or greater than, in the beri-beri centres; and where the vegetable diet is compulsory, neither humidity nor anœmia resulting from a non-albuminous diet can be chief etiological factors of beri-beri, or, to express my opinion with complete frankness, can be factors at all.

One can hardly suppose that any merit in the cure of beri-beri patients can be attributed to the springs themselves around which the stricken herd gather. For why do not the same mild chalybeate and sulphur compounds (see Dr. Geert's analyses) operate in the same manner at sea-level. Hot bathing is also out of the question, it being in Japan a universal, almost passionate, habit. Consider also this fact: There are in Japan some excellent arsenic springs. It is well known that arsenic is the principal remedy for chloro-anœmia. Yet beri-beri patients find no benefit in them. There is, at any rate, no rush there, as would certainly be the case if beri-beri was an anœmia.

I have obtained, recently, some facts about the beri-beri situation in the island of Java, and I think I will append a few to this sketch: The Batavia beri-beri hospitals are situated at Buitenzorg, the old capital of Java. They are built on very high grounds; it takes a two hours ascending drive from the seaport to reach them. The patients are brought thither from the sea-level. The doctors in charge of these patients feed them rice and curry and eggs in different forms. The patients themselves, strange to say, take exception to a meat diet. The chief source of success, the doctors avow, is the climate.

In the whole of Java, the beri-beri outbreaks are at sea-level.

One thing is made evident by these facts: the beri-beri specialists, not only of Japan, but of Java, the cradle of the disease, have been taught by the most persuasive of all masters, long experience, that the cure of beri-beri has little or nothing to do with the diet, as they feed their patients even with vegetables. They seem to know by instinct that the disease must disappear as the red corpuscles are recreated by the ozone of the mountain air. It is not, as I view the matter, the condition of the red corpuscles, in itself, that causes the disease, nor does their rehabilitation in itself constitute the cure. But, as these red corpuscles reacquire the faculty of carrying oxygen, the carbonic toxine is eliminated, and with it the very root and soul of the disease, Dr. Takaki's rice and anœmia theory to the contrary notwithstanding. It is the elimination of the paralyzing element, carried by the blood, which, when thus recreated, the red corpuscles are

[2]For most of these facts, I am indebted to Trans. of the Asiatic Soc. of Japan.

able to bring about; it is this elimination, and nothing else, that constitutes the curative action.

I will now beg the reader to ponder over the two following facts, and see if he can reconcile them with Dr. Takaki's theory: 1st. The mountaineers of Japan, who have the reputation of being rice gluttons, eating, in fact, nothing else, are never afflicted with beri-beri. 2nd. There is, in the mountains of Japan, one beri-beri centre, and only one. What is more, this exceptional place is 800 metres above sea-level, it is called Shinano.[3] But see how strikingly, here, the exception confirms the rule. Shinano is again surrounded by higher hills, so that it is really a cup from which the carbonic gases cannot escape. The outbreaks of beri-beri in Shinano are explained by the latter circumstance, not by any extra rice-gluttony of the Shinanoans, or the excessive humidity of their climate.

THE ORIGIN OF GOLD.

BY PHILIP LAKE, CAMBRIDGE, ENGLAND.

The subject of the origin of gold, or of the manner in which that metal has reached its present positions, is one which has at all times excited considerable attention, and the number of theories put forward has been almost as great as the number of writers on the question.

It is easy to understand the presence of gold in alluvial deposits, for this has clearly been derived from preexisting rocks; but the difficulty lies in determining how the auriferous quartz-reefs and other rocks which we look upon as the home of the gold, became impregnated.

Sir Roderick Murchison, from his observations in the Ural Mountains, originally held that non-alluvial gold was only found in Paleozoic rocks, and principally in his Lower Silurian; but he believed that it was not introduced into these rocks until shortly before the Drift period. Subsequently he was led to modify these views to a certain extent, and to admit that Secondary and Tertiary strata when penetrated by igneous rocks or impregnated by mineral veins, might also contain gold.

More recent observations show that gold may be found in rocks of any age in metamorphic strata; but all the evidence seems to support Murchison's next contention, viz., that gold is of igneous origin.

There is probably no more instructive area to illustrate this than Southern India, where the distribution of gold has been carefully worked out by Mr. R. B. Foote, of the Geological Survey of India. Almost the whole of this part of India is made of crystalline and metamorphic rocks; and in it there are a large number of gold fields, more or less rich. A closer examination of the country shows that we have here a large mass of gneissic and granitoid rock which is crossed by a number of bands of schist, lava flows, hæmatite beds and conglomerates. Mr. Foote has shown that these bands belong to a system which is distinct from, and newer than, the gneiss, and to this system he has given the name of Dharwar. He has shown also that all the gold fields of Southern India, with the possible exception of the Wynaad, lie within these Dharwar bands.

As usual, the gold is found principally in quartz-reefs; and it is a remarkable fact that though quartz-reefs are by no means uncommon in the gneiss, as well as in the Dharwar beds, yet those in the gneiss are never auriferous. It is clear therefore that the gold cannot have been introduced into the reefs from below, for in that case there would be no difference in that respect between the reefs in the gneiss and the reefs in the Dharwar.

Only one other possible conclusion remains, viz., that the gold originally lay in the Dharwar rocks themselves, and that it has since, by some process of segregation, been gathered together in the quartz-reefs.

It has already been stated that lava-flows occur among the Dharwar rocks; and my own observations have led me to believe that many of the schists also are lava-flows. In fact a very large part, if not the greater part, of the system appears to be of volcanic origin.

It may be concluded therefore that the gold which we now find in the auriferous reefs of Southern India was derived from the rocks of the Dharwar system; and that it was originally brought up from the depths of the earth by the lava-flows which form so large a part of that system.

ON THE EXTREMES OF HEAT AND COLD UNDER WHICH THE LIFE OF SPECIES IS POSSIBLE.

BY HENRY DE VARIGNY, SC. D., MUSUEM OF NATURAL HISTORY, PARIS, FRANCE.

Marquis de Nadaillac contributed some months ago (January 27, 1893, page 49) to this paper an interesting note concerning the extremes of heat and cold endured by man, on the extremes of external temperature which man has been able to resist. The topic I wish to call attention to is entirely different. We all know that man, for instance, when resisting the extremes of heat and cold, hardly alters at all his internal temperature, and that when for some reason or other the latter decreases or increases, life is in great peril. To show the extremes of heat and cold man can endure is merely to illustrate the means he has at his disposal to fight heat and cold and to maintain his own internal temperature, and as these means are numerous and powerful, we may well feel assured that man may resist very extreme conditions by intelligent use of the offensive or defensive weapons he is provided with. The matter I wish to call attention to is the very reverse, in one sense, of the facts quoted by Marquis de Nadaillac. I wish to show which are the extremes of heat or cold which individuals may really undergo permanently, without damage to themselves and posterity. To answer the question, we need to consider organisms which have no proper heat to speak of, but assume the temperature of their environment; we want what generally goes by the name of *cold-blooded*, or *heterothermal* organisms, and we must have them aquatic, not terrestrial, because we very well know that terrestrial cold-blooded animals do not necessarily have the same temperature as the air which surrounds them; nor do plants. Air is a bad conductor of heat, and in air evaporation and transpiration prevent the temperature from going very high. So we want organisms living in water, because in this case, as they hardly produce any heat, they must necessarily have the temperature of the water they live in, moreover we want our organisms to be able to withstand heat or cold, not only individually, but specifically: they must resist as individuals and as members of a species, they must be able to proceed to reproduction. In fact, what we want is the permanent extreme degree of water (in heat and cold) under which organisms are able to live, and to give off posterity.

As far as I can jadge at present, these extreme degrees are, in Centigrade scale, minus 2° and plus 74°.

Arctic explorations have shown that even within the

[3] 'Even the rule that the disease does not overstep certain quite low levels is shaken now; for the province of Shinano, walled in by mighty mountain chains, forms a plateau which, in many Kakke-ridden places, is raised 800 metres above the level of the sea. But, although these regions are not near the sea-level, they have yet a comparative depression; that is, they are low-lying plains, by the side of the circumjacent mountains, a circumstance of vast significance." BAELZ.

"Within the cities, also, the deep-lying parts show more cases of the disease than those of an elevated situation." BAELZ.