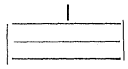
over the roller W, and then between the rollers G and H. The rollers F and H are the same size; but G is larger, and has a ratchet-wheel at its end. E is a rod joining D at D'. At the lower end of E is a ratchet-catch K, pressed upon by the spring L, which is also fastened to E. S is a rod fastened to D, and has on its lower end a wide framework  composed of horizontal slats. Between these slats pass the indicator or pointer of an aneroid barometer B, and a metal thermometer A. These pointers are made longer than usual, and have attached a needle-point at right angles in the vertical, as shown by P' and P. This whole apparatus is mounted on a frame or board, and put into a basket suspended from the lower end of a balloon. The three wires below are fine wrapped wire, and serve to hold captive the balloon as well as to cause the self-registrations to be made, by aid of the battery X at the ground. Let the balloon ascend, say 100 feet; then put 1 on 2-3, and N draws D down. This pushes E down (and the ratchet-catch glides over the teeth on G), and pushes S down also. This last causes P' and P to puncture the paper. Now open 2-3 and close 2-4; then N' draws D up, S is pulled up, and the points P' and P are freed. Also K catches on G, and draws off some paper from c, the paper being drawn between F G, over W, and between G H. Then the holes pricked by P' P are out of the way, and other holes can be punctured at another elevation of 100 feet for the balloon. A fixed pencil is also pressed against the paper at each observation, as a reference-point for the puncture by the index-point.

For the hair hygrometer we should have another pointer, P''. A small anemometer can be suspended from beneath the basket, and kept vertical by means of a weight. This anemometer causes a contact arrangement to close for an instant for every 100 feet of wind-motion. The two wires from the anemometer terminate at n and n', and, when the magnet N' is not attracting the armature, the points n and n' are free. When the current is passed through N', then n comes in contact with o, and n' in contact with o'; o and o' being joined to the wires 4 and 2, which run to the reel at the ground. At the ground we insert a telephone or a galvanometer in the wire 4.

The normal condition of the apparatus will be with the current passing through N', and the battery X will cause the galvanometer to give a constant reading; but, for every hundred feet of wind, the anemometer will close its circuit for an instant, and the dividing-up of the current at Z Z by including the anemometer in the circuit will cause a momentary deflection of the galvanometer (or will cause a slight sound in the telephone), and the observer can time these with a watch, and get the wind-velocities whenever he wishes them.

In place of N we could insert a spring, and do away with the wire 3, and probably various other changes would suggest themselves to any one actually constructing the apparatus.

FRANK WALDO.

Cincinnati, O., June 27.

Sea-sickness.

WITH regard to the subject of sea-sickness, treated of in an article in *Science*, June 3, I beg to offer a few remarks.

As to the causation of the affection, the process is a gradual one, affecting the balancing sense, which is not interfered with in the case of iron-plate workers. The sickness affecting these workers is caused by the successive shocks due to the hammering, and differs from sea-sickness in character and causation.

An article of mine in the *Lancet* of June 28, 1884, defines sea-sickness as follows: "The altered sensory impressions affecting those at sea interfere with the co-ordination of movements by which the body is adapted to its surroundings, and with the vomiting and other centres in the *medulla oblongata*. This interference causes sea-sickness."

The balancing of the body depends on the ordinary sensory impressions, and also on what Foster calls 'the afferent impulses, as it were, of a new sense,' from the semicircular canals, arising from variations of pressure in their ampullæ. With reference to the recent paper of Dr. James, the following quotation from my article above mentioned may be of interest: "In cases where the internal ear has been injured by otorrhœa following scarlatina or measles, we may suppose that the person learns to balance himself without the intervention of this new sense, the absence of which is compensated for in some way; and it is a curious fact, and one which throws considerable light on the etiology of sea-sickness, that such persons invariably escape this disease. . . . That deafness in itself does not prevent sea-sickness is in keeping with the fact that the afferent impulses from the semicircular canals do not give rise to auditory sensations" (*vide* Foster's 'Physiology,' 2d ed. p. 495).

It is reasonable to believe that no structural change takes place in the semicircular canals, due to the motion of the endolymph, else the longer the motions continued, the more marked would become the sickness. The altered impressions affect the brain directly, and sea-sickness is prevented by their action from being mollified or nullified by the educated conscious ego.

As to drugs, atropine has a sedative action on the *medulla*, etc., and renders the altered sensory impressions inoperative in producing sea-sickness. It should be given in drop doses of the liquor atropine, B.P., in a teaspoonful of water, every hour, till the physiological effect of the drug is produced.

The bromides have also a sedative action on the brain, but, to prevent sea-sickness, must be given in sufficient doses to produce bromism. As this is a serious condition, and one likely to affect the patient's reason and general health most injuriously, the bromides should be used with great caution, and only when prescribed and their action watched by a medical man.

T. T. REYNOLDS.

Steamship 'City of Chicago,' Jersey City, July 1.

The Function of Nitrogen in Manures.

IN works on agricultural chemistry it is usual to classify manures or plant-food substances as nitrogenous matter, phosphates, and potash; but, while the phosphates and potash enter into the substance of every part of the plant, the amount of nitrogen found in the cereals and food-plants generally is inconsiderable.

A few food-plants contain nitrogen as an essential element of their substance: thus pease contain from two and a half to three and a half per cent, and tea-leaves from five to eight per cent; but in the case of all these plants it is well known that they are capable of drawing the necessary supply of nitrogen from the atmosphere.

Without entering on the question of whether the small traces of nitrogen found in the substance of food-plants generally are essential or accidental, or that other question whether all plants requiring nitrogen are, like animals, capable of deriving it from the air, it is very safe to infer, from the slight trace of nitrogen found in the cereals and food-plants generally, that the ammonia, or nitrogenous substance convertible into ammonia, which is necessary to secure a good crop, has some other and more important function to perform than that of supplying nitrogen to the plant. It may be doubted, even, whether nitrogen is a plant-food for the cereals, or in any way essential to their proper development; but hydrogen, the other element of ammonia, is one of the prime constituents of all vegetable substances, and I infer that it is the easily liberated hydrogen in the ammonia that gives it its manurial value. The function of the nitrogen is simply that of a carrier of hydrogen.

Let me explain. The substance of all trees and plants, wood, stalk, bark, leaves, fruit, etc., is a chemical compound of the three elements, oxygen, hydrogen, carbon. The tree or plant absorbs carbonic acid from the air, which gives it two of the three essential elements, carbon and oxygen. It also takes up water, which is a compound of oxygen and hydrogen, by the roots; and by the mysterious chemistry of organic life, the water and carbonic acid being decomposed on contact, the liberated hydrogen and carbon unite with a portion of the oxygen into definite chemical combinations, the new substance arranging its atoms as cell-contents or cell-walls. All the oxygen of the water, with a portion of that from the carbonic acid, is liberated, and returned to the atmosphere. Given air, water, and potash, and a soil mechanically suitable, and we have all that is necessary to the full and healthy development of timber and fruit trees, flowering plants, and in fact almost every species of vegetation except the grasses, cereals, and principal food-plants, which cannot be grown under similar conditions. The fact that they will grow freely in soil containing ammonia, or decomposing animal matter convertible into ammonia, led to the conclusion that they wanted nitrogenous food. The fact that the nitrogen is not an important element of their substance at any period leads me to infer that these plants are incapable of decomposing water, and consequently dependent for their necessary supply of hydrogen upon ammonia or some other compound of hydrogen more readily decomposed than water. It is well known that while the nitrates of potash, soda, lime, etc., are all valuable auxiliaries to farmyard manures, they are of no value as a substitute for it. Very eminent chemists have been somewhat staggered at the results of their experiments in this direction; but precisely as the function of nitrogen in ammonia is to carry hydrogen, so the function of the nitrogen in the nitrates is to carry potash. Whether we dress the soil with nitrate of soda, lime, or potash, the result is the same. With potash salts in the soil, the addition of the nitrates of soda or lime leads to a double decomposition, and the conversion of the potash into nitrate. Sulphates and chlorides of these bases appear to have some small value as manure, although their composition remains unchanged; but in the mysterious laboratory of the growing plant the nitrate of potash is resolved into its elements. The potash allies itself with carbonic acid to form carbonate, or with carbon, oxygen, and hydrogen in various proportions to form the organates of potash (the citrates, tartrates, oxalates, etc.), so important to the development of fruits.

Whether we employ ammonia or the nitrates as manure, the nitrogen is liberated in the plant to unite with oxygen, and be radiated as common air. In the one case, hydrogen remains; in the other, potash.

The current theory of nitrogenous manure appears to be based on a complete misconception as to the function of the nitrogen in its various compounds; and when it is once clearly realized that hydrogen is the important food-substance yielded by ammonia, it will be of practical interest to determine whether this substance cannot be supplied more economically by the decomposition of water *secundem artem*. C. F. AMERY.

Geological Questions.

THE replies to the following questions by some of the most eminent American geologists have induced me to ask your assistance in getting a wider circle to consider them. They were framed for the purpose of enabling the writer to properly represent American thought on the subjects mentioned, in his report on the Archaean to the American Committee in August next. Those geologists who are willing to render the undersigned the valuable assistance of expressing their opinions on the matters involved, are requested to write the letter of the question, and give the answer as laconically as is consistent with a clear statement of their views. In alternative questions, like J or N, it will suffice to append the numbers of the clauses representing their opinions.

A. Do you agree to the suggestions contained in the report of the International Committee on Nomenclature ('Report of the American Committee on the Work of the Geological Congress,' pp. 49 to B, p. 57)? Please state explicitly if you are willing to accept the recommendations of the congress.

B. Do you favor the division of the Archaean Group into a definite number of systems? If so, give their names and the order of their succession.

C. Give the horizons of non-conformability in the Archaean.

D. Do you approve of the plan of subdividing the Archaean petrographically and of omitting corresponding chronological divisions and names?

E. Should the eruptives occurring in the Archaean rocks be classified with the latter, or separately?

F. Which, if any, of the following terms is applicable in American geology, and how applied? 'Hebridean,' 'Dimetian,' 'Arvonian,' 'Pebidian.'

G. Are there crystalline rocks in, and after, the Paleozoic lithologically indistinguishable from those of the Archaean?

H. Are there any crystalline rocks in the Archaean which do not occur later?

I. Is mineral constitution indicative of geological age?

J. Are the lower stratified crystallines: (1) of aqueous origin metamorphosed partly, or wholly, by igneous action; (2) of igneous origin metamorphosed in part, or in whole, by subsequent agencies; or (3) partly one and partly the other?

K. Are there evidences of organic life in the Archaean; if so, where, and what?

L. In your opinion, is Eozoon Canadense of organic origin?

LL. Do you approve the European map committee's (Professor Lossen's) system of coloring and classifying the eruptives?

M. Should Serpentine constitute one class of eruptives?

N. Is Serpentine, (1) sometimes, or (2) always an alteration product: (3) of eruptives, (4) of sedimentary rocks, or (5) of either?

O. What, in your judgment, is the proper disposition of the term 'Taconic?' If employed, what are its limits, and what terms should it replace?

P. How should the Cambrian be divided?

Q. Are 'Menevian,' 'Ordivician,' or any other more or less comprehensive foreign names, applicable in American geology? if so, how?

PERSIFOR FRAZER,
Reporter for Archaean.

Philadelphia, 201 South Fifth St., July 9.

The Charleston Earthquake.

IN reply to Prof. Joseph Le Conte's valued criticism (*Science*, x. p. 22), I would say that it seems to me that the method for estimating the depth of an earthquake-focus proposed by Mr. Hayden and myself differs radically from that proposed by Mallet in the 'British Association Report' of 1858. His inference that the horizontal motion has a maximum value where the 'angle of emergence' is 54° 44′ could be true only of normal waves. It cannot be true of the transverse waves. He ignores the transverse waves entirely in his formula; and the omission, I maintain, is fatal to its applicability. He also ignores the vertical component of the normal wave, which at such an angle is much more energetic than the horizontal component. What proportion of the horizontal motion is due to the normal waves can generally be determined at considerable distances from the origin when the facts upon the ground are clearly manifested. But at the very localities where such a determination is necessary for the application of Mallet's method the difficulty is greatest. It is just here, too, that all the components, vertical and horizontal, normal and transverse, blend together with such effect that not one of them can be ignored without fatal error. We must consider their total effect. But these motions compounded represent the intensity, i.e., the amount of energy per unit-area of wave-front. Mallet's 'circle of greatest destructiveness' has no real existence. It is a purely mathematical abstraction obtained by postulating conditions which do not have any separate existence.

Since writing the above, I have recurred to Mallet's paper, and find the following: "It is certain that in all great earthquakes the real mischief and overthrow at places pretty far removed from above the centre of impulse are done by the blow from the normal wave, which appears to come first; hence, the main observable effects are those of the normal, and we are justified and enabled, *in such localities*, to neglect the transversal. But within a considerable circle of area, whose boundary is evanescent, and whose centre lies at the point right above the origin, the actual effects of the transversal wave are very formidable, and can never be neglected." [Then why should he have suggested doing so?] "The ground beneath an object so situated, such as a house or pillar (as the distance from the origin to the surface is the minimum range of emergence, or shortest possible, and its energy therefore the greatest), is almost at the same instant thrown nearly vertically upwards by the normal wave, and at the same moment rapidly forced forwards and backwards in two directions orthogonal to each other; and this combined movement, which is that called 'vorticoso' by the Italians and Spanish Mexicans, is one that nothing, however solid and substantial in masonry, etc., can long withstand."

It is certainly a pleasure to find Mr. Mallet reasoning so justly; but in the remarks quoted it is apparent that he is taking account of