SUMMARY.

Synoptic observations of hydrographic phenomena have been made during July and August of last summer at three different points on the west coast of Sweden. The results prove that internal movements closely resembling those found at Bornö occur practically simultaneously also at distant localities. These vertical displacements of the boundary are found to be closely related to simultaneous variations in the wind velocity, a fact which has also been proved by a separate investigation of the Bornö records for 1911. The establishment of a permanent system of synoptic observations in the sea found the coasts of Scandinavia is at present in progress.

APPENDIX.

The hydrostatic densimeter described in a preceding paper has been modified in the following details so as to be better adapted for localities where sufficiently deep water can only be attained at some distance from the shore, and also to be independant of temperatures far below freezing point. (Fig. 6.) The U tube of glass is mounted upside down with a corresponding change in the position of its air traps *A*, *A*, and communication tubes, to which the submerged tubes are attached. The latter are of lead, one-fourth inch wide, and are supported by bronze wires running along the whole length of the tubes so as to save them from the strain due to their own weight. About 1 meter below the surface there is a biconical brass vessel of about 1 liter inserted in each branch of the system. The upper half of these vessels is filled with liquid paraffin (black in the figure), colored red with a scarlet dyestuff insoluble in water, and the same fluid is contained in the upper part of the system from the vessels and upward. Only the lower half of the U tube itself is filled with a mixture of water and alcohol of the approximate density 0.85 (4 parts of water to 6 parts of alcohol) which serves as index fluid. The sensibility of the system may be varied by taking other concentrations of the water-alcohol mixture (within certain limits). The instrument is quite as easy to mount and to read as the type previously described.

NOTES ON THE FLUCTUATIONS OF MEAN SEA LEVEL IN RELATION TO VARIATIONS IN BAROMETRIC PRESSURE.

By Capt. T. BEDFORD FRANKLIN.

[Abstract from Jour. Scottish Met'l Soc., vol. 18, 1918, pp. 30-31.]

A study of the data from self-recording tide gauges at Dunbar, Newlyn, and Felixstowe by Col. Sir Charles Close brought him to the following conclusions:

1. That the effect of the local variation of pressure on sea level is opposite in sign to, and 13.25 times the magnitude of, the barometric variation—that is, the ratio is the same as the ratio of the specific gravity of mercury to that of sea water. [The actual ratio varies from about 7–20.]

2. That there is an annual tide—the cause at present unknown—having an amplitude of 6 inches, with a maximum in November and a minimum in April.

As suggested in 1914 by Prof. D'Arcy W. Thompson, the discrepancies between the tidal variation and barometric curves may be accounted for by considering atmospheric pressure and winds together. For Newlyn, by assuming that the effect of the wind either in piling up the water or in pushing it out to sea is proportional to its pressure in pounds per square foot, such that the effect in inches of sea level is about 1.5 times the inshore or offshore component of the wind pressure, it is possible to account closely for the differences between the hydrostatic and observed effects. This effect on seven occasions cited was 1 to 7.5 inches.

It would, therefore, appear that by applying the appropriate wind correction the two curves may be made very nearly to fall upon each other, and that for the limited period under observation—December, 1916, to June, 1917—*the sea level responded immediately to the combined influences of barometric pressure and wind.*

THE EFFECT OF WIND ON SEA-LEVEL.

[Extract from Nature (London) Feb. 13, 1919, p. 471.]

* * * Changes of level due to winds cause some fluctuation in individual estimates of the ratio (from 7 to 20, roughly), but not sufficiently to mask the close connection between sea-level and barometric pressure.

In a narrow landlocked sea, however, it might be expected that the wind would have relatively greater influence, and this is confirmed by a recent study of the Baltic sea level by Rolf Witting (*Öfv. af Finska Vet.-Soc. Förh.*, vol. lix, A, 13. Helsingfors, 1917). The purely hydrostatic effect of a gradient of barometric pressure over any region is to produce an opposite slope of the sea surface; but such a distribution of atmospheric pressure is usually accompanied by winds directed along the isobars, with the higher pressure on the left (in the Northern Hemisphere). This tends to heap up the waters with a gradient perpendicular to the former one, and in the Baltic this slope appears to be about 1.8 times as great as the hydrostatic slope. The resultant gradient is rather more than twice the latter and is inclined to it in azimuth at about 55°.

AN INSTRUMENT FOR ACCURATE AND RAPID DENSITY MEASUREMENTS ON BOARD SHIP.

By A. L. THURAS.

[Author's summary, from Journ. Wash. Acad. Sci., 1917, 7: 605-612, 2 figs.]

A simple apparatus is described by which the density of sea water can be measured on board ship with speed and precision. With carefully calibrated bobbins a density measurement of a liquid of known temperature coefficient can be made in less than 10 minutes to an accuracy of more than two in the fifth decimal place. The particular advantage of the method lies in the facts that (1) by changing the temperature of the liquid its density can easily and quickly be brought exactly to the density of the bobbin, and (2) at equilibrium temperature the sensitivity of the method is unaffected by the motion of the vessel, the liquid and bobbin having the same density.

AN ELECTRICAL INSTRUMENT FOR RECORDING SEA-WATER SALINITY.

By ERNEST E. WEIBEL and ALBERT L. THURAS.

[Author's summary, from Journ. Wash. Acad. Sci., 1918, 8: 145-153, 3 figs.]

An apparatus to give a continuous record of sea-water salinity by the measurement of its electrical conductivity is described. A pair of electrolytic cells has been designed which when used with a suitable alternating-current galvanometer will give satisfactory operation in connection with a recorder. The temperature compensation is obtained by placing both cells, which are in the two arms of a Wheatstone bridge, in a uniform temperature bath.

WILLIAM ALLINGHAM.

William Allingham, for many years principal assistant in the marine branch of the Meteorological Office, died suddenly January 24, 1919, at the age of 69. His early life was spent at sea, but, owing to a disabling accident, he obtained in the early seventies a post in the Admiralty, then in 1875 he was transferred to the staff of the Meteorological Office. In addition to a practical knowledge of navigation and meteorology, Allingham was gifted with considerable literary ability. His chief works were the compilation of a Manual of Marine Meteorology, and in conjunction with Capt. Wilson-Barker, a treatise on Navigation, Practical and Theoretical.—*From Symons's Met'l Mag., Feb. 1919, p. 4.*

CAPTAIN MELVILLE WILLIS CAMPBELL HEPWORTH.

Apr. 27, 1849–Feb. 25, 1919.

The death of Capt. M. W. C. Hepworth, following so soon after that of Mr. Allingham, is a serious loss to the Marine Division of the Meteorological Office, of which he had been Superintendent since 1899. The Monthly Meteorological Charts of the North Atlantic and Mediterranean, as well as of the East Indian seas, were initiated during his tenure of office, and the later editions of the Barometer Manual for the Use of Seamen and the Seaman's Handbook of Meteorology were compiled under his direction and attained a large circulation. Capt. Hepworth was much interested in marine biology and in the temperature and salinity of the sea. For the many years while at sea he made a study of meteorology which prepared him for his official position.—*From Nature (London) Mar. 6, 1919, p. 8 and Symons's Met'l Mag., 1919, pp. 13–14.*

RELATION BETWEEN VEGETATIVE AND FROSTLESS PERIODS.

By JOSEPH BURTON KINCER, Meteorologist.

[Dated: Division of Agricultural Meteorology, Weather Bureau, Washington, D. C., Jan. 13, 1919.]

The two most important climatic elements with reference to plant growth are temperature and precipitation. Of these, temperature is the more effective in establishing the geographic areas within which certain plants thrive best on the one hand, or even fail to mature on the other, and it also determines the period of the year during which growth is possible.

In any study of plant growth as affected by temperature, there are two important phenomena that may be considered as constituting critical or basic points from which reckonings must be made; these are the vegetative temperature and frost. The first defines the potential period of plant growth, which is determined by the date in spring when the temperature rises sufficiently high to render active the protoplasmic content of vegetable cells, and thus produces growth, and the date in fall when it falls below this point and growth ceases. The frostless period is determined by the dates of the last killing frost in spring and the first in autumn. It is the object of this paper to study briefly the relation of these two basic periods, and their variations in length in different sections of the United States.

The average growing season as determined by frost occurrence is understood to be the number of days between the average date of last killing frost in spring and the first in autumn, but some plants are more susceptible to frost damage than others and consequently the growing season as thus defined varies in length in the same locality for different plants. This is also true for the vegetative period as determined by the amount of heat necessary to produce plant growth, considered independently of the occurrence of killing frost. It has long been known, however, that for most plants in temperate climates, the vegetative or active period begins in spring, as a general rule, when the mean daily temperature rises to 6° C. (42.8° F.), and ends in autumn when it falls below that value. These limits have been adopted for the purpose of this study of the relation of the vegetative to the frostless period.

Chart I shows the average dates in spring when the mean daily temperature rises to 43° and Chart II the dates in autumn when it falls below that value. The vegetative period, represented by the average number of days when the mean daily temperature is 43° or higher, is shown for different sections of the country by Chart III. This period is not the same, of course, for each year, but varies from year to year, as does the frostless season or any other period determined by the average dates on which phenomena occur. From the Rocky Mountains westward the charts are highly generalized, owing to the great variation in the topographic features of that section of the country.

Chart I shows that the advent of the vegetative period in an average year ranges from the first of February in the northern portion of the Gulf States to May 1 in extreme upper Michigan and northern New England. Chart II indicates that this period comes to an end, on the average, in the extreme northern districts about the middle of October, but it continues till the end of the year in the South. Chart III shows that the length of the period ranges from less than 180 days in the extreme north and in the central and northern portions of the Rocky Mountain region, to 365 days in the south Atlantic and Gulf districts, and also in the central and southern Pacific coast sections. (The latest frost charts are those appearing in the frost section of the Atlas of American Agriculture, recently published.[1] See also "The Probable Growing Season," by William Gardner Reed, MONTHLY WEATHER REVIEW, Sept., 1916, 44, 509–512.)

The normal daily march of temperature is closely allied with the annual march in establishing the vegetative period. For example: If we assume that most vegetation is awakened from the dormant state when the daily mean temperature rises to 43°, it is evident that prior to the date on which this occurs, the temperature during the warmer portion of the day would be sufficiently high to produce growth and consequently, it would appear, that some growth actually begins before the mean temperature rises to the vegetative point (on the average, the temperature during approximately one-half of the day is higher than the daily mean). This, however, is true only in a limited degree, as will be evidenced by a careful consideration of the amplitude of the daily extremes of temperature. This amplitude varies with the moisture content of the air and its attending phenomena, with the latitude, and also with the sea-

[1] Advance sheets 2, pl. II, sec. 1; issued, 1918; 34 x 48 cm., 12 pp., 12 colored maps, 10 weather maps, 10 graphs. Selected bibliography. Review in M. W. R. 1918, 46:516–517.