Germination of Seeds exposed to Low Temperatures.

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THIS investigation was undertaken in December 1921. Seeds of thirty species were placed in tin containers (druggists' ointment tins), one lot being left indoors in the laboratory, at a temperature of 75° F., the other lot being exposed out of doors, for 83 days, from January 9 to April 2. In both cases the seeds were kept perfectly dry. After the conclusion of the period indicated, the seeds of both lots were germinated between blotters for 10 days in the laboratory, at a temperature of 72°-75° F. One hundred seeds were tested from each lot, the germinated seeds being counted on the fifth, seventh, and tenth days. Fifteen varieties of garden seeds, belonging to seven species, gave a germination percentage at the end of 10 days of 67 per cent. to 63 per cent. in favour of the indoor lots. For eleven varieties, belonging to eight species, the germination percentage at the end of 10 days was as 70 per cent. to 66 per cent., also in favour of the indoor lots. The twenty-six varieties gave an average percentage germination at the end of 5, 7, and 10 days of 42 : 36, 62 : 58, and 69 : 65 respectively, for the indoor and the outdoor lots, or a preponderant percentage superiority of 6 per cent., 4 per cent., and 4 per cent. respectively, for the three successive periods, in favour of the lots kept indoors.

From the above summary, it appears that a small average increased germination percentage occurred in the case of seeds kept at laboratory temperature. It was noticed that the seeds of cool temperate species developed a germination percentage higher by 25 per cent. (54 : 20) than those of the warm temperate species kept at laboratory temperature, during the first 5 days of the germination period, although the increased percentage was but 14 per cent. (43 : 29) in favour of the same group exposed to the outside winter temperature. The total germination percentage, however, was approximately the same in both cases.

The mean temperature out of doors for the period of the experiment was as follows, in degrees Fahrenheit: Jan. +3·0, Feb. +0·4, Mar. +24·7, Apr. +41·5, May +60·0.

In the winter of 1923, another lot, consisting of fourteen species, in thirty-three varieties, all of them cool temperate vegetable and field seeds, were exposed as before on January 26. On May 12 the different lots of seeds were tested for percentage of germination. In the preceding year's experiment the germination test was made in the laboratory for plant physiology of the University of Manitoba. In the second year the germination tests were conducted in the official Dominion Seed Laboratory at Winnipeg. The results obtained were as follows: As the average of the summary shows, there was a difference of 4 per cent. in favour of the seeds kept at laboratory temperature,—about 2 per cent. less than the average at the end of 10 days for the twenty-six species and varieties tested the preceding year. At all events, the results, although not conclusive, at least point to a slight diminution in total vitality, as the result of continued exposure to low winter temperatures at the latitude of Manitoba. It should be stated that all the seeds tested were in a thoroughly air-dry condition before the beginning of the test.

Sixty-six varieties, belonging to fifteen species, were tested, including carrot, Swedish turnip, mangel, sugar beet, barley, flax, crimson and white clover, cucumber, cauliflower, celery, egg plant, and cabbage. The total averages for all varieties tested were as follows:

	4-day test.	10-day test.
Inside . . .	56	73
Outside . . .	57	75

There is therefore seen to be practically no difference in the results as between the seeds kept indoors and those kept outside. If some of the individual cases are examined separately, three varieties of carrots gave at the final test 69 per cent. and 68 per cent. respectively for the seeds outside and inside; six varieties of Swedish turnip, 75 per cent. and 75 per cent.; three varieties of mangels, 56 per cent. and 62 per cent.; three varieties of turnip, 71 per cent. and 73 per cent.; three varieties of cucumber, 79 per cent. and 81 per cent.; four varieties of cabbage, 98 per cent. and 77 per cent.

It thus appears, when the details can be taken in numbers sufficient to indicate an average result, that the data agree with the general average. Inasmuch as the data herein are at variance with the general experience of practical men, horticulturists, etc., with regard to the practical utility of chilling seeds, it is concluded that the general factor of moisture is the effective one, and that the layering of seeds in a moist substratum accounts for the effectiveness of the practice, rather than the temperature factor alone.

Barogram Analysis in Weather Forecasting.

THE Italian meteorologist, Francesco Vercelli, has made a laborious study of barographic records from various parts of the world, and various periods and seasons, submitting these curves to a process of periodigram analysis on the lines familiar in tidal investigations, or as applied to the study of seiches in lakes by the late Prof. Chrystal. The results are described in full detail in a booklet published last year in Rome, under the auspices of the Geophysical Institute of Trieste, entitled "Nuovi esperimenti di previsioni meteorologiche."

From the generalised point of view, the barometric curves are shown to contain the well-known diurnal period which is so outstanding in the tropics, various periods ranging between a few days and a month, and an annual period, together with a small "insoluble residue," representing what must be regarded as irregular fluctuations. The amplitudes of these several periods, and other characteristics thereof, differ greatly according to latitude, season, and continentality. If the periodal composition of a given barogram is known, it becomes possible to synthesise its prolongation on the assumption that none of the contained periods die out or others reappear, and thus to make a forecast of the course of barometric pressure for a longer period than is possible by the ordinary synoptic chart method.

Vercelli claims—and the responsibility for the statement must rest with him—to have obtained remarkably good agreement between the predicted and actual continuations of his curves, and to have used this method of weather forecasting with much success in circumstances of grave responsibility on the Italian Front during the War. He indicates the main source of error to be the liability to cessation, or temporary suspension, of any of the component periods, or the reappearance of others. He also points out that the paper in question, discussing the analysis of single curves, is only the commencement of the subject, since the next step will consist in co-ordinating the analyses of curves from several places; this would greatly enhance the usefulness of this method of forecasting.

The author does not, however, appear to lay enough stress on the fact that forecasting pressure is by no means equivalent to forecasting weather, and that the correlation between rainfall and the height of the barometer at a place, or even the connexion between rainfall and pressure distribution over an area, is none too close from a forecaster's point of view. One has also to consider the tendency of the weather to get into dry or wet "grooves"; for it is well known that during pronouncedly wet spells, downpours occur in passing barometric configurations that would scarcely yield a drop during a dry spell. Moreover, it does not follow that Vercelli's method, even if found practicable in Italy, would answer in England, where it is possible that the relationship between pressure and weather may be rather more complex. It is just such climatic peculiarities we want to discover, and it is not too much to say that even if a universal application of Vercelli's system to weather forecasting proved wholly unserviceable, which is scarcely likely, it could not fail to bring to light any such interesting climatological differences between one region and another. L. C. W. BONACINA.

Wind, Wave, and Swell on the North Atlantic Ocean.[1]

DURING a voyage from Southampton to Trinidad and back by R.M.S. *Oruba* the period of the waves was taken several times daily, and from this their speed was calculated. The speed of the wind was ascertained by means of a Robinson anemometer (lent by the Meteorological Office), due allowance being made for the speed of the ship and the direction of the wind.

The water is very deep from a short distance beyond Ushant, and free from strong currents so far as Barbados. The speed of the wind ranged from 13·9 to 23·6 statute miles per hour. That of the waves was in all cases less, the difference ranging from 1·0 mile an hour to a little more than 8·0 miles an hour. The latter is sufficient to keep a light flag flying. Anything less than 1 mile an hour is reckoned a calm. The difference was not proportional to the speed of the wind; nevertheless a relationship emerges when account is taken of the observations which were made simultaneously of the swell of the sea. When swell and wave ran precisely in the same direction (as sometimes occurred in the region of the Trade winds) and on one day when no swell was recorded, the speed of the wave was so nearly equal to that of the wind that the breeze blowing over the ridges was only equal to the "light air" which barely suffices to give steerage way to a fishing smack. Such a light air would be detected on land by drift of smoke but would not move a wind-vane. Thus there was no longer a battle between wind and wave.

When the swell followed but crossed the wave the difference in speed of wind and wave was greater, and this difference increased rapidly when the crossing swelling swell was meeting, instead of following, the wave. When the waves were much slower than the wind their height was always small, and sometimes their fronts were short and irregular. It was evident that the growth of waves in both length and height was much hindered by a crossing swell, and it can be safely inferred that the general absence of swell is a sufficient reason for the rapid rise of waves upon enclosed seas. When a wind comes on to blow in the direction of the ocean swell with a speed greater than that of the swell, the growth of large, steep waves is very rapid (doubtless even more rapid than their growth from smooth water), but this occurrence is relatively rare in the North Atlantic.

The direction of the breaker out at sea was found to be intermediate between that of wave and swell (the breaker being formed when they override), so that the practice of observing the direction of "the curl on the water" as a method of determining the direction of the wind gives an erroneous result whenever there is a crossing swell, which is the usual condition upon the oceans. The general run of the waves, on the contrary, gives a trustworthy indication of the direction of the wind.

[1] Substance of a paper by Dr. Vaughan Cornish read before Section E (Geography) of the British Association at Toronto on August 8.

Mountain Structure.

THE origin of mountains continues one of the most controverted problems in geology, because geological maps of mountain areas are most difficult to prepare, and the interpretation of mountain structure involves appeal to layers of the crust far too deep for direct observation. The American Geological Society has arranged a symposium of nine papers on the development of mountains,[1] which is the best available summary of modern opinion on the subject and illustrates its diversity.

The series opens by a masterly sketch by Prof. Schuchert of the development of research on orogeny from its foundation by H. H. Rogers, and of the evolution of North America, illustrated by 17 maps. He compares the American school with Haug's view of geosynclinals, which he rejects as untenable. Amongst several useful new terms proposed is "tafrogenesis" for rift valley formation.

Mr. Longwell's paper on Kober's theory is appropriate, as it deals with an extension of the subsiding belt explanation of mountain formation. Kober reclassifies the Alpine elements to avoid that asymmetry in mountain chains which Suess emphasised as their distinctive feature. Prof. Hobbs rejects Suess's arrangement of the Asiatic arcs, and assigns many of them to a direction of movement opposite to that adopted by Suess.

The structure of Appalachia naturally plays a large part in the symposium, and is discussed by J. B. Woodworth and Arthur Keith, whose conclusions are opposite. The former adopts isostasy, which Keith criticises adversely. He attributes the Appalachians to the intrusions of many granitic batholiths; in a valuable discussion of rival theories he rejects the shrinkage of the earth, owing to the astronomical disallowance of the necessary reduction in size; but if the geological evidence for the contracting earth is adequate the astronomers will doubtless find some reconciliation of that fact and their calculations.

The structure and building of the Rocky Mountains is discussed by G. R. Mansfield and W. T. Lee, whose paper is accompanied by appendices by C. E. Van Ostrand and W. D. Lambert. Mansfield rejects Kober's view that rift valleys are accompanied by compression, and insists that they are due to tension. Lee describes the Southern Rocky Mountains as due to vertical uplift in the restoration of isostatic equilibrium.

[1] Symposium on the Structure and History of Mountains and the Causes of their Development. Bull. Geol. Soc. Amer., Vol. 34, Pt. 2, June 30, 1923, pp. 151-380, 1 pl.