constant velocity of the spherical wave, and the other the decreasing velocity of the surface or emergent wave. By connecting these points by rectangular co-ordinates, an equilateral hyperbola is developed, the centre of which is the focus x, and the character of which depends on the depth of the focus. The hyperbola becomes more and more triangular in form as the depth becomes less (as in taking the surface at $c'd'$, $c''d''$), until, if the focus is at the surface, the hyperbola becomes a right-angled triangle; i.e., the surface wave passes over equal spaces in equal times. If, therefore, we plot accurately the times on AB, and the corresponding places on CD, we may develop the hyperbola and calculate its centre; or else by accurate trial we may find a point which shall be the centre of circles passing through corresponding times and places. That point will be the focus. Such is a very general account of the method, given in my own way. For more accurate detail, Seebach's work must be consulted.

We believe that this method, in a thickly settled country dotted over with observatories on railroad-stations where accurate time is kept, will prove the most accurate. Dutton and Hayden object to this method that it is important to have the accurate time of arrival

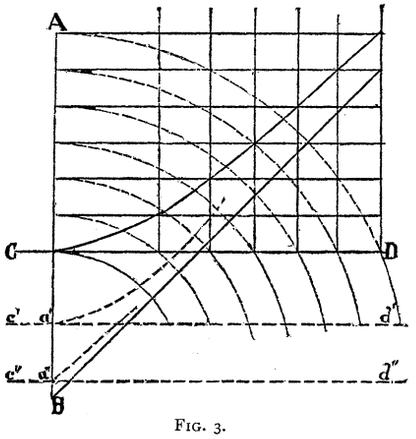

FIG. 3.

of the wave, because there are two kinds of waves, — the normal and transverse, — which run with different velocities. The answer to this is, that it is only over a comparatively small area that, on any method, observation can be relied on for estimating depth. Inspection of Fig. 3 shows that the arm of the hyberbola very soon becomes almost straight; the velocity of emergence at any considerable distance becomes sensibly the same as that of the spherical wave, and therefore can no longer indicate depth. But over the small area where the curve of the hyperbola, or change of velocity, is rapid, the time of arrival of the different waves would not greatly differ. At any rate, the use of seismographs which decompose the complex earth-motions will record these different waves separately, and thus enable us to determine the law of decrease of one of them — the normal — with accuracy.

In conclusion we would insist that we cannot any longer afford to study earthquakes without seismographs. The Geological Survey ought to have these in different parts of the country. The University of California has recently gotten three of these of the best character (Ewing's and Gray-Milne's), which will soon be set up in different parts of the State. JOSEPH LECONTE.

Berkeley, Cal., June 21.

The Corresponding Volumes, etc., of Ice and Sea-Water.

THESE determinations were made in Hudson Strait (latitude 62° 33′ 45″ north, longitude 70° 41′ 15″ west), in an inlet having a width of a little more than half a mile. I am thus particular in giving the width, because in a very narrow tidal harbor, with the ice fast on either shore, the line of flotation of the ice would sensibly alter with a rising or falling tide. In this instance I was particular in watching for such a difference, under these opposite conditions; but, if present, it was insensible.

The determination was made on Feb. 3, 1885, when the temperature of the air was — 3° F.; for the water, 26°.7 F.

A hole having been cut through the ice, of such a size as to prevent any sensible error owing to capillarity, its thickness was found to be 2 feet 9.6 inches from surface to surface; on top of the ice was an estimated average depth of snow of 3 inches, of such a density that by weight it was equal to 1.1 inches of the ice: the total thickness of ice, or its equivalent, would therefore be 2 feet 10.7 inches. Of this amount, 32.5 inches were submerged; leaving, therefore, 2.2 inches of ice, or its equivalent, above the water-line.

Therefore sea-water-ice floats with one part above the water-line and fourteen and eight-tenths below. Expressing the volume of a given quantity of sea-water by unity, its volume, when converted into ice, would be 1.0634; and their densities as 0.922 to 1.000.

W. A. ASHE.

The Observatory, Quebec, June 24.

Death of W. O. Ayres, M.D.

THE death of Dr. W. O. Ayres, one of the early members of the California Academy of Sciences, has recently been made known.

He was specially interested in the study of ichthyology, and for many years after his arrival in California, in the intervals of an extensive medical practice, contributed to this department of natural history by his investigations of and publications upon the fishes of California. At the first meeting of the academy of which there is any published record, Sept. 4, 1854, he presented descriptions of two new species, *Labrus pulcher* and *Hemitripterus marmoratus*, which still stand, though the generic status has been modified, — now *Harpe pulchra* and *Scorœnichthys marmoratus*. His contributions to the ichthyological knowledge of the Pacific coast were frequent for many years, especially from 1854, as above, to the year 1863. His scientific inquiries sometimes extended, though rarely, towards other forms of animal life. He returned to his native State, Connecticut, about 1872 or 1873. His services to the cause of science on the Pacific coast in those early days entitle him to grateful remembrance. R. E. C. S.

U. S. Nat. Mus., June 28.

Cause of Consumption.

THE experimental together with the clinical study of tuberculosis has established the view that there are three factors in its causation: —

First, The presence of the parasite, the tubercle-bacillus, as a pathogenic element. This factor is necessary for the production of the disease.

Second, Heredity figures as a prominent element in about thirty per cent of the cases ordinarily met with.

Third, Mal-hygienic and debilitating agents, such as foul air, sedentary occupations, violations of the laws of health, and diseases, have a powerful effect, by impairing the nutrition, in developing the disease.

Heredity and lowered vitality cannot of themselves produce tuberculosis, but clinically they play an important *rôle* as factors by rendering the individual more vulnerable to bacillary influence.

FRANK DONALDSON, M.D.

Baltimore, Md., June 29.

Volapuk.

YOUR correspondent, 'H. T. P.,' in your issue of the 24th of June, asks for information about Volapük. I can refer him to a most interesting article upon this subject, which appeared in the *Bulletins de la Société d'Anthropologie de Paris*, 1885, pp. 317 – 321. The article is by M. Kerckhoffs, who has published the following work, 'Cours Complet de Volapük,' par A. Kerckhoffs (Paris, 1886), and contains a sketch of the structure of the language and some interesting information about its prospects, progress, etc. A. F. CHAMBERLAIN.

Toronto, June 28.

Queries.

7. DEATHS AND THE TIDE. — A physician living near the sea states that during the past five years he has noted the hour and minute of death in ninety-three patients, and every one has gone out with the tide, save four who died suddenly by accident. Is there any other evidence to sustain this statement? — D.