CONTINENTALITY AND TEMPERATURE.

By C. E. P. BROOKS.

(Abstracted from Quart. Jour. Royal Meteorological Soc., April, 1917, pp. 159-174; and October, 1918, pp. 253-270.)

The problem of determining the power and influence of the geographical changes of the earth on temperature has been approached by the mathematical method of partial correlation. The region selected for this investigation lies between the latitudes 40° and 60° north, and the western coast of Europe east to longitude 90° east. The stations, 56 in number, were given their proper coordinates of height, continentality, and radiation received. Continentality refers to the percentages of land and water area inside concentric circles centered at the station. These measures are termed C_5, C_{10}, C_{20}, respectively, the subscripts giving the radius of the circles in degrees. By finally determining the partial correlation coefficients between the variables, continentality, height, and radiation, on the one hand, and temperature on the other, the following conclusions were reached:

First. *Effect of height.*—Two stations in same latitude and having the same continentality coefficients, but differing in altitude by 100 meters, should differ in their mean temperature by 0.61°C. in January and 0.45°C. in July. These figures are quite within the limits of the observed values.

Second. *Effect of radiation.*—Two stations at the same altitude and having equal continentality coefficients but differing in latitude by 20° should differ by 19.2° C. in January and 7.1° C. in July, the more southerly being the warmer in each case.

Third. *Effect of continentality.*—Expressing the continentality coefficient in terms of degrees (C.) per square kilometer, we find:

	C_{10-20} (°C.×10⁻⁹)	C_{5-10} (°C.×10⁻⁹)	C_{0-5} (°C.×10⁻⁹)
January	−33	−164	−21
July	+40	−20	+111

Fourth. It appears that with continentality 0, i. e., a station entirely surrounded by sea for at least 20° the basal temperature (effect of sun's heat not included) for January is 284.9° A., and for July 227° A. Where continentality is 50, basal temperature is 269.1° A. for January and 232.9° A. for July. Where continentality is 100, i. e., no water within 20° radius, the temperatures for January and July are, respectively, 253.3° A. and 238.7°A.

These figures signify that, apart from radiation from the sun and sky, the difference, heat received—heat given away, is very much greater (algebraically) in winter than in summer. This heat transference takes place partly as actual radiation to the sky, and partly by the agency of the wind and convectional currents.

An attempt to discuss the temperatures changes in different geological ages was made, and the period chosen was the Litorna time "when the Baltic was larger and more salt than now, and when the Scandinavian countries had a warmer and more temperate climate, as shown by the distribution of animals and plants at that peroid." Upon reconstructing a map to conform with the probable distribution of land in that period, it was found that certain of the continentality factors balanced each other, with the result that there was little or no change of temperature as a result. The conclusion was, not that the temperature distribution of that age did not differ from the present, but that the equations employed in obtaining present values were good only when applied to the present land and sea distribution of Europe. Hence, new equations were formed which resulted in showing that the January temperatures over the northern Baltic exceeded the present by 3°; south of that point the temperatures decreased until northern Germany was slightly colder than at present. This is shown to agree with the opinions of the most eminent authorities, and emphasizes the fact that changes of continentality are entirely sufficient, without any astronomical considerations, to account for changes of climate in long periods.

In summarizing the results of the investigation, I may confidently say that the method of partial correlation in connection with land and sea distribution is a powerful tool in the hands of climatologists and geologists, but it is a tool of a very technical nature, and expertness in its use can only be gained by practice.

The second paper is a more elaborate treatment of the effect of continentality on temperature, and takes up the effect of latitude. This point was neglected in the first paper because of the small region of the earth's surface employed in the discussion; but here the whole world is considered, and, obviously, the effect of latitude is an important factor. In this investigation, the average mean temperature in January and July at each point of intersection of two 10° coordinates were obtained, and then these values were compared with the percentage of land within a 10° circle around the point of intersection. Land to the east and west of each point, as well as ice, was expressed in percentage, and each point was treated by the method of partial correlation for effect of land to the west, supposing land to the east, and ice, constant; then, the effect of land to the east, with land to the west, and ice, constant, and the effect of the ice supposing land to the east and west constant. The temperature was obtained by this formula: Temperature = basal temperature + ice coefficient × percentage of ice + land west coefficient × percentage of land west + land east coefficient × percentage of land east.

The following interpretation of the results from a geographical standpoint is obtained:

1. In winter the effect of land to the west is always to lower temperature. This holds in every case except at 10° south and 20° south.
2. In winter, the effect of land to the east is almost negligible. The only important exception to this rule is 70° north, which may be considered as coming within a belt of polar east winds.
3. In summer, the general effect of land whether to east or west is to raise temperature, but the effect is nowhere anything like so marked as the opposite effect in winter.

In discussing the influence of the distribution of insolation it is interesting to note that while the water hemisphere reaches its maximum calculated temperature in latitude 10° south, the land hemisphere has its maximum at 30° south. The maximum of heat received in January occurs at about 33° south. The thermal equator is thus much less mobile over the ocean than over the land.

The glacial periods are discussed, leading to the following generalization: "Over the earth as a whole the glacial period was due not alone to fall of temperature or to increased snowfall, but to both, the former being predominant in high latitudes and decreasing toward the Tropics where it vanished, and the latter increasing from a small but effective part near the poles until in the Tropics it was the sole cause." The theory of climatic evolution is outlined on the basis of rise and fall of the earth's crust, under the weight of the ice sheet. The rise of the earth causing a lowering of temperature with the consequent formation of glaciers, the weight of the ice sheet in turn causing the crust to sink back, raising the temperature and melting the ice. This is traced through four periods, the maximum rise of land in each period being less than in the preceding. Thus it is demonstrated that the "climates of the world are the result of geographical conditions of the world," and "that within certain limits climatic and geographic conditions react one on another to produce continuous though very slow changes in both."—*C. L. M.*

PERIODICITY OF WINTER TEMPERATURES IN WESTERN EUROPE.[1]

By C. EASTON.

[Reprinted from Science Abstracts, Sect. A, Sept. 30, 1918, §913.]

All available data are collected and carefully sifted, reports of exceptionally mild winters being used in addition to those of severe ones. Each abnormal winter is given a coefficient of temperature ranging between +5 and −5, the remaining winters being marked zero. The series covers 1,157 years. The data are investigated with a view to determining periodicities. An 89-year period is traced and it is further found that in the past 65 years, for which reliable thermometric observations are available, the temperature sequence of this 89-year period can be clearly followed, thus affording confirmation of its reality. The chief features of the fluctuation are that in the first quarter of the 89 years cold winters prevail and in the last quarter warm ones. A sine wave of 44½ years seems to be an important part of the 89-year fluctuation. It is considered that the results are sufficiently definite to be of some assistance in long-range forecasting. No evidence is found of a gradually increasing or decreasing frequency of severe winters in historical times.[2]—*J. S. Di[nes.]*

[1] Physikalische Zeitschrift, June 1, 1918, 19: 234-237.

[2] See also review in Geogr. Rev., 1918, 4: 398.

BIBLIOGRAPHY.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Professor in Charge of Library.

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

Bavaria. Meteorologische Centralstation.
Deutsches meteorologisches Jahrbuch für 1914–15. Jahrgang 36–37. München. 1916–19. 2v. charts (part. fold.) tables. 33 cm.

Cienfuegos. Colegio "Nstra. Snra. de Montserrat." Observatorio.
Anales. No. 8. Observaciones meteorológicas de 1918. Habana. 1919. tables. 32½ cm.

Colombo. Observatory.
Report for the year 1918. Colombo. 1919. 2 p. l., J1-J20 p. charts (part. fold.) tables. 33½ cm. (Reprinted from the Ceylon blue book for 1918.)

Dorno, C[arl Wilhelm Max].
Welchen Nutzen bringen die Polarisationsbeobachtungen der atmosphärischen Optik, Meteorologie, Geophysik und Astronomie? charts (part. fold.) 23½ cm. (In Mitteilungen der Vereinigung von Freunden der Astronomie und kosmischen Physik, Berlin. 29 Jahrg. Heft 6/7. Sept. 1919. p. 71–86.)

Easton, C[ornelis].
Periodicity of winter temperatures in western Europe, since A. D. 760. Amsterdam, [1917,] cover-title. 16 p. fold. chart. 5 tables. 26½ cm. (Reprinted from Proceedings. Vol. 20. No. 8. K. Akademie van wetenschappen te Amsterdam.) [Reviews: Geogr. Rev., 1917, 4: 398; and this page, above.]

Ellis, Arthur J.
Geology and ground waters of the western part of San Diego county, California, by A. J. Ellis and C. H. Lee . . . Washington. 1919. 321 p. plates. maps (part. fold.) charts (part. fold.) tables. diagrs. (part. fold.) 23½ cm. At head of title: Department of the interior. U. S. Geological survey. Water-supply paper 446. "Publications consulted," p. 288–290. [Includes extensive data of precipitation and evaporation, largely from non-Weather Bureau stations.]

Fontserè [y Riba], Eduardo.
Movimiento de las nubes altas y medias en el zenit de Barcelona. Con la colaboración de D. G. Campo Cunchillos. Barcelona. 1919. 11 p. charts. tables. 29½ cm. At head of title: Memorias de la Real academia de ciencias y artes de Barcelona. Tercera época. Vol. 15. Núm. 8.

Great Britain. Meteorological office.
Codex of resolutions adopted at International meteorological meetings. Supplement summarising the resolutions adopted by the International meteorological committee meetings held in Berlin, 1910, and Rome, 1913. London. 1919. 12 l., 25 cm. M. O. No. 200.
Professional notes no. 4–7. London. 1919. 4v. charts. tables. 24½ cm. M. O. 232d–g. Contents: (4) Upper air temperatures at Martlesham Heath, Feb. 1917 to Jan. 1918, by W. F. Stacey. (5) On the use of the normal curve of errors in classifying observations in meteorology, by E. H. Chapman. (6) The variation of wind velocity with height, by E. H. Chapman. (7) The climate of north-west Russia. [See abstracts, MONTHLY WEATHER REVIEW, Aug., 1919, **47**: 572.]

Great Britain. Meteorological office. Advisory committee on atmospheric pollution.
Report on observations in the year 1917–18. Forming the 4th report of the committee for the investigation of atmospheric pollution. London. [1919] 23 p illus. tables. charts. 29 cm.

Grover, Nathan C[lifford].
Surface water supply of Hawaii, July 1, 1917 to June 30, 1918. . . . Washington. 1919. 172 p. tables. 23 cm. At head of title: Department of the interior. U. S. Geological survey. Water-supply paper 485. [Rainfall, p. 163–167.]

Guam. Agricultural experiment station.
Report, 1918. Washington. 1919. 61 p. plates. tables. 23½ cm. [Meteorological observations, July, 1917–June, 1918, incl. Observations were taken in Guam during the fiscal years 1912–1914 and recommenced on July 1, 1917.]

Guernsey. Meteorological station.
Observations météorologiques, 1918. Guernsey. 1919. 20. p. tables. 28 cm.

Hartman, C. M. A.
Het klimaat van Nederland. B. Luchttemperatur. Utrecht. 1918. 104 p. tables. 24½ cm. At head of title: K. Nederlandsch meteorologisch instituut. no. 102. Mededeelingen en verhandelingen 24. In Dutch and French.

International catalogue of scientific literature.
14th Annual issue. F. Meteorology, including terrestrial magnetism. London. 1919. viii, 181 p. 21½ cm.

Jinsen. Meteorological observatory.
Annual report of the meteorological observatory of the Government-general of Chosen for the year 1917. Jinsen. 1919. 4 p. l., 134 p. fold. map. tables. 30½ cm. Final leaf in Japanese.