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- Tams, E[rnst].** Über die Frequenz der Nachstöße starker Beben. p. 145-150. (12. März.)
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NOTES FROM THE WEATHER BUREAU LIBRARY.

By C. FITZHUGH TALMAN, Professor in charge of Library.

A LIST OF METEOROLOGICAL ISOGRAMS.

The subject of the meteorological isograms was somewhat fully discussed by the present writer in the Scientific American Supplement of Nov. 12, 1910, and in that connection the writer presented a list of such named isograms as had come to his notice. Further search of meteorological literature, as well as the recent growth of the vocabulary, enables him to present herewith a much larger list and one that is believed to be nearly complete. The author will be glad to have his attention called to any that he has overlooked. The isograms of terrestrial magnetism, and many isograms that are of general application in physics and are therefore occasionally met with in meteorological diagrams (e. g., *isenergetic* and *isentropic*), lie beyond the scope of the present compilation.

The term *isogram* was suggested by Francis Galton in 1889¹ as a convenient generic designation for lines, on a chart or diagram, indicating equality of some physical condition or quantity. These lines are, of course, used in many sciences, but much the largest number of those to which particular names have been assigned belong to meteorology. In German such lines have sometimes been called *Isolinien*, or *Isarithmen* ("iso-lines" or "isarithms"). Dr. W. N. Shaw, in his "Forecasting Weather" (London, 1911), calls them *isopleths*, but the latter term has for years borne a more specific meaning in meteorology (as explained below), and its use in the same broad sense as *isogram* is to be regretted, as leaving the *isopleth* in the narrower sense without a distinctive name. As Hann says in his "Lehrbuch der Meteorologie" (3d ed., 1915, p. 91) the name *isopleth* is literally appropriate for any line connecting equal numerical values, but custom has limited its use to a particular class of such lines. Meteorological isograms have sometimes been known as *isometeoric lines*, and those used in climatology as *isoclimatic lines*.

¹ Nature, 40, 1889, p. 651.

Magnetic isograms were published (by Halley) as early as 1701, and appeared on manuscript charts even earlier, but the first meteorological isograms were Humboldt's isotherms of the globe (1817). Humboldt also suggested the use of two other meteorological isograms: viz, the *isothere*, connecting places having the same temperature in summer, and the *isochimenal*, connecting those having the same temperature in winter; but he did not actually draw them. He contented himself with a description of their course with respect to the annual isotherms, and with noting the summer and winter temperatures at several points on his isothermal chart.

Theoretical isobars for the Atlantic and Indian oceans were drawn by H. K. W. Berghaus in 1839; in accordance with the views then prevailing they were straight lines parallel to the equator. The first isobars based upon actual data of observation were those drawn for France by Renou, in 1864, and the first isobars for the whole globe were published by Buchan (who called them *isobarometric lines*) in 1868.

In recent years the number of named isograms has increased rapidly, but they have received tardy recognition in the dictionaries, and even in scientific reference-books. One result of this is seen in the frequent coining of synonymous expressions. A writer who finds it convenient to apply a name to an isogram can not readily ascertain whether a suitable one has already been proposed; he therefore proceeds to christen it *à sa guise*.

The application of the names of the isograms is, and should be, somewhat elastic. Thus an isotherm is *any* isogram of temperature; not merely of mean annual temperature, as was stated, until very recently, in the English dictionaries. Similarly, the *isotalantose* should be defined as *any* isogram of range; the element and period in question being indicated by a qualifying expression when necessary; but as a rule this can be gathered from the context. In other words, the names of the isograms should have a more or less generic application; otherwise the terminology of these lines would need to be multiplied *ad infinitum* to satisfy all the requirements of the graphic representations of this character used in meteorology.

The following list indicates the date of introduction and the author of each term and the earliest instance of its use, so far as this information could be obtained by the compiler:

aerotherm. Isopleth showing the daily march of temperature over a given place up to a few meters above the ground; drawn for comparison with geotherms. (T. Homén, Acta Soc. sci. Fenn., **23**, no. 3, 1897, p. 95.)

anisallobar. Isogram of rise of barometric pressure in a given time; a positive isallobar. (N. Ekholm, "Das Wetter auf der Nordsee während der ersten Hälfte von Juni, 1911," 1913, p. 14.)

baroisobar. Same as *isallobar*. (F. G. Friesenhof, Met. Zeit., **22**, 1905, p. 235.)

chionosynchrone. Isogram of the duration of snow on the ground. (E. W. Kaminska, Bull. Acad. sci., Cracovie, sér. A, 1912, p. 874.)

choroisootherm. Isotherm used in representing the distribution of temperature in space; the common form of isotherm, as on isothermal maps and weather maps; distinguished from the *chronoisotherm*, which shows the distribution of temperature in time. (W. Köppen, Met. Zeit., **2**, 1885, p. 287, foot-note 3.)

chronoisotherm. Isopleth of temperature; a thermo-isopleth. (R. H. Scott, "Elementary meteorology," Lond., 1883, p. 49.)

chthonisootherm. A line drawn from the equator poleward along a meridian, passing through points beneath the earth's surface having the same temperature as the surface at the equator. (G. Bischof, "Die Wärmelehre des Innern unsers Erdkörpers, 1837, p. 174-175.)

equiglacial line. Isogram of the condition of the ice in rivers, lakes, harbors, etc. There are three classes of these lines; viz., *isopectics*, *isotacs*, and *isopags* (all defined below). Some writers apply this term only to the isopag (e. g., H. H. Hildebrandsson, Ann. Bur. cent. mét. France, 1878, I, p. C. 34. An example of the broader use occurs in S. Günther, "Lehrbuch der phys. Geographie," 1891, p. 250.)

equipluve. Isogram of pluviometric coefficient. This isogram is analogous to, but not identical with, the *rainfall isomer*. Cf. *isomer*. (B. C. Wallis, Scot. Geogr. Mag., **30**, 1914, p. 364. Equipluves were drawn by A. Angot in 1895 but not so named.)

equipotential curve. In atmospheric electricity, an isogram of potential.

geoisotherm (geisootherm). Same as *isogotherm*.

geotherm. Isopleth showing the daily march of temperature at various depths in the ground. (T. Homén, Bidrag till kännedom af Finlands natur och folk, **54**, 1894, p. 234.)

homobront. Same as *isobront*.

hygropleth. Isopleth of dew-point temperature. (T. Homén, Acta Soc. sci. Fenn., **23**, no. 3, 1897, p. 96.)

hypertherm. Isogram of positive departure from normal temperature. (H. Arctowski, "L'enchaînement des variations climatiques," 1909, p. 94.)

hypotherm. Isogram of negative departure from normal temperature. Hypertherms and hypotherms are special cases of the *isametral*. (H. Arctowski, "L'enchaînement des variations climatiques," 1909, p. 94.)

hyposisootherm. Isotherm drawn on a vertical section of the atmosphere (sometimes also of the ground) to show the distribution of temperature in the vertical. (Translation of the term "Höhenisotherme" used by H. and A. Schlagintweit, "Untersuchungen über die physikalische Geographie der Alpen," 1850, Tafel viii and ix.)

isabnormal (isoabnormal). Same as *isanomal*. (H. W. Dove, "Die Verbreitung der Wärme auf der Oberfläche der Erde," 1852, Charte IV, English subtitle.) An application of this term to isametral of barometric pressure, formerly entered on synoptic weather charts, is recorded in R. Abercromby's "Weather," 1887, p. 7.

isactine. Isogram of chemical intensity of solar radiation. (R. Radau, "La lumière et les climats," 1877, p. 72. Probably not earliest use.)

isalea. Isogram of the amount of insolation, expressed in thermal units. (J. Westman, Nova acta Reg. soc. sci., Upsala, ser. 4, **2**, no. 7, 1910, p. 21.)

isallobar. Isogram of the amount of change in barometric pressure within a specified period. (N. Ekholm, Met. Zeit., Hann-Band, 1906, p. 230. Previously named *baroisobar*.)

isallotherm. Isogram of the amount of change in temperature within a specified period. (A. Defant, Sitzb. K. Akad. Wiss., Wien, Abt. IIa, **119**, 1910, p. 740.)

isametral. Isogram of the temporary departure of an element, during a particular period, from the local normal. (H. W. Dove, "Die Monats- und Jahresisothermen in der Polarprojection," 1864. [Not paged.]

isanakatabar. Isogram of pressure-amplitude during the passage of cyclones and anticyclones. (W. J. S. Lockyer, "Southern hemisphere surface-air circulation," 1910, p. 10-11.)

isanemone. Isogram of wind velocity. (L. Brault, Ann. Bur. cent. mét. France, 1880, IV, p. ix.)

isanomal (isanomalous line). Isogram of anomaly; i. e., of the departure of the local mean value of an element from the mean pertaining to the latitude. (H. W. Dove, "Die Verbreitung der Wärme auf der Oberfläche der Erde," 1852, p. 20.)

isanthesic line (isanthesical line; isantheric line; isanther). In phenology, the isochrone of the first blossoming of any specified plant. (L. A. J. Quetelet, Bull. Acad. roy. sci. Bruxelles, 9, 1842, p. 67.)

iseric line. Same as *isotalantosc*. (D. Ragona, Annuario della Società dei naturalisti di Modena, 1866, p. 41.)

isoabnormal. See *isabnormal*.

isoamplitude, line of. Isogram of range or amplitude. (Cited as a "mot mal forgé" by E. de Martonne, "Traité de géographie physique," 1909, p. 126. Source not stated.)

isoatmic line. Same as *isothyme*. (T. Okada, Bull. Centr. meteorol. observatory of Japan, 1, 1904, p. 14.)

isoaurore. Isogram of frequency of auroras; also called *isochasm*. (S. Tromholt, "Under the rays of the aurora borealis," 1885, 1, p. 248. Probably used previously by the same writer.)

isobar (isobaric line; isobarometric line; formerly also isobare). Isogram of barometric pressure. (H. K. W. Berghaus, "Physikalischer Atlas," "Vorbemerkung," 1838, p. 63. The form *isobare*, i. e., the German singular unaltered, was used by A. K. Johnston in his "Physical atlas," 1849.)

isobarometric line. Isogram of mean monthly range of barometric pressure. (L. F. Kämtz, Schweiggers Jahrb. Phys und Chem., 1827, p. 168. The inappropriateness of the term in this sense was recognized by the author, and it is now obsolete.)

isobathytherm. Isogram of the depth at which a given temperature occurs—applied to temperatures in the ocean. (C. Wyville Thomson, Proc. Roy. soc. Lond., 24, 1876, p. 465, foot-note. Most dictionaries erroneously define this term as synonymous with *isothermobath*.)

isobront (isobrontal line; isobronton). A thunderstorm isochrone; usually an isochrone of the first thunder, loudest thunder, or beginning of rain in a thunderstorm. Also called *homobront*. (W. von Bezold & C. Lang, Bavaria, K. meteorol. Central-Station, "Beobachtungen der meteorol. Stationen," 1, 1879, p. xxxvi.)

isochasm. Same as *isoaurore*. (H. Fritz, Vierteljahrsschr. Naturf. Gesell. Zürich, 12, 1867, p. 354.)

isocheim. (Also *isochime, isochimene, isocheimal, isochimal, isocheimic, isochimonal, isocheimonal, isochimonal, isocheimonal*.) Isogram of winter temperature. (A. von Humboldt, Mém. de phys. et de chim. de la Soc. d'Arcueil, 3, 1817, p. 529.)

isochion. Isogram of snow. This term has been applied to isograms of (1) depth of snow lying on the ground, (2) number of days with snow, and (3) altitude of snow-line.

isoclimatic line. Any isogram of climate.

isocoefficient. Isogram of the pluviometric coefficient. (Nonce-use in "Das Wetter," 31, 1914, p. 275.)

isocryme (isocrymal; isocrymic line). Isotherm for a specified coldest period of the year—applied chiefly to water-temperatures. (J. D. Dana, Amer. journ. sci., (2) 16, 1853, p. 153-154.)

isodense. Same as *isopycnic*. (N. Ekholm, Met. Zeit., 7, 1890, p. 378, foot-note 2.)

isodiaphore. Isogram of difference; e. g., between the mean values of an element for two specified months.

Originally used in a comparison of the unreduced barometric pressure at different seasons. (R. Spitaler, "Die periodischen Luftmassenverschiebungen," 1901, p. 16. Applied by G. Roster, "Climatologia d'Italia," 1909, p. 157, to an isogram of annual range of temperature.)

isodrome. See *thermoisdrome*.

isodynam. An isogram of force; in meteorology, generally of wind-force, and then synonymous with *isanemone*.

isoeral. Isogram of the temperature in spring.

isogrotherm. (Also *geisotherm* or *geoisotherm*.) Isogram of the temperature of the ground. Probably applicable to any form of subterranean isotherm, but was applied originally to an isogram of the temperature at the depth of no annual variation—assumed to average about 25 meters—the data being obtained from the temperature of springs. (A. T. Kupffer, Ann. der Phys. u. Chem., 15, 1829, p. 180.)

isogon. Isogram of wind-direction. (J. W. Sandström, K. Svenska Vetenskapsakad. Handl., 45, no. 10, 1910, p. 12.)

isogradient. Isogram of gradient; applied by J. Kleiber to the isogram of horizontal pressure-gradient. (Met. Zeit., 7, 1890, p. 401.)

isohel (isohelic line). Isogram of duration of sunshine. (H. König, Abh. [Nova acta] der Kais. Leop.-Carol. deutschen Akad. der Naturf., 67, no. 3, 1896, p. 324.)

isohyet (isohyetal; isohyctose). Isogram of the amount of rainfall.

isohygromeric line. Isogram of atmospheric moisture. (D. G. Dalgado, "Climate of Portugal," 1914, p. 104, calls the isogram of relative humidity an *isohygro*.)

isohyst. Same as *isohyet*.

isokatanabar. Isogram of monthly range of barometric pressure. Same as Kämtz's *isobarometric line*. (W. Köppen, Met. Zeit., 29, 1912, p. 502.)

isomenal. Isogram of monthly mean; especially of temperature.

isomer. Isogram of the percentage of an annual total occurring in a specified month, or other period. (C. Salter, Quar. Journ. Roy. meteorol. soc., 40, 1914, 323. See further *ibid.*, 41, 1915, p. 14.)

isometabole. Isogram of interdiurnal variability of any element; i. e., of average change between observations 24 hours apart. (H. Bahr, Met. Zeit., 28, 1911, p. 500.)

isometeoric line. A meteorological isogram.

isometeorgrade. Isogram of "grade," in a notation proposed by C. Ritter. See op. cit. (Int. meteorol. Cong., Paris, 1889, Mémoires, p. 91.)

isometoporal. Isogram of the temperature in autumn.

isoneph (isonephelic line). Isogram of cloudiness. (E. Renou, Ann. Soc. météorol. de France, 27, 1879, p. 126.)

isoomber. An untenable synonym of *isothyme*.

isoorthotherm. Isogram of "orthotemperature." See op. cit. (F. Kerner von Marilaun, Sitzb. K.k.Akad. Wiss., Wien, 122, IIa, 1913, p. 290.)

isopag. The equiglacial line indicating the duration of the ice-cover in rivers, harbors, lakes, etc. (K. L. Veselovskii, 1857.)

isoparallage. Same as *isotalantosc*. (C. H. D. Buys Ballot, "Verdeeling der warmte over de aarde," 1888, p. 16, cites F. W. C. Krecke, Verslagen v. de Sectievergaderingen, Prov. Utrechtsche genoostch. v. Kunsten en Wetensch., 1862.)

isoplectic. The equiglacial line of the first ice in winter. (M. Rykachev, "Über den Auf- und Zugang der Gewässer des Russischen Reiches," 1887, p. 47.)

isophane. In phenology, isochrone of the occurrence of any periodic phenomenon of plant life. (S. Günther,

"Die Phänologie," 1895, p. 40, cites H. Hofman. The term is defined by Hoffmann in Thiel's Landw. Jahrbücher, 14, 1885, p. 842, but may be earlier.)

isophasm (of pressure). Term applied by W. Krebs to an isogram of the percentage of agreement of local pressure variations with those occurring in India. (Weltall, 6, 1906, p. 120.)

isophenological line. Any phenological isochrone.

isophthor. Isogram of damage by a storm. (A. Walter, "The sugar industry of Mauritius," 1910, p. 150.)

isopleth. A line showing the variation of an element in relation to two coordinates; one of the coordinates representing the time of the year (month), and the other usually the time of day (hour), but sometimes space (especially altitude).² (Introduced into meteorology by L. Lalanne, 1843; named by Ch. Vogler, "Anleitung zum Entwerfen graphischer Tafeln," 1877, p. 7.)

isopycnic. (Also *isopyc*, *isopyk*, *isodense*, *isostath*.) Isogram of atmospheric density. (Met. Zeit., 7, 1890, p. 378, foot-note 2.)

isostath (*isostathmic line*). Same as *isopycnic*. (C. Abbe, Rept. Chief Signal Officer, U. S. A., 1889, pt. 2, p. 95.)

isosthene. Line along which the atmosphere is in equilibrium. (M. Möller, Met. Zeit., 1, 1884, p. 242.)

isotac. The equiglacial line of the breaking up of the ice in spring. (M. Rykachev, "Über den Auf- und Zugang der Gewässer des Russischen Reiches," 1887, p. 40.)

isotalantose (*isotalantous line*). Isogram of range or amplitude; generally applied to the mean annual range of temperature. Same as *isoparallage*. (A. Supan, Zeit. f. wiss. Geogr., 1, 1880, p. 141.)

isothere (*isothermal*). Isogram of summer temperature. (A. von Humboldt, Mém. de phys. et de chim. de la Soc. d'Arcueil, 3, 1817, p. 533.)

isotherm (*isothermal* [*line*, etc.], *isothermous line*). Any isogram of temperature. (*Isothermal circles*, *lines*, or

² In its most familiar form the diagram of isopleths shows the normal or average value of a meteorological element at any hour of the day during any month of the year. The two ostensible time-coordinates really correspond, respectively, to the orbital and rotational positions of the earth. For an example of an isopleth diagram in which one coordinate represents altitude, see J. Hann, "Handbuch der Klimatologie," 3d ed., Stuttgart, 1, 1908, p. 217. In two charts of water-temperature published in Annalen der Hydrographie, 89, 1911, Tafeln 36 and 37, the coordinates are, respectively, time and latitude, and time and longitude.

parallels were first described by A. von Humboldt in the Latin "Prologomena" prefixed to Bonpland, Humboldt and Kunth's "Nova genera et species plantarum," 1, 1815. See p. xxviii and *passim* thereafter. Such lines were first published by Humboldt in connection with the separate reprints of his memoir, "Des lignes isothermes et de la distribution de la chaleur sur le globe," from Mém. de phys. et de chim. de la Soc. d'Arcueil, 3, 1817. They did not accompany this memoir as originally published.)

isothermobath. Isogram of temperature in a vertical section of a body of water. (C. Wyville Thomson, Proc. Roy. soc. Lond., 24, 1876, p. 465, foot-note.)

isothermohyps. A thermoisopleth, one coordinate of which is altitude.

isotherombrose. Isogram of summer rainfall.

isothyme. Isogram of amount of evaporation; an isoatmic line. (C. F. Marvin, U. S. Mo. weather rev., 37, 1909, p. 142.)

katisallobar. Isogram of fall of barometric pressure in a given time; a negative isallobar. (N. Ekholm, "Das Wetter auf der Nordsee während der ersten Hälfte von Juni, 1911," Copenhagen, 1913, p. 14.)

palæo-. Prefixed to the name of an isogram, denotes that the latter pertains to some past geologic epoch; as, *palæoisotherm*.

synbarometrical line. Isobar on a synchronous weather chart. (H. Hennessy, Trans. Roy. Irish acad., 24, 1871, p. 425. [Read Jan. 14, 1867.]

syngeothermal line. Isogram of the surface temperature of the ground at a given moment. (H. Hennessy, Trans. Roy. Irish acad., 24, 1871, p. 415. [Read Jan. 14, 1867.]

synthermal line. An isotherm based on simultaneous observations. (H. Hennessy, Trans. Roy. Irish acad., 24, 1871, p. 376. [Read Jan. 14, 1867.]

thermoisodrome. Isogram of the "thermodromic quotient"—a mode of expressing the contrast between spring and autumn temperatures. (F. von Kerner, "Thermoisodromen," Abh. K. k. geogr. Gesell., Wien, 6, 1905, no. 3.)

thermoisopleth. An isopleth of temperature; a chronoisotherm. (F. Erk, Met. Zeit., 2, 1885, p. 286.)