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JANUARY-MARCH 1939

COMPILED BY

W. AYVAZOGLOU

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GEOPHYSICAL ABSTRACTS 96, JANUARY–MARCH 1939

Compiled by W. AYVAZOGLOU

1. GRAVITATIONAL METHODS

4749. American Askania Corporation, Gravity meter: Oil Weekly, vol. 91, No. 8, p. 100, Houston, Texas, 1938.

A brief description is given of the principle of the new portable gravity meter. The principle is based on the electrical determination of the lengthening of a vertical spring due to changes of the gravitational field. As the gravity meter is airtight, variations of atmospheric pressure do not affect readings on it. The time required for one reading, including the set-up, is 4 to 5 minutes. The weight of the instrument is about 125 pounds.—*W. A.*

4750. Andreev, B. A., Geological significance of the gravity map of Karelia, of Finland, and of the Leningrad region [in Russian]: Central Geol. Service, Geophysic, No. 7, pp. 1–26, Leningrad, 1938.

The writer discusses briefly the geologic literature pertaining to measurements of gravity, describes the geology of the region, and gives data regarding densities of rocks of Karelia and of the Leningrad region. Geological factors causing gravity anomalies are examined; and maximum values of anomalies are determined by calculation. The fundamental geological factor causing the appearance of gravity anomalies is the inhomogeneity of densities of rock in the upper layers of the crystalline pre-Cambrian basement. This is illustrated by a direct comparison of the geologic and gravity maps of Karelia and Finland. Conclusions as to the probable structure of the pre-Cambrian for those places have not yet been directly determined by geological data. From the direction of the gravitational anomalies it is concluded that the direction of the strike of the pre-Cambrian rocks in the Leningrad region is from north-northeast to south-southwest. The strike is apparently connected with the Karelian folding and passes through eastern Finland and southwestern Karelia.—*W. A.*

4751. Bertrand, G., Principe d'une méthode de mesure rapide de g en valeur relative [Principle of a method of rapid measurement of relative value of g]: Acad. sci. Paris Comptes rendus, vol. 207, No. 6, pp. 356–357, August 8, 1938.

A weight Mg is supported by a vertical wire of ferromagnetic material, for example, invar, which vibrates with fundamental frequency, F, between the poles of a horseshoe magnet, around which a coil is wound; F is deduced with an accuracy of $1/10^{6}$ from the frequency of the current therein induced. Variations in g are deduced from the equation $2F=L\sqrt{Mg/\mu}$. The arrangement is standardized by varying M. Necessary precautions and corrections are described.—*C. A. S., Sci. Abstracts, vol. 41, No. 490, 1938.*

4752. Goudey, Raoul, Mesures de l'intensité de la pesanteur en France pendant l'année 1938 [Measurements of the intensity of gravity in France during 1938]: Acad. sci. Paris Comptes rendus, vol. 208, No. 3, pp. 164–166, 1939.

Values of the intensity of gravity at 59 stations in France are given in a table. Measurements were made by three Holweck-Lejay gravimeters, Nos. 52, 518, and 651.—*W. A.*

4753. Gulatee, B. L., Gravity reductions and the figure of the earth: Gerlands Beitr. Geophysik, vol. 53, No. 4, pp. 323–336, Leipzig, 1938.

The accuracy of the various formulas for deducing the rise of the natural geoid with respect to its reference spheroid from the gravity anomalies is considered. The merits and demerits of the various methods for reducing observed gravity from ground level to geoidal level for the above purpose are discussed.—*Author's abstract.*

4754. Hess, H. H., Gravity anomalies and structure of the West Indian island arcs [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, Part 2, p. 1885, Washington, 1938.

Vening Meinesz's discovery of high negative anomalies in the vicinity of island arcs is probably the most important contribution to knowledge of the nature of mountain building made in this country. A belt of strong negative anomalies is now known to extend from the east end of Cuba, north of Haiti and Puerto Rico, around the outside of the Lesser Antillean arc. After crossing Barbados and Trinidad it extends westward north of the South American coast as far as the coast of Colombia, where the structural features probably bend southward to follow the Central Cordillera. This belt is interpreted as caused by the downbuckling of the upper 25 km. of the earth's crust. The belt may lie over a "deep" (the topographic expression of the downbuckle) or over a ridge flanked by deep troughs (the buckle with incompetent material squeezed up from its core).

A close correlation in space and time between the postulated buckling of the crust and the intrusion of serpentinized peridotites is noted. Thrusting and overturning outward on both sides from the axis of the negative anomaly belt are observed and suggest alpine structure. Volcanic activity, seismic activity, faulting, and heavy sedimentation all show a direct relation to the anomaly belt.

Suess' conclusion that the Lesser Antilles are the structural connection between the Greater Antillean ranges and the Venezuelan Andes seems correct.

4755. Lejay, Pierre, Carte gravimétrique des Philippines [Gravimetric map of the Philippine Islands]: Acad. sci. Paris Comptes rendus, vol. 207, No. 24, pp. 1148–1151, 1938.

Values of gravity on the islands of Negros, Cebu, Bohol, Mindanao, Sama, and Luzon are given in a table. It is shown that the subsurface structure of the Philippine Islands is very complicated and is closely related to the irregularities of the surface. Contrary to the general rule, strong positive anomalies were found in mountainous regions. The compensating effects of many oceanic basins near the coast are clearly manifested. The anomaly of Davao (−22 milligals) probably represents the extreme northern part of the negative anomalies traced by Vening Meinesz from the region south of Sumatra to that southeast of Mindanao.—*W. A.*

4756. Lejay, Pierre, Mesures de gravité aux Iles Philippines [Measurements of gravity in the Philippine Islands]: Acad. sci. Paris Comptes rendus, vol. 207, No. 19, pp. 828–831, November 7, 1938.

Values of gravitation obtained from measurements made at 130 stations on the Luzon and Panay Islands by means of Holweck-Lejay gravimeters 42 and 622 are given in a table. The value at the base (Manila Observatory), $g=978.360$, as determined by the Coast and Geodetic Survey, was close to that of 978.359, which was determined by our measurements made in 1934. From differences in the measurements made by the two gravimeters, a conclusion as to the degree of reliability of the measurements may be derived.—*W. A.*

4757. Roux, Georges, Mesures de l'intensité de la pesanteur au Maroc [Measurements of the intensity of gravity in Morocco]: Acad. sci. Paris Comptes rendus, vol. 207, No. 17, pp. 713–715, October 24, 1938.

Values of the intensity of gravity were determined by the Holweck-Lejay pendulum 67. The results of measurements made at 24 stations are summarized in a table. Corrections for topography and isostasy were not made. The accuracy of measurements remained within 5 milligals.—*W. A.*

4758. Schleusener, A., Der Einfluss der Genauigkeit des Skalenwertes auf die Brauchbarkeit von Gravimeter-messungen. [The influence of the accuracy of the scale value on the usefulness of gravimeter measurements]: Oel und Kohle, vol. 14, No. 46, pp. 957–959, Berlin, 1938.

The writer investigates the influence of an insufficiently accurate scale value on the interpretation of disturbances of gravity. He examines local and regional gravimeter measurements and establishes the fact that an error in accuracy of the scale value of about 2 percent may be neglected because the uncertainty of geologic factors is, as a rule, much higher.—*W. A.*

4759. Schlumberger, Marcel, and Baranov, Vladimir, Sur les anomalies de pesanteur dans la règion d'Alençon [On the anomalies of gravity in the region of Alençon]: Acad. sci. Paris Comptes rendus, vol. 207, No. 21, pp. 970–972, November 21, 1938.

The writers describe the detailed gravimetric study that was made in the region of Alençon for the purpose of completing the results obtained by Holweck and Lejay in 1933. Measurements were made with the Thyssen gravimeter at 35 stations. The course of the anomaly is shown on a map. The curves agree well with those determined by Holweck. The following tentative explanation of the cause of the anomaly is given: The region of Alençon lies between the Paris Basin and the old formations of the Armorican massive. These formations are more dense than the sediments of the Paris Basin. It is probable, therefore, that the anomaly is due to this difference in density.—*W. A.*

4760. Sezawa, Katsutada, and Kanai, Kiyoshi, Effect of cooling on a plastic earth under gravitational forces, Part 1: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 2, pp. 244–255, 1938.

From mathematical discussion it is ascertained that the effect of cooling on the plastic deformation of any layer of the earth under gravitational forces is small. Cracking is not likely to be very marked or even to occur unless the earth is incompressible in the earliest stage of consolidation.—*W. A.*

4761. Sezawa, Katsutada, and Kanai, Kiyoshi, Effect of cooling on a plastic earth under gravitational forces, Part 2: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 3, pp. 527–537, 1938.

Continuing previous work (see abstract 4760), in which a layer of uniform thickness was assumed to be cooled uniformly, the present paper deals with those conditions in which the cooling in the earth's crust is any function of distribution with depth. It is ascertained that, even with irregular distribution of temperature and mass density, the effect of cooling of any part of the earth on its plastic deformation is very slight compared with that of the gravitational forces on the same deformation. A very significant condition is that the rigidity of the crust shall not be zero. In calculating the condition of stress or the displacement of a solid body under the effect of both gravitational forces and temperature, it is possible to deal with the problem by considering separately the two effects in question. A numerical example of varying mass density is given.—*W. A.*

4762. Sezawa, Katsutada, and Kanai, Kiyoshi, Gravitational stability of the earth at its liquid cooling stage: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 2, pp. 234–243, 1938.

At the liquid stage of the earth that part near its surface cools more rapidly than the inner part, the physical equilibrium becomes unstable, and in consequence the upper denser mass submerges into the lower medium. If the sunken mass were small the condition of cooling and of density would have been altered soon and a state of stability attained. If on the other hand the sunken mass were of large dimensions such as those specified by the authors in the present mathematical discussion, the thermal modification would have become impossible, and the unstable state would scarcely have been altered.—*W. A.*

4763. Swick, C. H., Gravitational determination of deep-seated crustal structure of continental borders: Observations and methods [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, pp. 1962–1963, Washington, District of Columbia, 1938.

Gravity data near the Atlantic and Gulf coasts have been considerably increased during the past 3 or 4 years by special projects carried out by the Coast and Geodetic Survey at the request of geologists and geophysicists who have been making structural studies of continental borders. With the aid and advice of those interested, the stations have been carefully selected with relation to known structural features. At the same time they have been so placed as to supplement as much as possible other geophysical investigations of the same areas. All determinations have been made with the modern Brown pendulum apparatus, and most of them have been made with two sets of instruments to insure the integrity of the results within the desirable limits of 1 or 2 milligals. All the results have been reduced by the Hayford-Bowie isostatic method. Many of the stations are along lines at right angles to structural trends or to the coast, and the gravity profiles thus obtained are, therefore, of maximum usefulness in geophysical interpretations. Several stations have been placed in the vicinity of deep wells, especially in the work done last winter in northern Florida and in southern Alabama and Georgia. It is anticipated that a study of the gravity anomalies, with relation to the structure as revealed by the logs of the wells, will permit a more accurate interpretation of the results of gravity at other points in the same general region.

4764. Tsuboi, Chuji, and Fuchida, Takata, Relation between gravity anomalies and the corresponding subterranean mass distribution: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 2, pp. 273–284, 1938.

Previous work (see Geophys. Abstracts 95, No. 4590) is extended from a two-dimensional to a three-dimensional distribution of gravity anomalies by the application of the potential theory.—*W. A.*

4765. von Zwerger, Rudolf, Schwerestörungen zwischen Aller und Steinhuder-Meer Linie [Gravity anomalies between the Aller River and the Steinhuder Lake line]: Oel und Kohle, vol. 14, No. 46, pp. 943–953, Berlin, 1938.

The writer describes in detail the results of a gravimetric survey carried out in the Hannover oil-bearing region, and he illustrates his article with maps and diagrams. He discusses several possible geological interpretations.—*W. A.*

4766. Woollard, G. P., Gravitational determination of deep-seated crustal structure of continental borders: Structural interpretation of gravity observations [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1966, Washington, 1938.

Highly significant information regarding the deep-seated structure of the crustal rocks underlying the Atlantic Coastal Plain has recently been provided by pendulum gravity observations.

A series of gravity profiles, mainly normal to the coast, have been established in the past 2 years by the Coast and Geodetic Survey. Three of these have followed the lines of seismic traverses, thus permitting direct comparison of results yielded by these different exploratory methods.

The observations of gravity have revealed broadly systematic variations in gravitational force in the Coastal Plain region. These are to a minor degree expressive of variations in the thickness of the sedimentary column but primarily result from structural zoning of rocks of unlike specific gravity within the basement crystallines. The parallelism of the gravity anomaly "belts" thus revealed to the trend of the Appalachian Mountain system is sufficient to prove that the crustal structures are products of the same mountain-building forces that produceed the Appalachians.

Three major structural zones paralleling the Appalachians have been revealed by iso-anomoly maps: First, a marked gravitational trough or zone of deficient gravity, more or less co-linear with the Blue Ridge Mountains and the zone of thrust faults that follows its trend and continues through the upper Hudson River Valley; second, a gravity ridge with several superimposed domes shown to extend from western Massachusetts through New York City, Philadelphia, and Washington into the central Piedmont of the South Atlantic States; and third, another gravity trough, recognized by Longwell, in the Narragansett Basin of New England, which apparently continues beneath the ocean and reappears in the large negative anomaly area of Cape Hatteras, North Carolina.

Sufficient work has been done to prove that, with further gravity control, far more can be learned about the nature of these major crustal features and about the many minor ones whose presence is suggested by individual or groups of anomolies.

4767. Wright, F. E., and England, J. L., Improved torsion gravity meter [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1907, Washington, 1938.

The Geophysical Laboratory has been interested for many years in the study of the elastic behavior of different materials and in the development of a torsion gravity meter for field use. It has realized that, to assure constancy of operation, the elastic element should be under load only while a measurement is being made; that periods of rest are needed to dissipate the slight strains introduced on occupation of a station; that the temperature of the spring should be kept constant ($\pm 0.01°$C.); that the dry air pressure inside the instrument should be low and less than 5 mm. hg.; and that a definite time schedule of operation should be followed in each measurement.

During a recent 8 months' test period with apparatus built in 1929, many widely separated gravity stations were occupied and reoccupied. The values obtained at different times for any given station agreed within 1 milligal. A new instrument has now been completed that is more compact and lighter than that of 1929, has more effective thermal insulation, has an improved optical system, and is better adapted to field use. The temperature is held constant by means of either ice or an electrically controlled thermostat. The apparatus is mounted in a motor truck, and measurements are made without removing it from the truck. The time required for occupying a station is 15 or 20 minutes.

2. MAGNETIC METHODS

4768. Brant, A. A., Interpretation of dip-needle surveys: Canadian Min. Met. Bull., vol. 41, No. 320, Transactions sections, pp. 501–516, Montreal, Quebec, 1938.

The following information necessary for carrying out an accurate dip-needle survey has been pointed out: (1) A dip needle should be used which, at magnetically undisturbed stations, registers a small normal angle of dip not greater than 15° and preferably 0°; (2) the surveyed territory must be covered by a sufficient number of readings if the disturbing formations are to be outlined; readings should be made particularly close together wherever the dip is changing or above normal and wherever the overburden is thin; (3) a geological survey should be carried out in conjunction with the dip-needle survey; the eventual interpretation of the dip-needle measurements should be compatible with, and substantiated by, the known geology of the district; as many kinds of rocks may cause magnetic anomalies, and as the sensitivity of the dip needle is very limited, correlation between magnetic effects and geology as revealed by outcrops or drilling is essential; (4) for reliable work, the geology and field measurements are transferred to a scale map; the anomalous dips are found, and contours joining points of equal anomalous dip are drawn; (5) the strike and extent of the magnetic formation may be approximately determined from the contour map; if the formation is extensive, its strike may be roughly indicated by joining points of maximum dip on adjacent traverses; if sufficient measurements have been taken, the resulting contours may distinguish faults; (6) the position of maximum dip relative to the magnetic body depends on (a) the attitude of the body, (b) its depth, (c) the region in which it occurs, (d) the slope of the terrain over it, and (e) the normal angle of dip of the needle used; (7) if the magnetic disturbance is great and the body has

fairly uniform dimensions, some idea of its dip, breadth, and perhaps depth can be obtained by studying the variation of anomalous dip along a line traversing the body.

Examples and characteristic dip curves are given.—*Author's abstract.*

4769. Johnson, W. R., Jr., Geomagnetic reconnaissance on the Coastal Plain of northeastern North Carolina [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1951, Washington, 1938.

The writer is engaged in making a geomagnetic reconnaissance survey of the northeastern Coastal Plain of North Carolina. Vertical field balances of the Schmidt type, manufactured by the Askania Corporation, have been used, and three traverses across the area have been made in a general east-west direction. The writer believes that the profiles obtained from this survey show effects of the relief of the crystalline basement rocks. It is hoped that this and further work may yield information concerning the physiography of this area in Cretaceous time. Mark C. Malamphy has ascribed somewhat similar profiles to the effects of the relief of crystalline rocks underlying Triassic, Permian, and older formations in the Santa Catharina region of Brazil.

4770. Koenigsberger, J. G., Stabilität der magnetischen Thermoremanenz in Tongegenständen und Gesteinen bei Bestimmungen des magnetischen Erdfeldes in der Vergangenheit [Stability of magnetic thermoremanence in clay products and rocks in determining the earth's magnetic field in the past]: Gerlands Beitr. Geophysik, vol. 53, No. 4, pp. 345–351, Leipzig, 1938.

Objects of baked clay, bricks, vessels, and igneous rocks have a residual magnetism, J_{Rc}, which is acquired while cooling from the Curie points of their contained magnetism in the earth's field. The relation between J_{Rc} and the volume susceptibility for fields <2 *Oe*, the maximum remanence per cubic centimeter, and the coercive force vary with the material, the intensity, and the duration of baking. The fundamental differences between bricks of different material are brought out by heating. Besides the decrease of residual magnetism produced by heating, there is a spontaneous decrease at ordinary temperatures that becomes more rapid the lower the Curie point and the coercive force; for high values of these J_{Rc} is permanent. For obtaining reliable conclusions, a study of the magnetization-temperature curves of the material is advised.—*G. E. A., Sci. Abstracts, vol. 41, No. 491, 1938.*

4771. MacCarthy, G. R., and Straley, H. W., Geomagnetic reconnaissance of the Carolina Coastal Plain [abstract]: Geol. Soc. America Bull., vol. 49, No.12, part 2, pp. 1953–1954, Washington, 1938.

The writers have made a number of magnetometric traverses along highways across the Atlantic Coastal Plain between the latitudes of Myrtle Beach, South Carolina, and Beaufort, North Carolina. Observations have been made at intervals varying from 0.1 mile to 5 miles. These surveys have been connected with others in the Piedmont, in the Appalachian Mountains and Plateaus, and in northeastern North Carolina. Financial assistance has been obtained from the Rockefeller Foundation and the American Association for the Advancement of Science.

Results to date show that there is: (1) A magnetically disturbed area in the neighborhood of the Wilmington, North Carolina, arch, (2) a magnetic depression near Florence, South Carolina, associated with a buried Triassic basin, and (3) a series of low magnetic highs extending in

an interrupted irregular line from the latitude of Myrtle Beach to that of Beaufort.

4772. Mainka, Karl, Ergebnisse der geophysikalischen Gebirgsschlagforschung [Results of the geophysical investigation of quakes]: Forschungen und Fortschritte, vol. 14, No. 28, pp. 319–321, Berlin, 1938.

In addition to the seismological investigations of earthshocks made in the mining district of Upper Silesia (see Geophys. Abstracts 88, No. 3583), the author describes some preliminary magnetic investigations made by him for establishing the connection between the appearance of sunspots and magnetic disturbances of the earth. The results showing this connection are graphically represented for the 11-year period 1926–1937. Another similar 11-year period of observation in the mining district of Upper Silesia is recommended for the confirmation of the results.—*W. A.*

4773. Maksimov, B. M., Application of magnetometry for prospecting salt structures in the central part of the Dnieper-Don Basin [in Russian]: Razvedka Nedr, vol. 8, No. 10, pp. 41–43, Moscow, 1938.

The results of magnetic methods of prospecting for salt domes in various regions of the Dnieper-Don Basin are mentioned. From these results it is concluded that: (1) The Dnieper-Don salt domes appear in connection with diabase intruded into the upper part of the dome, (2) the existence of the diabase makes it possible to apply the magnetic method in prospecting for salt domes within the Dnieper-Don Basin, (3) the investigation by magnetic methods of salt domes over which no diabase is expected is also desirable owing to the fact that anomalies represented by the minimum of the vertical component may be found based on the structure in general, and (4) the study of breccia, especially of the diabase breccia, should be made for obtaining petrographic characteristics of magnetic minerals of the heavy mineral fraction.—*W. A.*

4774. Nagata, Takesi, Magnetic anomalies and the corresponding subterranean mass distribution: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 3, pp. 550–576, 1938.

Results are given of studies of the relations between magnetic anomalies and subsurface mass distribution. In the three chapters of the article the author discusses mathematically: (1) Magnetic anomalies and a corresponding subsurface magnetized plane, (2) magnetic anomalies and the corresponding magnetized dikes, and (3) magnetic anomalies in dip and declination and the corresponding subsurface magnetized plane. Examples are given.

Correction formulas must be applied to the observed values if the undulation of the earth's surface is so large that the surface cannot be treated as a horizontal plane.—*W. A.*

4775. Schmidt, Adolf, Über die Erdmagnetische Säkularvariation in Deutschland während der letzten Jahrzehnte [On the earth's magnetic secular variation in Germany during the last decades]: Gerlands Beitr. Geophysik, vol. 53, No. 4, pp. 360–367, Leipzig, 1938.

A correction is discussed concerning the geographic longitude that is to be applied to the results given by H. Reich in his work "Secular variation of vertical intensity in Germany from 1901 to 1931" (see Geophys. Abstracts 66, No. 2124) in order to eliminate from the results cumbersome formulae of a purely mathematical nature. These formulae were caused by the fact that the time of the beginning of the minimum of Z in

central Europe was shifting from east to west during the period 1901 to 1931.—*Author's abstract translated by W. A.*

4776. Shpak, V. A., Magnetic coring [in Russian]: Sovietskaia Geologia, vol. 8, No. 8–9, pp. 128–131, Moscow, 1938.

The writer describes the possibility of analyzing rocks penetrated by boreholes according to their magnetic properties. He shows in a series of sections of boreholes the magnetic characteristics revealed by magnetic coring; he describes his apparatus, constructed on the principle of induction devices, and gives a schematic design. A comparison of the results of the electrical and magnetic coring proved to be very favorable.—*W. A.*

4777. Straley, H. W., Geomagnetic reconnaissance in the Appalachian Mountains [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1962, Washington, 1938.

Gravitational and magnetic field work in the Appalachian region indicates the possibility that the major anticlines are not cored with igneous and/or crystalline metamorphic rocks of high density or magnetic permeability. Experimental studies suggest that the anticlines west of the Blue Ridge fault may be localized over thrust-fault blocks of sedimentary rock that have suffered fragmentation. It is suggested that the Blue Ridge fault block acted as a plunger, before which the Paleozoic sedimentary rocks were folded and faulted as they were pushed westward toward the edge of the Appalachian wedge.

4778. Watson-Monro, C. N., Reconnaissance survey of the variation of magnetic force in the New Zealand thermal regions: New Zealand Jour. Sci. Technology, vol. 20, No. 2B, pp. 99B–115B, Wellington, 1938.

Relative measurements of magnetic vertical intensity have been made in thermal regions of New Zealand with the object of investigating the relations between thermal and volcanic activity and basic intrusions in the rhyolite. To aid in the interpretation of the results, the magnetic susceptibilities and the Curie point at which the examined rocks lose their magnetization were determined. The magnetometer used was a Schmidt vertical variometer of the Askania type adjusted to a sensitivity of 34 gammas per division.

In concluding, the author suggests the following magnetic work as valuable in any systematic geophysical work in the thermal regions: (1) A magnetic mapping of the whole region with both vertical and horizontal variometers, (2) the employment of a short-period magnetograph with continuous recording such as that used by Japanese experimenters (see Geophys. Abstracts 91 and 92, Nos. 3970 and 4130), who found that a volcanic eruption was preceded for many hours by violent magnetic disturbances, (3) measurements taken of vertical and horizontal intensity from time to time might give an indication as to whether rocks are cooling, and (4) relations between seismic disturbances, land tilts, and magnetic variations might throw light on substructure.—*W. A.*

3. SEISMIC METHODS

4779. Angenheister, G., Untersuchung des Untergrundes mit Hilfe von sinusförmig erregten Bodenschwingungen [Investigation of the subsoil with the aid of sinusoidal ground oscillations]: Union géod. géophys. internat., Assoc. séismologie, ser. A, No. 15, pp. 226–243, Nogent-le-Rotrou, France, 1937.

Elastic waves produced by explosion are, as a rule, used in the seismic method for investigating the subsurface. In the new method described in this article the elastic waves are generated by special oscillating machines. Velocities of these waves, excited by sinusoidal agitation of the ground, are measured. A brief description is given of the oscillating machine and of the receiving seismographs (two for the horizontal component and one for the vertical component). Results of observations made in homogeneous ground and in stratified ground are shown in diagrams. The existence is established of an empirical relation between the velocity of propagation of the oscillations of the ground and the maximum value of the "admissible ground pressure" (load per unit of surface), and thus is derived the possibility of practical application of the method described to the construction of buildings. A table shows this relation for various kinds of ground.—*W. A.*

4780. Bateman, H. B., Rayleigh waves: Nat. Acad. Sci. Proc., vol. 24, No. 8, pp. 315–320, Washington, 1938.

With the interaction of air and ground, air waves are generated during an earthquake. The problem investigated mathematically is a type of free vibration of the air and ground having characteristics of the Rayleigh wave except that the velocity of propagation is less than that of sound in air instead of slightly less than the velocity of the shear wave in the ground. The effect of variation of wind-velocity and air-temperature with height is also considered. The effects and speed of ground roll are discussed and its variation with the depth of the focus. In a further paper (ibid., pp. 321–325) various relations of Coulomb's function bearing on Rayleigh waves are treated mathematically.—*R. S. R., Sci. Abstracts, vol. 41, No. 491, 1938.*

4781. Birch, Francis, Variation of seismic velocities within a simplified earth model [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1925, Washington, 1938.

Murnaghan's theory of finite strain has been applied in an approximate form to a study of the density and velocity variations in a simplified model of the earth outside the core. The model consists of two homogeneous layers, each at a uniform temperature. Following Jeffreys, the writer separated the layers by a first-order discontinuity at a depth of 474 km. Above 474 km. the variations of the velocities in this model are shown to be practically identical with Jeffrey's "observed" values. The main features of the velocity-depth curves are represented with fair precision down to the core. This is of course no longer true if the velocities are supposed to vary continuously through the 474-km. level. In either case, in order to reproduce closely the rate of change of velocity immediately below 474 km., a gradual change of composition must be introduced. The variation of density in the two-layer case is very close to that derived by Jeffreys and Bullen by numerical integration of the "observed" velocities, on the supposition of adiabatic compression of homogeneous layers. The validity of the Jeffreys-Bullen method is shown to depend upon the existence of a small temperature gradient or of compensating factors, which cannot be evaluated. It is suggested that a more rigorous solution of the equations of motion derived from the theory of finite strain might prove of value in interpreting the oscillatory character of seismic records as well as the direction of the ground motion associated with various wave types.

4782. Birch, Francis, and Bancroft, Dennison, Elasticity and internal friction in a long column of granite: Seismol. Soc. America Bull., vol. 28, No. 4, pp. 243–254, Berkeley, California, 1938.

The forced resonant vibrations of a long column of Quincy granite have been studied with the object of discovering the effect of frequency upon the velocities of elastic waves. Longitudinal, flexural, and torsional modes were used, covering the frequency range 140–4,500 cycles per second. For these frequencies the velocities were independent of frequency to within 1 percent or less. The internal friction was also roughly independent of frequency, with $Q=150$. The damping of seismic waves is considered with reference to these results.—*Author's abstract.*

4783. Birch, Francis, and Bancroft, Dennison, The elasticity of certain rocks and massive minerals: Am. Jour. Sci., vol. 237, No. 1, pp. 2–6, New Haven, Connecticut, 1939.

The results of dynamical measurements of elastic constants at ordinary pressure and temperature are reported for a few rocks and massive minerals. The elasticity of the massive pyrite and magnetite specimens is discussed in terms of the elastic coefficients of single crystals of these materials.—*Authors' abstract.*

4784. Bullard, E. C., and Gaskell, T. F., Seismic methods in submarine geology: Nature, vol. 142, No. 3603, pp. 916–917, London, 1938.

The possibility of using seismic methods for investigating submarine geology has been applied to measurements on the eastern side of the Atlantic. The writers investigated five stations on a line extending 170 miles west-southwest from the Lizard. At each station geophones, connected with recording apparatus in a ship, were lowered to the bottom of the ocean. Records were made of the ground motion produced by the explosion of charges of as much as 62 pounds of TNT laid on the floor of the ocean and fired from a motorboat. Fifty-six records were obtained, and time-distance curves were constructed. The writers found that off the coast of the Lizard a surface layer 1,000 feet thick, in which the velocity of the elastic waves was 11,000 feet/seconds, was underlain by rocks (probably igneous) in which the velocity was 23,000 feet/seconds.—*W. A.*

4785. Bullen, K. E., On the epicenter of the 1934 Pahiatua earthquake: New Zealand Jour. Sci. Technology, vol. 20, No. 2B, pp. 61B–66B, Wellington, 1938.

Attention is drawn to the fact that the actual epicenter of the Pahiatua earthquake of March 5, 1934 (see Geophys. Abstracts 93, No. 4315), is considerably to the west of epicenters assigned in previous tentative solutions based on local records. The origin-time also needs an increase of about 11 seconds. The need for a westerly epicentral displacement of the order of 1° arises from a preliminary analysis of the overseas data so far available, although the latter are not yet complete enough to fix the epicenter with complete precision. It is shown that a reinterpretation of the local records in the light of recent findings is in agreement with the revised epicenter. Reference is made to certain implications of the new solution.—*Author's abstract.*

4786. Byerly, Perry, Determination of deep-seated crustal structure in California [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, pp. 1946–1947, Washington, 1938.

Methods of computing structure from earthquake data are discussed and compared with the methods of refraction prospecting. Seismographic data in California have led to the following conclusions regarding deep-seated structure:

(1) For the central and southern parts of the State the average total thickness of the surface layers (above the mantle) is 30 to 40 km. with about 15 km. of granite at the top and two or three layers below it.

(2) Under the southern part of the Sierra there is a root that does not extend under the valley on either side but only under the high part of the range. This root projects into the mantle, that is, below the surface layers less than 40 km., probably considerably less.

(3) The San Andreas fault extends north from where it broke in 1906 in Mendocino County at least as far as the epicenter of the earthquake of July 6, 1934 (41°26′ N., 125°24′ W.). In this region it has a dip of about 84° at a depth of about 30 km. The distribution of epicenters indicates that the seismic activity characteristic of the California coastal zone does not extend north of the region near Cape Mendocino. It is suggested that this is due to the dying out of the fault zone where the continental structure ends and the Pacific structure begins.

(4) There is some indication that the submarine scarp extending west from Cape Mendocino is connected with an active fault.

4787. Caloi, Pietro, Earthquake shocks with local origin, shocks at Cansiglio in October 1936, part 14: Ricerca Scientifica, No. 2, pp. 408–446, Rome, October 1938.

This is a contribution to the study of the characteristic seismic disturbances of northeastern Italy. Determinations are given of the epicenter and the hypocentral depth of the strong shock of Cansiglio on October 18, 1936, together with data of 39 European and Asiatic stations. Determinations of the course of the most notable phases are given. The velocity is compared with the results of observers in central Europe. The existence of two new phases is proved. Details are given of the thickness of the strata affected. The direction of the movement of the crust on the surface is considered. Evidence is given that the principal shock was due to a fracture caused at a depth of about 17 km. by a pair of inclined forces.—*J. J. S., Sci. Abstracts, vol. 42, No. 493, 1939.*

4788. Davison, Charles, Earthquake sounds: Seismol. Soc. America Bull., vol. 28, No. 3, pp. 147–161, Berkeley, California, 1938.

The reports of sounds in a large number of earthquakes, mainly British, are analyzed. The sounds are usually low-pitched and are almost on the limit of audibility—below it in the reports of some observers. They appear frequently to be heard before, more rarely after, the shock, and their maximum appears to coincide with that of the shock. The area of audibility is usually rather less than that in which the shock is felt, rarely the reverse.—*C. A. S., Sci. Abstracts, vol. 41, No. 491, 1938.*

4789. Devlin, J. J., The electromechanical transducer in the new Benioff seismograph: Seismol. Soc. America Bull., vol. 28, No. 4, pp. 255–258, Berkeley, California, 1938.

In his article "A linear strain seismograph" (Geophys. Abstracts 82, No. 3012), Benioff mentions a revised electromechanical transducer that has decided advantages over the transducer described in a previous

article, "A new vertical seismograph" (see Geophys. Abstracts 41, No. 985). In the first, transducer coils were wound around pole pieces that were designed to form a shunt on one side and, together with an armature piece, a set of working air gaps on the other. A variation in the length of the air gaps produced a change of flux in the pole pieces and a consequent electromotive force in the coils. Bullard, in his article "The theory of the Benioff seismograph" (see Geophys. Abstracts 94, No. 4461), questions the validity of the shunt in the magnetic circuit and suggests a balanced transducer. Mathematical analysis of the new transducer, given in this article, seems to be the answer to these difficulties. The variations in flux in the later model being more nearly linear, the objections raised by Bullard to the design of the older model are eliminated.—*W. A.*

4790. Ewing, Maurice, Topography of the buried land surface of the former continent of Appalachia: From seismic evidence [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, pp. 1948–1949, Washington, 1938.

In the Atlantic Coastal-Plain region the old land surface of Appalachia lies buried beneath the Cretaceous and post-Cretaceous sedimentary formations. On this buried land surface there was, before burial, a certain amount of topographic relief, and consequently questions have arisen both as to the depth of burial and as to the magnitude of the topographic inequalities upon it.

Recent experimentation with the refraction method of seismic surveying has shown that the depth and slope of this basement surface can be determined by this method and that something may be deducible regarding the magnitude of the topographic inequalities.

To begin exploration aimed at determining how far eastward the old continent of Appalachia once extended and how far below sea level this former land surface now lies buried, three land seismic-refraction profiles have been run in the Atlantic Coastal Plain, and two marine profile extensions have been made offshore.

The method of study was to work from the known to the unknown. Accordingly, the original traverse was made from the Fall Line, where the old surface crops out from under the Coastal Plain, to the coast, with observation points spaced about 5 miles apart. Thus the seismic characteristics of the buried surface were identified at the outcrop, and it was easily followed not only to the coast but also out to sea.

Since the original work in Virginia, profiles have been established across the Coastal Plain of New Jersey in two localities. One of these was located so as to permit a geologic check from well-log data, and the results of this check were uniformly satisfactory. Since the early work in relatively shallow water, the marine investigations have been mainly the development of a technique and of instruments that would yield results when operating in depths of water of 3 miles or more.

The results of the seismic investigations have shown that the surface extends under the Coastal Plain and the continental shelf with an increasing degree of dip as one progresses seaward; that the surface has about 280 feet relief; and that the basement rock is variable, as shown by variations in the seismic velocity.

4791. Ewing, Maurice, Woollard, G. P., and Vine, A. C., Geophysical investigations in emerged and submerged Atlantic Coastal Plain, part 4, Cape May, New Jersey, Section [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1880, Washington, 1938.

Seismic refraction measurements of the depth to the crystalline basement rocks were made at 12 stations on a line from Bridgeport, New Jersey, to Avalon, New Jersey. The depths showed a gradual increase seaward from the Fall Line near Bridgeport to over 5,000 feet at the coast. The changes in slope noted for the surface of the basement were consistent with those observed in previous investigations, and the depths gave excellent agreement with the available well-log data. Two seismic horizons were mapped in the overlying sediments. These agreed with those found on the Barnegat Bay section and were correlated with the same geologic horizons from well-log data.

4792. Guyot, Edmond, L'étude des séismogrammes [study of seismograms]: Soc. neuchâteloise sci. nat. Bull. 62, pp. 157–184, 1937.

The following two problems can be solved by the study of seismograms: (1) From the data of earthquakes recorded at several stations the exact position of the focus of an earthquake can be determined, and (2) information can be obtained on the courses and velocities of different waves.

Certain details of seismograms can be explained from hypotheses established on the constitution of the earth. Inasmuch as seismic waves penetrate deep into the earth, the seismologist may furnish interesting information to the geologist, especially regarding the thickness of layers. The following matters connected with earthquakes are discussed: (1) Latitude and longitude of the epicenter, hour of origin, depth of focus, and velocities of waves, (2) phases of earthquakes, (3) velocity of propagation of the waves, (4) longitudinal ($\overline{P}$) waves, (5) transversal ($\overline{S}$) waves, (6) other waves ($\overline{PP}$, $\overline{SS}$, $\overline{SP}$, P_sP, S_sS, P_sS, S_sP), (7) traveltimes of waves, with tables showing the traveltimes of waves, in seconds, from the surface to depths of 25 km., (8) determination of the epicenter, (9) determination of the depth of the focus (two methods), and (10) microseisms, that is, oscillations of the ground produced by traffic, volcanic eruptions, storms, wind, and other causes. A list is given of earthquakes (the foci of which were in the Canton of Neuchâtel) that occurred from 1928 to 1937. The list shows the date of the earthquake, the distance of the epicenter from the city of Neuchâtel, the amplitude, and the phase.—*W. A.*

4793. Heck, N. H., Earthquake problems of the Coastal Plain [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1950, Washington, 1938.

Although earthquakes have been few and generally of low intensity in the Coastal Plain, the region has claim to seismic fame as having had one of the great earthquakes of the United States and of the earth during historic times—the Charleston earthquake of 1886. Its outstanding character has been demonstrated by surface changes. This region should be investigated by seismic and other geophysical-exploration methods to find out whether there was a slipping at the surface of the basement rock. Such an investigation should not be restricted to the immediate locality: there should be several profiles from the Piedmont region to the edge of the Continental Shelf such as that by Ewing in the latitude of Norfolk, Virginia. Such an investigation has promise of the key to the occurrence of the Charleston earthquake.

Lesser earthquakes from New Jersey to Florida are discussed, as well as the possibility of similar shocks on the Continental Shelf. Available seismological stations in the region are listed and the need for additional stations pointed out.

4794. Heck, N. H., Recent advances in seismology [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1925, Washington, 1938.

(1) New stations and modernization of old ones.

(2) Development of earthquake information services.

(3) Strong-motion program and possibilities of studies of structure from such records.

(4) Ground-vibration work.

(5) Discussion of question of regional anomalies in transmission time of earthquake waves.

(6) Continuation of triangulation and leveling in regions subject to earthquake.

(7) Some regional projects and their relation to national program.

4795. Hodgson, E. A., Structure of the earth as revealed by seismology: Royal Astron. Soc. Canada Jour., vol. 32, pp. 273–298, July–August 1938.

After introductory remarks on earthquake zones, seismographs, and types of waves, the refraction method to determine the thickness of the earth's crust is explained. The time-distance graph used to get velocities at any depth in the mantle is considered next and particularly the Herglotz-Wiechert method. Information relating to the core is largely incomplete for reasons given. Lastly, the use of the reflection method for a survey of the upper crust in locating oil-bearing layers is discussed.—*R. S. R., Sci. Abstracts, vol. 41, No. 490, 1938.*

4796. Hubbert, M. K., Design elements of a self-integrating strong-motion accelerometer [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, pp. 1925–1926, Washington, 1938.

The records of present strong-motion seismographs show the accelerations, d^2x/dt^2, plotted graphically as a function of time. The velocity, dx/dt, and the displacement, x, are obtained by tedious graphical single and double integrations.

The present study concerns the problem of simplifying and shortening this procedure by employment of the analogous relations between mechanical and electrical quantities. Mechanical accelerations can be converted by a suitable pick-up into variations of electrical current or voltage. This can be transformed into variations of light intensity and recorded on a variable-width or variable-density sound track. By running this sound-track record through a photocell circuit at increased speed, electrical oscillations can be produced which are a replica of those produced by the earthquake except for their higher frequencies and which may be set at any convenient level. An integrating circuit is then possible whereby these variable currents are integrated electrically and plotted by means of oscillographs into three simultaneous curves of acceleration, velocity, and displacement, respectively.

This same unintegrated sound-track record may also be used to drive a shaking table by means of a simple auxiliary network or to motivate an electrical network whose parameters are so chosen as to constitute an electrical model of a mechanical system upon which data are sought.

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4797. Hukunaga, Mituo, and Sato, Mitunosuke, Crustal deformations in central Taiwan, part 1: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 2, pp. 300–316, 1938.

The results of the present study are summarized as follows:

1. From the results of retriangulation of the primary-triangulation points in the central part of Taiwan, where the destructive earthquake of 1935 occurred, the horizontal strain components are calculated for each triangle having three adjoining triangulation points at their vertices. The geographical distribution of rotation, dilatation, shear, maximum shear, as well as the principal strains, are shown.

2. The mode of deformation is discussed on the basis of two different assumptions—the one that the deformation is continuous in the zone of active faults and the other that the deformation is discontinuous there.

3. In that region where the epicenters of the aftershocks were concentrated, the earth's crust was elevated in a marked manner, as it had already been elevated in other districts.

4. A linear relation between the horizontal and the vertical disturbances was noticed and its physical meaning considered.—*Authors' abstract.*

4798. Iida, Kumizi, Relation between the normal tangential viscosity ratio and Poisson's elasticity ratio in certain soils: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 2, pp. 391–406, 1938.

In two previous papers (see Geophys. Abstracts 89, No. 3709, and 91, No. 4002) the author discussed the elastic properties that certain kinds of soil showed when the soils were subjected to vibration. To determine the velocity of elastic waves in the specimen of soil, the author constructed a diagram in which the fundamental resonance periods obtained from experiments were plotted as ordinates and the heights of the waves in the same specimen of soil as abscissas. Because the curves showing these relations did not pass through the origin of coordinates, the author concluded that these results are due to the viscosity of soil.

In this paper the writer discusses the results of experiments with elastic properties and the solid viscosity of certain kinds of soil. Having investigated the relations between their properties and the water content, he finds that the elastic constants and solid-viscosity coefficients diminish somewhat rapidly with the increase in water content. A mathematical discussion, diagrams, and tables are given.—*W. A.*

4799. Inouye, Win, Notes on the origin of earthquakes, part 6: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 3, pp. 597–631, 1938.

Assuming that both normal and tangential stresses change rather rapidly on the surface of a spherical cavity at the seismic focus, the writer compares data of several deep-focus earthquakes with the results of a theoretical treatment of elastic waves.—*W. A.*

4800. Jacobsen, L. S., and Ayre, R. S., Experimentally determined dynamic shears in a 16-story model: Seismol. Soc. America Bull., vol. 28, No. 4, pp. 269–311, Berkeley, California, 1938.

The paper discusses the dynamic behavior of a 16-story building model representing an idealized office building. The model is subjected to "standardized" types of ground motion, and the dynamic shears between adjacent stories are measured. The rigidity of the first story is varied

so that the effect of a "flexible" first story on the dynamic shears is demonstrated. It is concluded that flexibility in the first story decreases the dynamic shears everywhere in the building when the same degree of "tuning in" with the ground-motion frequency is postulated. Moreover, it is concluded that design rules in current practice are in fair agreement with the shears that may be expected when the building is vibrating in or near its fundamental mode, but that current practice does not allow for shears due to the higher modes unless a comparatively flexible first story is used.—*Authors' abstract.*

4801. Jones, A. E., Empirical studies of some of the seismic phenomena of Hawaii: Seismol. Soc. America Bull., vol. 28, No. 4, pp. 313–337, Berkeley, California, 1938.

This paper is a study of the local earthquakes recorded at only one station, although the records of subsidiary stations as well as macroseismic observations were used in the original locations of foci. The character and magnitude of the seismograms are studied with regard to the period and amplitude of their waves and to their origin in the earth's crust. Somewhat different results should be found from the records of the outlying stations.—*W. A.*

4802. Kanai, Kiyoshi, Three dimensional vibrations of a framed structure: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 3, pp. 538–549, 1938.

In continuation of an earlier investigation a general solution is obtained for the three-dimensional vibration of a structure which in itself is apparently in a two-dimensional condition. This is found to depend upon certain conditions of the structure as well as the direction of movement of the seismic vibrations. The detailed nature of the vibrations for different cases has been considered. The mathematical results were confirmed by model experiments from which it was shown that in spite of the extremely complex forms of the mathematical solutions there was little error even in the numerical constants of the solution.—*R. S. R., Sci. Abstracts, vol. 41, No. 492, 1938.*

4803. Kawasumi, Hirosi, Historical sketch of the development of knowledge concerning the initial motion of an earthquake: Union géod. géophys. internat., Assoc. séismologie, ser. A, No. 15, pp. 258–330, Nogent-le-Rotrou, France, 1937.

This historical sketch is divided into two parts. In part 1 the writer deals with the development of our knowledge respecting the nature of seismic waves, and in part 2 he discusses the mechanism of the occurrence of earthquakes as revealed through studies of their initial motions.

The writer reviews the development of our knowledge concerning the nature of the first impulse of *P* and *S* waves. He proves that the first impulse of the *P* wave is a longitudinal wave generated by a disturbance near the hypocenter and propagated throughout the globe by means of the elastic material composing the earth's interior. Although this wave is subjected to modifications while being propagated through the earth's interior, nevertheless much valuable information concerning the hypocentral region is obtained from studying it. The *S* wave, which is interpreted as a transverse wave that radiates from the hypocentral region at the same time as the longitudinal *P* wave, also reveals much information concerning the generation of them both. One of the present

problems, therefore, is the study of these waves with special reference to the structure of the earth's interior. In connection with the study of the *P* and *S* waves, the writer discusses other bodily waves that result from reflection and refraction of these waves.

A reference list of 256 titles is given.—*W. A.*

4804. Landsberg, Helmut, The Clover Creek earthquake of July 15, 1938: Seismol. Soc. America Bull., vol. 28, No. 4, pp. 237–241, Berkeley, California, 1938.

The area affected by this earthquake coincides with the limestone valley between the Tussey Mountains on the east and the Dunning, Short, Loop, and Lock Mountains on the west; the Juniata River is the boundary on the north. The highest intensity was felt along Clover Creek. A summary of the observed intensities of the shock is given in a table, and an isoseismal map drawn from the data of this table is shown. Two possible causes of the earthquake—a cave-in and a tectonic movement—are presented, and arguments are discussed in favor of them both.—*W. A.*

4805. Lee, A. W., Traveltimes of seismic waves *P* and *S*: Meteorol. Office, Geophys. Mem., vol. 9, No. 76, 16 pp., London, 1938.

The travel times of *P* and *S* waves are examined, by use of the data published in the International Seismological Summary of 1930 and 1931, for 146 well-recorded earthquakes. The shocks are all of normal focal depth. The observations of *P* are in good agreement with the traveltime table published by Jeffreys and Bullen in 1935. For *S* the observations are generally later than the tabulated times at distances less than 28° and earlier than the tabulated times beyond 60°. For distances beyond 28° the observations support the amended table given by Jeffreys in 1936. The departures of the *S* observations from the tables at distances less than 28° are discussed. It is found that there may have been some confusion in the identifications of *S* up to about 12°, but at the greater distances the discrepancy cannot be explained in that way. Reexamination of the Kew records for a number of earthquakes at distances from 12° to 28° shows that, at least for some shocks, the arrival of *S* is preceded by a small movement, but this is so inconspicuous that it cannot be mistaken for the large onset generally accepted as *S*. A new table of traveltimes for *S* has been constructed from the International Seismological Summary observations of the 146 earthquakes. The interpretation of the observations from the Kew seismograms is improved by the use of this new table.—*Author's abstract.*

4806. Lee, S. P., Notes on the Galitzin seismometer: Seismolog. Bull. Chiufeng Seismic Station, vol. 3, No. 2/3, pp. 119–125, Changsha, 1938.

The writer describes the following changes made to reduce the cost of maintenance of the Galitzin seismometer:

1. *New arrangement of registration apparatus.* Originally the three components were registered separately, whereby measurements had to be made on one sheet after another. In the new arrangement all three components are registered on one sheet. An ordinary flashlight lamp is used in the modified lamp shelter designed for a special lamp serving as the source of light for photographic registration. The changes made in the timekeeper (a pendulum clock) are described.

2. *Diagrams for determination and computation of constants.* To avoid repetition of calculations of constants, the writer constructs special diagrams and explains their use.—*W. A.*

4807. Lee, S. P., Some deep-focus earthquakes that occurred recently in central Asia: Seismol. Bull. Chiufeng Seismic Station, vol. 3, No. 2/3, pp. 107–118, Changsha, 1938.

Some deep-focus earthquakes that occurred in the region close to the Pamirs are discussed. The region is complicated in tectonic structure. Details are given of the earthquake of January 9, 1933, and records of it are summarized in a table. Summaries are added of seismographic records of several smaller earthquakes that occurred in the same region.—*W. A.*

4808. Linehan, Daniel, Recent earthquakes in New England [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1926, Washington, 1938.

Following the recent inception of several seismic stations in the New England area with identical instruments of high magnification, a considerable number of local quakes have been recorded and their epicenters determined.

This paper considers those quakes that have occurred during the past 2 years and treats of the seismicity of the various sections of the New England area affected, the traveltimes employed, the various problems encountered in working this area, and some methods used in combating these problems.

4809. Lynch, Joseph, Attempt to harmonize the seismological and geological data of deep-focus earthquakes [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1926, Washington, 1938.

Seismologists find it necessary to postulate a depth of about 400 miles for some quakes. From a geological standpoint, an earthquake mechanism is difficult to picture at such a depth. The present paper suggests the possibility that the seismologist's focus is an image of the real quake, which occurs much nearer the surface.

4810. McMurry, H. V., Periodicity phenomena in deep-focus earthquakes [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1926, Washington, 1938.

Data were assembled for about 300 earthquakes with focal depths of not less than 100 km. and for which the determination of epicentral location, time of occurrence, and focal depth were considered reliable. They were analyzed collectively and in selected groups by the method of periodogram analysis which appeared most suitable. Tests were made on periods of 6, 12, and 14 months and for correlation with twice the lunar- and solar-hour angles. The results were abnormal only for a group of shocks associated with foci distributed along the western coast and interior of South America, where a high correlation with twice the lunar-hour angle was found.

The correlation suggested an association of tidal stress with earthquake occurrence. Accordingly, computations were made on the magnitude and form of the stress variations due to earth tides. It was concluded that tidal stress variations approximate harmonic changes sufficiently well to warrant a search for lunar-hour angle correlation but are too irregular to make the statistical results of such studies valuable in furthering information concerning the mechanics and environment of deep-seated earthquakes.

The importance of other agencies in causing stress variations in the earth was studied. It was concluded that oceanic tidal loads and to a lesser extent erratic barometric changes are capable of producing stresses

in the earth comparable with stresses due to the earth tides. The irregularity of both oceanic tidal loads and barometric pressure fluctuations renders them unsuitable subjects for study.

4811. Mercanton, P. L., Le nouveau sismographe Kreis-Wanner du service suisse de sismologie [The new Kreis-Wanner seismograph in the Swiss Department of Seismology]: Acad. sci. Paris Comptes rendus, vol. 207, No. 6, pp. 374–375, August 8, 1938.

A detailed description is given of a new vertical seismograph which has been installed at Degenried-Zürich to replace the Wiechert apparatus. With an amplification of 150 times, the period is 10 seconds. The stationary mass is 1,100 kg. An electrical method is used to compensate for temperature. The registrations obtained are remarkably good, and Rayleigh and Love waves are easily recognized.—*R. S. R., Sci. Abstracts, vol. 41, No. 490, 1938.*

4812. Miyabe, Naomi, Hukunaga, Mituo, and Sato, Mitunosuke, Crustal deformations in central Taiwan, part 2: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 3, pp. 578–596, 1938.

By using the data of horizontal and vertical displacements of triangulation points, the writers present in this paper a study of the modes of crustal deformation associated with the earthquake of April 21, 1935, which occurred in central Taiwan (Formosa). Outstanding results of the study are given. (For part 1, see abstract 4797.)—*W. A.*

4813. Neuberger, H., On the estimation of focal depth from macroseismic data: Seismol. Soc. America Bull., vol. 28, No. 4, pp. 259–261, Berkeley, California, 1938.

The formulas so far developed for estimating the focal depth of earthquakes from macroseismic data have not proved very satisfactory because a sufficient number of seismographic records for accurate computation of the focal depth is not available for many earthquakes. An attempt to get from macroseismic data at least an estimate of the focal depth is made in this article.—*W. A.*

4814. Nishimura, Genroku, and Takayama, Takeo, Seismic waves due to tractions applied to the inner surface of a spherical cavity in an elastic earth: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 2 pp. 317–354, 1938.

The present paper is a continuation of a previous one on the same subject (see Geophys. Abstracts 92, No. 4167). Assuming a spherical cavity in an elastic earth, the writers give a mathematical discussion of the vibrational motions of particles lying some distance away from this cavity that are caused by elastic waves propagated from the cavity walls. The tractions applied to its inner surface are of the shock type.—*W. A.*

4815. Perrine, C. D., Cause of earthquake ruptures: Nature, vol. 142, No. 3602. pp. 876–877, London, 1938.

At the present time, because of a diversity of theories, there is no established theory of the cause of earthquake rupture. To test the influence on earthquake ruptures of tidal stresses caused by the sun and moon, the writer examined records of the 59 most destructive shocks in the past three centuries and of 40 heavy shocks reported in the past 2 years. In both these groups about 80 percent appeared at the time of new and full moon. Perrine considers this as evidence in favor of the

view that the gravitational action of the sun and moon determines the time when ruptures due to earthquake stresses about geological faults take place.—*W. A.*

4816. Rössle, Per., Seismische Arbeiten im Gebiet zwischen Allermündung und Weserbergland [Seismic work in the region between the mouth of the Aller and the Weser highland]: Oel und Kohle, vol. 14, No. 46, pp. 943–945, Berlin, 1938.

The seismic-refraction method was used for investigating this area. Two fundamentally different regions were established: The northern region, in which the traveltimes ranged between 1.18 and 2 seconds for a distance of 4,000 m., and the region south of a line approximately connecting Wildeshausen and Hoya, in which the traveltimes ranged between 1.30 and 1.80 seconds. The area is almost unknown geologically. Several assumptions are made. Shorter traveltimes found at several places must be considered to originate from special structural conditions.—*W. A.*

4817. Sezawa, Katsutada, and Kanai, Kiyoshi, Anomalous dispersion of Rayleigh waves: Imp. Acad. Tokyo Proc., vol. 14, No. 7, pp. 246–249, July 1938.

Calculations in a previous paper (see Geophys. Abstracts 95, No. 4649) dealt with a special condition of anomalous dispersion of Rayleigh waves. To obtain the general features of the problem, the authors now extend their calculations to some widely different conditions and show graphically the results. Besides discussing these results, they discuss again, from a more analytical point of view, the nature of the velocity equation obtained 3 years earlier.—*W. A.*

4818. Sezawa, Katsutada, and Kanai, Kiyoshi, Damping of periodic visco-elastic waves with increase in focal distance: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 3, pp. 491–502, 1938.

Rayleigh waves, Love waves, and plane and radial bodily waves, all of which are transmitted through visco-elastic bodies, are discussed mathematically.—*W. A.*

4819. Sezawa, Katsutada, and Kanai, Kiyoshi, Formation of boundary waves at a surface of a discontinuity within the earth's crust: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 3, pp. 504–525, 1938.

This paper is a mathematical investigation of the way in which waves generated from a point source in a solid excite boundary waves at any discontinuous surface in the same solid. The problem treated involves two dimensions only. Dilatational and distortional primary waves are considered.—*W. A.*

4820. Slichter, L. B., Seismological investigations of the earth's crust, using quarry blasts [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1927, Washington, 1938.

A progress report is given of results to date on the observations of large quarry blasts in New England. With portable equipment a blast of 15 tons was successfully observed to distances of 165 km., at six stations. Records from six portable instruments were obtained as well as synchronized records from four stationary seismic observatories. The results of these observations will be discussed.

4821. Smit-Sibinga, G. L., Additional note on the relation between deep-focus earthquakes, gravity, and morphology in the Netherlands East Indies: Gerlands Beitr. Geophysik, vol. 53, No. 4, pp. 392–394, 1938.

In 1937 the writer made an attempt to correlate the deep-focus earthquakes in the Netherlands East Indies (see Geophys. Abstracts 93, No. 4393). The more exact data recently published by Gutenberg and Richter (see Geophys. Abstracts 93, No. 4314) support the main conclusions of the writer regarding the relations between deep-focus earthquakes, surface geology, and gravity. It is not clear to the writer on what facts Visser bases his opinions, given in his article "Seismic isobaths in the East Indian Archipelago" (see abstract 4822).—*W. A.*

4822. Visser, S. W., Seismic isobaths in the East Indian Archipelago: Gerlands Beitr. Geophysik, vol. 53, No. 4, pp. 389–391, Leipzig, 1938.

The seismic isobaths in the Netherlands East Indies constructed by Smit-Sibinga are discussed (see Geophys. Abstracts 93, No. 4393, and abstract 4821). His results have no real value; on the contrary they give a false impression of certainty; they are not supported by the investigation of Gutenberg and Richter.

A possible connection with Vening Meinesz's gravity anomalies is discussed.—*Author's abstract.*

4823. von Thyssen-Bornemisza, Stephan, Ein neues Gerät zur Schnellbestimmung von Laufzeiten elastischer Wellen in Bohrkernen [A new device for the quick determination of traveltimes of elastic waves in cores]: Oel und Kohle, vol. 14, No. 46, pp. 960–962, Berlin, 1938.

The new apparatus and the procedure for measuring traveltimes by using cores taken from boreholes are described. Velocities of elastic waves traveling through cores from a series of different materials including possible errors involved, are given in two tables.—*W. A.*

14. ELECTRICAL METHODS

4824. Gorbenko, L. A., On the increased data of resistances obtained during the coring of boreholes drilled in the Azneft [in Russian]: Azerbaidjanskoe Neftianoe Khoziaistvo, vol. 18, No. 7/8, pp. 11–14, Baku, 1938.

Apparent specific resistances obtained during the coring of the same borehole at different times may change (1) if the specific resistance of the clay solution filling the borehole is changed, (2) if the depth of penetration of the clay solution or water into the layer changes during the interval between the two corings, and (3) if the specific resistance of the rock undergoes changes produced, for example, by the change in the characteristic properties of the liquid by which the rock is saturated.

From the examination of the diagrams obtained by a second coring of boreholes in the region of Azneft, the writer observed an increase in apparent resistances in the zone of watered sands and clays. The resistance in oil-bearing rocks changes only very little. The causes of increased resistances may be the following: (1) Increase in the amount of salt in clay solutions owing to the influx of mineralized water from the upper horizons, and (2) penetration of the solution and of its water into the permeable layers if the mineralization of the solution is smaller than the mineralization of water in the layers.

The writer concludes that the question of increased apparent resistivities and of depth of penetration of the borehole solution may be solved by using lateral coring.—*W. A.*

4825. Gorbenko, L. A., and Denisevich, V., Changes of the resistances of rocks depending on their section [in Russian]: Azerbaidjanskoe Neftianoe Khoziaistvo, vol. 17, No. 5/6, pp. 62–71, Baku, 1937.

In this report the writers study specific resistances of oil-bearing rocks and find that these depend on (1) the specific resistance of the liquid with which a layer is saturated (corresponding data on specific resistances of water solutions are given), (2) the porosity of the rock (a curve showing the dependence of the specific resistance on porosity is given), and (3) the size of grains, which is important only in case of weak concentrations of the solution (the resistance increases in small-grained rocks). The following conclusions are drawn: (1) A relation can be established between the lithological properties of rocks and their specific resistances, (2) specific resistances may be determined from the fundamental parameters of rocks, and (3) characteristics of rocks may be determined from the resistances.—*W. A.*

4826. Gorbenko, L. A., and Rabinovich, Z., Spontaneous polarization of Kirmakinsk and sub-Kirmakinsk layers [in Russian]: Azerbaidjanskoe Neftianoe Khoziaistvo, vol. 18, No. 9, pp. 29–32, Baku, 1938.

Spontaneous polarization (*SP*) of the Kirmakinsk and sub-Kirmakinsk layers in the region of the eastern part of the peninsula of Apsheron was studied. The amplitudes of the *SP* curve within these layers are small; thus the determination of the lithologic character of rocks by means of spontaneous polarization is difficult and sometimes even impossible. In this article the possibility of application of spontaneous polarization for the interpretation of the results of measurements is discussed. Data obtained by electrical coring in boreholes of this region are examined and are shown in diagrams.—*W. A.*

4827. Guizonnier, R., Étude des irrégularités de la phase de la composante diurne du champ électrique terrestre [Irregularities of the phase of the diurnal component of the earth's electric field]: Acad. sci. Paris Comptes rendus, vol. 207, No. 6, pp. 372–374, and No. 7, pp. 403–404, 1938.

Graphs have been made connecting longitude and the hour of maximum of the diurnal component for a pronounced perturbation using local and Greenwich time. The abnormal diurnal component is the resultant of the normal diurnal component and a semidiurnal perturbation which is accentuated for five observatories but less marked for others. Each ordinate of the semidiurnal component was combined with the two preceding ones and the two following ones at 6- and 12-hour intervals to get mean values. The results are shown graphically, and the amplitude of the maximum for the semidiurnal component is accentuated. Tests with curves for Kakioka, Christchurch, and Colorado confirm this view. Such a semidiurnal variation suffices to explain the abnormal phase of the diurnal component of the earth's electric field given by analysis.—*R. S. R., Sci. Abstracts, vol. 41, No. 490, 1938.*

4828. Liogenky, S. Y., On the question of determining the depth of outcropping pegmatite veins by the resistance method [in Russian]: Razvedka Nedr, vol. 8, No. 10, pp. 44–46, Moscow, 1938.

Laboratory tests with models in tanks are described. The sizes of models investigated are given in a table and may be compared with veins 200 to 400 m. long and 6 m. thick. Data of measurements are shown in graphs.—*W. A.*

4829. Poldini, E., Geophysical exploration by spontaneous-polarization methods: Mining Mag., vol. 59, Nos. 5 and 6, pp. 278–282 and 347–352, 1938; vol. 60, No. 1., pp. 22–27, and No. 2, pp. 90–94, London, 1939.

The author reviews the phenomena of underground electrical polarization and discusses their application to the location of metalliferous ore bodies.

The original article, in French, appeared in the Bulletin du Laboratoire de Géologie de l'Université de Lausanne, No. 61, 1938, and in the Memoires de la Société Vaudoise des Sciences Naturelles, vol. 6, No. 40, Lausanne, 1938, under the title, "Les phénomènes de polarisation spontanée électrique du sous-sol et leur application à la recherche des gîtes métallifères" (for abstract see Geophys. Abstracts 93, No. 4365).—*W. A.*

5. RADIOACTIVE METHODS

4830. Evans, R. D., and Kip, A. F., The radium content of marine sediments from the East Indies, the Philippines, and Japan, and of the Mesozoic fossil clays of the East Indies: Am. Jour. Sci., vol. 36, No. 215, pp. 321–336, New Haven, Connecticut, 1938.

The mean radium concentration in 11 terrigenous mud ocean-bottom deposits from the vicinity of the East Indies, the Philippines, and Japan is 2.5×10^{-12} gm. Ra per gm., or about 5 to 10 times the usual values for sedimentary rocks. The terrestrial occurrences of so-called fossil deep-sea clays on Borneo, Rotti, and Timor have a much lower radium concentration than contemporary deep-sea red clays or even terrigenous muds. These analyses suggest either that radium, not uranium, is primarily precipitated in the ocean-bottom sediments, or that the East Indian fossil deep-sea clays are shallow-water deposits. The geological evidence supporting the abyssal origin of these deposits seems strong enough to warrant the conclusion that the high radium content of fresh deep-sea red clays is due mainly to the precipitation of radium itself, without regard to the oceanographic behavior of uranium.—*Authors' abstract.*

6. GEOTHERMAL METHODS

4831. Bereskin, M., The effect of moisture on the thermal constants of some rocks [in Russian]: Central Geol. Service, Geophysic, No. 7, pp. 27–38, Leningrad, 1938.

The theory of the method used for the investigation of thermal properties of rocks that are due to moisture is briefly described in the first part of the article. The method, called the "method of the regular regime" (see Geophys. Abstracts 81, No. 2976), makes it possible to determine simultaneously the heat-conductivity coefficient λ, the temperature-conductivity coefficient a, and the specific heat c.

The second part deals with a description of the methods of determining temperature conductivity of wet samples, the method of moistening samples, and the arrangement for keeping samples at a constant humidity. The results, given in graphs, of experiments with tuff, pumice, and chalk show the dependence of λ, c, and a on the degree of humidity in the sample. It is established that the coefficient of thermal conductivity increases in proportion to the amount of humidity. Specific heat of the sample also increases with the increase of humidity in the sample.

Basing his judgment on these experiments, the writer emphasizes that in compiling data for thermal constants of rocks it is necessary to indicate the degree of humidity in a sample.—*W. A.*

7. UNCLASSIFIED METHODS

4832. Bullen, K. E., Composition of the earth at a depth of 500–700 km.: Nature, vol. 142, No. 3597, pp. 671–672, London, 1938.

Attention is directed to evidence from different branches of geophysics, all of which suggests a considerable increase in the electrical conductivity, μ, with the increase of depth beyond 150 km., the really important increase in μ occuring at a depth of about 700 km. This evidence suggests also that a change occurs in the properties of the earth at a depth of the order of 500 to 700 km. below the surface.—*W. A.*

4833. Dauvillier, A., Sur la structure interne de globe et la genèse des continents et des océans [Internal structure of the earth and the origin of continents and oceans]: Acad. sci. Paris Comptes rendus, vol. 207, No. 9, pp. 452–454, August 29, 1938.

The earth is regarded as consisting of a central ferronickel (11% Ni) nucleous $d=8.0$, surrounded by sima of the composition of stony meteorites, $d=3.0$–3.4. The radioactivity of this is only $\frac{1}{100}$ of that of the portion outside, and so only sufficient to maintain the temperature uniformly at 1,200°. It is enclosed in an isothermal "furnace" of sial maintained at this temperature, $d=2.8$–3.0, which is regarded as consisting of granite floating on pasty basalt magma. On cooling, the granite crust solidified first and subsequently broke up to form a polygonal network, the meshes being more or less circular, similar to the "seas" of the moon, each depression being bordered by a fosse and ridge, and forming the originals of the five oceans. The seas originated through reduction of the metallic oxides of the sial by the H_2 of the then atmosphere to form metal and H_2O; H_2O on the moon has all escaped.—*C. A. S., Sci. Abstracts, vol. 41, No. 491, 1938.*

4834. Davidson, J. L., A geophysicist in the Netherlands Archipelago: Petroleum Engineer, vol. 10, No. 1, pp. 205–210, Dallas, Texas, 1938.

A description is given of the life of a geophysicist on field work in the tropics.—*W. A.*

4835. Day, A. L., Volcanoes, geysers, and hot springs: Franklin Inst. Jour., vol. 226, No. 3, pp. 341–352, Lancaster, Pennsylvania, 1938.

The composition and physical character of the magma and the participation of steam and other gases in the action are considered. Differences in the action of volcanoes, hot springs, roaring fumaroles, steam jets, and geysers in various localities are discussed. These lead to the conclusion that volcanoes and hot springs have a common source of energy, the magma approaching the surface and cooling there, and that the most active agents in volcanic outbreaks and hot springs are the more volatile components of the magma. These seek to escape as they approach the surface, and subsequent behavior is determined by their composition, by the total energy available, by the temperature, and by the local conditions encountered.—*R. S. R., Sci. Abstracts, vol. 41, No. 491.*

4836. Gabriel, V. G., Five billion barrels geophysically discovered at a cost of $100,000,000: World Petroleum, vol. 9, No. 13, pp. 34–42, New York, 1938.

After giving a historical outline of the development of several methods of geophysical prospecting, the author discusses briefly the principles of the seismic, torsion-balance, pendulum, gravimeter, magnetometer, electrical, soil-analysis, geothermal, and radioactive methods. He shows in a table the fields discovered wholly or partly by geophysics in the Gulf Coast area. In his conclusion he writes: "Assuming that the United States oil reserves were equal to 5,323,000,000 barrels in 1925 (A. P. I.), 12,000,000,000 barrels in 1932 (Garfias), 13,063,000,000 barrels in 1936 (A. P. I.), and 15,507,000,000 barrels in 1937 (A. P. I.), and accepting Pratt's estimates pertaining to the major oil fields' discoveries resulting from geophysical exploration in the United States as equaling 9.3 percent for the years from 1926 to 1930, and 55.0 percent from 1931 to 1935, we find, by the law of averages, that 5,605,000,000 barrels of oil were discovered prior to 1938 by the application of geophysical prospecting as follows: 781,000,000 barrels in the period from 1926 to 1930, 1,930,000,000 barrels from 1931 to 1935, and 2,894,000,000 barrels in 1936 and 1937, crediting 60 percent oil discovery to geophysical methods in the last 2 years. Accepting $101,700,000 as the total sum spent on geophysical prospecting in the United States prior to 1938, we obtain the average cost of geophysical discovery equal to 1⅘ cents per barrel of oil. The total expenditure on geophysical prospecting is composed of the following items: (1) Seismograph, $69,000,000; (2) torsion balance, $21,000,000; (3) magnetometer, $4,500,000; (4) gravimeter and pendulum, $3,400,000; (5) electrical prospecting, excluding Schlumberger's electrical logging and including the Eltran method, $3,000,000; (6) soil analysis and others, $800,000.

"The study of the data pertaining to the drilling of wildcat wells shows a marked increase in probabilities or chances of bringing oil wells in later years, especially on geophysically tested structure. Increases in depth of drilling for oil structure from year to year can be partly attributed to the increase in exploration power in depth from year to year of some of the geophysical methods."

The article is illustrated by photographs and has a list of 28 references.—*W. A.*

4837. Johnson, E. A., and McNish, A. G., An alternating-current apparatus for measuring small magnetic moments: Terres. Magn. and Atmos. Electr., vol. 43, No. 4, pp. 393–399, Baltimore, Maryland, 1938.

A method of measuring the moments of small magnetic dipoles is described. The dipole to be measured is rotated inside of a fixed coil, and the voltage induced in the coil is measured by means of an alternating-current amplifier. The limiting sensitivity is computed from the calculated signal voltage and the thermal agitation in the input circuit. In the practical application the theoretical sensitivity is approximately obtained, and moments of 3×10^{-7} *CGS* unit can be detected and with a specimen 1.5 cm. on a side 8×10^{-8} *CGS* unit/cc. can be detected. The method has been applied to the measurement of the polarization in sedimentary deposits.—*Authors' abstract.*

4838. Johnson, W. R., Jr., and Straley, H. W., Tracing pegmatite dike geophysically [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1951, Washington, 1938.

The writers have made geoelectrical and geomagnetic surveys of a pegmatite zone in the eastern granite belt of North Carolina with results somewhat contrary to those of Kondvatiev and of Liogenky. The magnetic method proved more satisfactory than the electrical in tracing the zone because the country rock to the southeast of the structure is a biotite schist of high magnetic permeability.

4839. Kelly, S. F., Geophysical exploration: Mining and Metallurgy, vol. 20, No. 385, pp. 61–65, New York, 1939.

This is an annual review of the geophysical approach to the study of the phenomena of the earth. Especially important are the following achievements: (1) Maurice Ewing's researches in the development of instruments and techniques for deep-sea seismic-refraction studies; (2) the direction and slope of the basement surface obtained from data of a new refraction profile between Chester, Pennsylvania, and Avalon, southwest of Atlantic City, New Jersey; (3) Ewing, Woollard, and Landsberg's studies of traveltime records for determining whether the speed of seismic waves is the same beneath ocean basins as beneath continents; (4) the practical and commercial value of large-scale geophysical studies; (5) the various methods used abroad (in such countries as Poland, Australia, New Zealand, Brazil) as well as in the United States for working out major features of concealed geological structure; and (6) geophysical activities by the Missouri Geological Survey and by the United States Geological Survey in Montana, electrical studies of stratigraphy in Michigan, geophysical studies of underground-water resources in the Hawaiian Islands and in Texas, successful location of sulphide deposits in Japan by geophysical methods, and many other achievements.

The appearance of a new technique in prospecting for oil—that of the soil-gas analysis—has received considerable attention and may prove to be an important tool. Another interesting development in the exploration for oil is the sample-taking gadget of the Schlumberger Well Surveying Corporation, a gadget useful in connection with electrical logging. The evidence of a trend toward a greater attention to geothermal technique in the oil field is noted. Progress in the application of geophysics is welcomed.—*W. A.*

4840. Longwell, C. R., Relative roles of geology and geophysics in determining crustal structure [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, pp. 1952–1953, Washington, 1938.

Two groups of geologists hold mistaken evaluations of geophysical methods as aids in the solution of structrual problems. In one group, now diminishing in numbers, there is skepticism that geophysics can make precise and dependable contributions. A second and perhaps larger group errs in attributing to geophysics almost magical powers in searching out concealed structure, unaided by geologic observations. A saner and better-informed viewpoint appreciates both the value and the limitations of geophysics and recognizes the necessity of coordinating geologic and geophysical efforts.

Two geophysical techniques, one using seismic vibrations and the other gravity measurements, have been found most useful in attacking

structural geologic problems. Success with either technique requires that definite geologic information be used as a starting point and as a constant check. Seismic explorations of the continental margins start logically with preliminary tests on the land where the structural relations of rock masses are known accurately and "feel their way" across coastal-plain cover to the sea floor. Gravimetric studies should start from stations located strategically with relation to known structural features and should take account of the full geologic history of the region. Several recent geophysical projects illustrate the necessity of coordinating all possible geologic information to be obtained from surface surveys and from borings.

Geophysicists have equipment that can reveal hidden structural features of fundamental importance. It is the part of geology to give intelligent direction in the use of this equipment and to provide every possible key for interpretation of the results.

4841. Lundberg, Hans, Geophysics applied to geology [abstract]: Geol. Soc America Bull., vol. 49, No. 12, part 2, pp. 1936–1937, Washington, 1938

The paper comprises a general review of the problems to which modern geophysical methods may be applicable, particularly the usefulness in tracing geologic features such as contacts, sheared zones, faults with or without displacements.

A number of results picked from the last 2 years' surveys on the North American Continent are shown. They include the location of sulphide bodies and quartz veins, the outlining of silicified zones and acid dikes, the tracing of shear zones and mineralizations, as well as geologic contacts under heavy overburden and under water, depth determinations of overburden, and contouring of bedrock under heavy drift covers.

A general analysis of the physical properties of rocks is made to illustrate the requirements for a successful solution of the geological problems. A brief review is made of the principles involved. It is proposed to interest the mine owners, as well as governments and geological institutions, so that geophysical surveys will be carried out over larger areas than has previously been done, in order to prove how useful the methods are. Examples are shown where the exploration of large areas with one or two geophysical methods has made it possible to solve intricate and complicated structural problems.

It is suggested that a law or rule should be made to compel filing of geophysical data with the government of geological institutions in order to preserve results that are valuable and in many cases have involved a considerable outlay of money. Otherwise, these valuable data are lost.

4842. Lundberg, Hans, Some geophysical data on the meteor crater in Arizona. [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1953, Washington, 1938.

The paper describes briefly the Meteor Crater and the geology of the surrounding area. A short summary is given of the various attempts to locate the buried meteor, including drilling, shaft sinking, etc., made prior to the present geophysical survey.

The results and conclusions drawn from geophysical observations point to an area to the south of the crater as the probable location of the meteor. Here the magnetic anomalies indicate the presence of magnetic bodies below the present bottom of the crater.

The observed geophysical anomalies cannot be explained by any known geological features and are believed to arise from the breaking up of the original meteor into several large fragments and numerous small pieces, before coming to rest in the shattered ground to the south of the crater.

A new attempt to reach the meteoric material will be started shortly.

4843. Makhambetov, A., Survey of the new Dossor [in Russian]: Azerbaidjanskoe Neftianoe Khoziaistvo, vol. 17, No. 5/6, pp. 57–62, Baku, 1937.

Dossor is one of the oldest places under exploitation in the Emba oil-bearing region. Gravitational, seismic, and electrical methods of prospecting are used, and the results, shown on maps and profiles, agree well with the geologic map. The following electrical resistances of the rocks penetrated by boring were established by electrical coring: 4 ohm-m. at a depth of 1,224 m., 6 ohm-m. at a depth of 1,135 m., 12 ohm-m. at a depth of 1,070 m.; the electrical resistances ranged from 4 to 6 ohm-m. at depths of 1,150 to 1,165 m. The resistance of the salt was 200 ohm-m. The position of the salt dome was verified by several boreholes. A gas survey is recommended for obtaining more details.—*W. A.*

4844. Medovsky, I. G., Tolmachev, B. V., Diakonov, D. I., and Yurovsky, Y. M., Geophysical methods of prospecting [in Russian]: Razvedka Nedr, vol. 8, No. 11, pp. 34–42, Moscow, 1938.

Electrical methods of geophysical prospecting, electrical coring of boreholes, and gas-survey methods are briefly described.—*W. A.*

4845. Minakami, Takeshi, Explosive activities of volcano Asama and tiltings of the earth's surface: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 2, pp. 372–389, 1938.

This paper summarizes the remarkable changes in tilts that were observed during the period from January 1934 to December 1937; that is, during the active and inactive stages of the volcano Asama. The marked changes in the inclination of the ground during the active stage of the volcano are clearly different from the seasonal and other variations that occur during the calm stages. As tilting on a large scale began about 2 months before the explosive activity, which started on April 20, 1935, the writer suggests the possibility of forecasting eruptions.—*W. A.*

4846. Modriniak, N., Geophysical work: New Zealand Department of Scientific and Industrial Research, Geological Survey Branch, Report for 1937–38, Wellington, 1938.

Activities in the investigation of part of the Kotuku oil field, the General Gordon area, near Reefton, and the Waiuta area are described. Tests were made under working conditions with the new seismic recorder, the radiometer, and the power buzzer.

The Kotuku area was studied by the seismic-refraction method. The evidence obtained was not convincing enough to justify the assumption of faulting and steep dips indicated by previous surveys. It is recommended that data of refraction and reflection shooting be combined with data of a test well to permit a correlation of theoretical and practical results and to assure correct interpretation.

In the General Gordon area the main object of the survey was the tracing of the General Gordon Reef. The potential-drop ratio method was used. Anomalies were recorded and mapped. The results indicated the probable southward continuation to Union Creek of a reef near the Ballarat workings.

In the Waiuta area the object of the geophysical investigation was to determine the position and northward extent of the Blackwater Reef. The magnetic method was first employed but, as the observations showed that the magnetic properties of the dike were not sufficiently pronounced to have a decided influence on the magnetic balance, the magnetic work was discontinued. The potential-drop ratio method was next used and is still in progress.—*W. A.*

4847. Nowak, Jan, Die Frage der Grenzen des polischen Ölbeckens der Flyschzone [The question of the boundaries of the Polish flysch-zone oil basin]: Acad. polonaise sci. Bull. internat., No. 6–7A, pp. 354–365, Cracow, June–July 1938.

The search for methods by which the potential values as well as the possibilities of areal expansion of the Polish-Carpathian oil regions may be estimated has revealed the following essential facts:

1. The demarcation of the oil regions toward the south by a zone of cold acidulous springs, within which oil is not known to occur. The parallel trend of the borders of both zones can be explained as in nature.

2. The distribution of gravity anomalies in the Carpathian Mountains indicates the position of deeply buried oil-bearing zones. The oil in the flysch zone of the Polish Carpathians is, according to present information, related to the saddle-shaped swell of this regional depression.—*Author's abstract translated by W. A.*

4848. Pirson, S. J., Ground gas survey is a promising tool: Oil Weekly, vol. 91, No. 5, pp. 34–46, Houston, 1938.

Not only does gas escape to the surface by paths of least resistance such as faults, but it is also able to travel through apparently consolidated and homogeneous rocks in a continuous manner; and above oil and/or gas fields an effusion of hydrocarbon gases into the atmosphere takes place continually. The gas may travel through thousands of feet of overburden by (1) permeation, (2) effusion, or (3) diffusion.

Shales and water horizons have a very small permeability, and as shale beds and water horizons are always present above oil reservoirs, it seems unlikely that permeation is a very important factor in this escape of gases. However, permeation may take place through faults and joints. Hence there may be a high hydrocarbon-gas distribution corresponding to a fault. There will be some fractionation in permeation; and by Darcy's law it is possible to calculate the approximate soil-gas concentration under given conditions. Effusion also will lead to some fractionation, for the lighter hydrocarbons will escape most readily. Formulas have been developed for the rate of effusion, and they may be valid for openings of $5–100 \times 10^{-8}$ cm. diameter.

Diffusion of gas through a solid is essentially chemical in nature, for the gas molecules actually penetrate the molecular structure of the material in order to emerge on the other side of a separating solid partition. This phenomenon is perhaps a most important factor in explaining the presence of hydrocarbons in the soil, for it gives the necessary explanation for the travel of gas through impervious strata such as massive limestones, shale beds, water-bearing horizons, etc. Fick's law, which governs the diffusion, is of the same type as Darcy's law and gives similar pictures for the hydrocarbon concentration in the soil.

Samples of air from the ground or of soil are taken from holes a few inches to 30 feet deep in a series of profiles across the area under test, and the gases are recovered in the laboratory. It appears that the heavy

hydrocarbons alone are sought, although in Russia two fractions are collected to give the heavy hydrocarbon number $(HC)^H$ and the light hydrocarbon number $(HC)^L$. This permits oil and gas fields at shallow depths to be distinguished. For deeper fields some distinction is still possible, for a gas field will not show any appreciable heavy hydrocarbon number. Hydrocarbon concentrations in the soil air of 1 in 1,000,000 seem to be significant, and for the best results from a survey it is necessary to measure to 1 in 10,000,000. Formulas have been derived by Antonov and Sokolov for computing the depth of the gas source, and the former proposes to calculate the field pressure also.—*G. D. H., Jour. Inst. Petroleum Technologists, vol. 24, No. 181, 1938.*

4849. Stetson, H. T., Time problem in connection with geophysical study of crustal structure [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1959, Washington, 1938.

Gravimeters have been developed sufficiently sensitive enough for recording tidal movements in the earth's crust in the vertical direction. To detect and record possible tangential movements involves the measurement of geographical coordinates by precise astronomical methods.

Extensive studies of longitude variations between the two sides of the Atlantic give some promise that the necessary degree of precision can be attained. The determination of longitude differences, for example, between Greenwich and Washington rests essentially upon the comparison of time determinations deduced from the transits of stars over the respective meridians. To compare time so determined, however, requires the immediate intercommunication of the results by radio signals. Making allowances for such known factors as could render apparent differences in longitude variable, residuals resulting suggest periodic displacements that may be related to crustal tides.

The reality of physical displacements corresponding to the observed periodic changes in longitude rests upon the assumption that the velocity of propagation of radio signals is the same in either direction over the connecting great-circle arc. For lower radio frequencies there appears at present no definite evidence against such an assumption. The assumption, however, is so important and fundamental that experimental investigation of its validity is paramount.

The possibility that information relative to the nature, causes, and amounts of differential horizontal movements of parts of the earth's crust may come from such study emphasizes the need for continued daily interchange of time signals between the United States and Europe. As astronomical methods appear to be the only ones capable of checking displacements of the plumb line referred to fundamental coordinates in space, the problem becomes important from the geophysical point of view when crustal structure is concerned.

A special committee of the American Geophysical Union recently set up for the study of cosmic terrestial relationships will undertake investigation and evaluation of present available data with a view to collaborating in the work of the two other special committees—one, the committee on the geophysical and geological study of ocean basins, and the other, a similar committee for the study of continental arcas.

4850. Tagung der Deutschen Geophysikalischen Gesellschaft in Jena [Meeting of the German Geophysical Association in Jena], editorial note: Petroleum Zeitschrift, vol. 34, No. 44, pp. 19–20, Berlin, 1938.

The following reports, made at the meeting of the German Geophysical Association, are discussed briefly: (1) Seismic methods, by Mintrop; (2) Investigation by seismic-reflection methods of salt domes in the Harzland, by Trappe; (3) Magnetic measurements of the second order made in Germany in 1937, by Bock; (4) Task of the commission appointed by the International Society of Geodesy and Geophysics for investigating the continent and the bottom of the ocean, by Angenheister; and (5) Gravity determinations in coal mines, by Jung.—*W. A.*

4851. Thom, W. T., Jr., Opportunities and needs for collaborative research in the further study of continental borders [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1964, Washington, 1938.

To all workers in earth science our coastal areas are of special interest, for such border regions not only present unusual opportunities for checking new geophysical methods and appliances against known geologic conditions but also provide the necessary points of departure for geophysical surveys aimed at the disclosure of the geological structure of suboceanic areas and at the solving of some of geology's most vital and most baffling problems.

In future exploration of coastal regions (and of oceanic basins) structural geology must be used in planning the studies to be undertaken and in the final interpretation of results obtained—with geodesy, astronomy, and geophysics required for the execution of these studies.

In the Gulf Coast sector the work of the oil companies and of the petroleum geophysicists has revealed a developing major trough, or geosyncline, approximately parallel to the south Louisiana coast and containing perhaps 30,000 feet or more of relatively recent sediments. Further compilation of general and nonconfidential geophysical data (which almost surely can be had through the cooperation of the Society of Exploration Geophysicists) will undoubtedly amplify and clarify this picture in many important particulars.

In the Atlantic Coast region, among the immediately important problems are the determination of the former eastward extent, degree of subsidence, and time of subsidence, of the ancient continent of Appalachia, whose western margin emerges along the Fall Line, and whose eastern margin lies at an unknown (and at least considerable) distance offshore. In the Pacific Coast region the seaward tracing of active faults, of submerged topography, and of continental structural features similarly provide highly interesting and important problems. In this region, as in the Atlantic and Gulf Coasts, the work to be undertaken is so extensive and so varied that its planning and execution call for the broadest possible collaboration between scientific organizations, research institutions, and governmental and commercial agencies, if the United States is to do its fair share in developing the new fields of geophysical-geological research presented by our continental borders and by the world's ocean basins.

4852. Todd, J. D., and Roper, F. C., Geophysical improvements open way for exploring vast virgin area of upper coastal trend: Oil Weekly, vol. 91, No. 4, pp. 25–30, Houston, Texas, 1938.

Fruitless results of the early exploration of this area are mentioned. Recent important advancement in geophysical methods (electrical logging of boreholes) and improvement of instruments (new gravimeters, reflection seismograph) seems to have opened a way for investigating

the structure of the upper coastal trend (Gulf Coast district of Texas and Louisiana) despite difficulties that formerly made such work of little value.—*W. A.*

4853. Triplett, Grady, Geophysical advancements responsible for Illinois: Oil Weekly, vol. 91, No. 13, pp. 17–18, Houston, Texas, 1938.

The writer mentions briefly the history of the Illinois Basin and its relation to geophysics and states that it is no exaggeration to give full credit to the geophysical branch of science for the development in southern Illinois.—*W. A.*

8. GEOLOGY

4854. Bubnoff, Serge von, Structure of the earth: Naturwissenschaften, vol. 26, No. 30, pp. 490–493, July 29, 1938.

Reference is made first to Kossmat's view that the North Pole lies in a bay surrounded by old continents while the South Pole lies in an old, earlier-solidified, block of the Antarctic. The growth of the northern continent (Europe, Asia, America) has been by sliding along lines of folding with cores over Canada, Scandinavia, Finland, and east Siberia, whereas the southern continent has broken up along the lines of the Atlantic and Indian Oceans. Climatic and geological evidence in support of these views is discussed. The views lead to the idea of the whole earth's surface acting as a quasi-homogeneous region of deformation. The relation of these views to Wegener's continental drift theory is examined.—*R. S. R., Sci. Abstracts, vol. 41, No. 490, 1938.*

4855. Griggs, David, Convection currents and mountain building [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1884, Washington, 1938.

A model has been built that illustrates the way in which convection currents in the earth's subcrust may be instrumental in the development of continents, geosynclines, and mountain ranges. The apparatus shows the formation of folds and nappes. By varying the velocity of the currents, it is possible to reproduce the major structures of many of the great mountain systems. Various types of gravity anomalies may be inferred from these structures, and the consequence of return to isostatic equilibrium can be demonstrated.

4856. Stetson, H. C., Continental shelf off eastern United States: Present knowledge and future problems [abstract]: Geol. Soc. America Bull., vol. 49, No. 12, part 2, p. 1960, Washington, 1938.

The east coast continental shelf and slope have been studied by means of surface samples, long cores, rock fragments dredged from walls of submarine canyons, and very recently by seismic methods. The arrangement of sediments on the shelf, their source, the profile of equilibrium and depth of wave action is discussed. It is evident that the sedimentary conditions which produced the Coastal Plain are still in operation.

Long cores taken on the slope for the purpose of correlating conditions of deposition here with those of the Atlantic Basin show that everywhere a cold-water fauna lies a few feet below the present-day warm-water fauna. In some cases two alternations of warm- and cold-water forms are found. Present-day sediments are very different from those of the immediate past. Occasionally the cover of Recent and Pleistocene sediments has been penetrated, and older sediments have been reached.

Bedrock dredged from the Georges Bank Canyons indicates a succession from Upper Cretaceous through late Pliocene. In the valleys south of the Hudson the mantle of what is presumed to be Pleistocene deposition is too thick to be penetrated.

Seismic technique has been adapted for use at sea in both deep and shallow water. Some data have been obtained in the shallow water over the shelf; but on the slope and in the ocean basin, work has scarcely progressed beyond the experimental stage.

The immediate problems are discussed and the present limitations indicated.

4857. Trueman, A. E., Transparent models to illustrate geological structures: Nature, vol. 142, No. 3597, p. 672, London, 1938.

A description is given of transparent models that may be useful for demonstrating structural relations. Such models consist of a glass box, 6 by 7 by 3½ inches, formed by four glass sheets fitted into slots in a wooden base. Over the top is a sheet of cellophane fastened along the edges. This upper sheet, on which the geologic map may be drawn, is cut by 13 narrow slits, each of which is vertically above a V-shaped groove in the wooden base. Thirteen sheets of celluloid showing successive sections across the structure represented are thus kept vertically in their position and can readily be taken out to demonstrate the section along any line. Viewed from the side, the models are sufficiently transparent for the whole structure to be seen in three dimensions.—*W. A.*

9. NEW BOOKS

4858. Alpin, L. M., Contribution to the theory of electrical coring of boreholes [in Russian], Glavneft NKTP, U. S. S. R., Transactions V. K. G. R., No. 11, 88 pp., illus., 1938.

This book deals with the fundamental problem of electrical coring and determination of the dependence of the apparent specific resistance on the true resistance of the medium.—*W. A.*

4859. Davison, Charles, Studies on the periodicity of earthquakes, 107 pp., London, Thomas Murby and Co., 1938. Price 13s. bd. net.

The book summarizes and extensively revises the conclusions on earthquake periodicity that have been published in many articles during the past 40 years and more. In the concluding chapter Davison discusses how the results he obtains throw light on the movements of the earth's crust.—*S. C., Nature, vol. 142, No. 3598, 1938, condensed by W. A.*

4860. Deuxième Congrès Mondiale du Pétrole [2d World Petroleum Congress], Paris, 1937, vol. 1, section 1, 1937.

Abstracts of the following papers on geophysics presented at the 2d World Petroleum Congress are given in the Journal of the Institute of Petroleum Technologists, vol. 24, Nos. 180 and 181, London, 1938: (1) German geophysical survey, by O. Barsch; (2) Report on the geophysical investigations undertaken in Italy by the A. G. I. P., by E. Soler; (3) Developments in exploration geophysics since 1935, by E. E. Rosaire; (4) Physicist and tectonics, by R. Maillet and R. P. Ceccatty; (5) Evolution of the problems and methods of applied geophysics, by M. Schlumberger and R. Maillet; (6) Thyssen gravimeter and its application in the examination of the saliferous Basin of Alsace, by B. Favre; (7) Astatized pendulum as a static instrument for gravity

measurements, by G. Ising; (8) Thyssen gravimeter, 1935–1937, by A. Schleusener; (9) Problem of determining the overhang of salt domes by torsion balance, by R. Vajk; (10) Magnetic and gravimetric measurements in eastern England, by J. H. Jones; (11) Magnetic properties of rocks met in the wells drilled in the search for oil in Madagascar, by A. Savornin; (12) Locating pipe lines by radio, by C. M. Brecheisen; (13) Application of resistivity measurements in the Rumanian petroliferous basin, by M. J. J. Breusse; (14) Electrical anisotropy of the ground and pseudoanisotropy, by R. Geneslay and F. Rouget; (15) Borehole surveys with high-frequency currents, by O. Martienssen; (16) Examples of the application of Schlumberger electrical logging to the study of a complex geological structure, by L. Migaux; (17) Control of the results obtained with the electromagnetic dip-meter on a known geological structure, by M. Schlumberger and H. G. Doll; (18) Application of Schlumberger electrical logging in oil-field operations, by J. H. M. A. Thomeer; (19) On the methods of calculation in seismic-reflection prospecting, by M. J. Bazerque; (20) Elimination of systematic errors in seismic-reflection work by the method of closed polygons, by G. Bouche; (21) Determination of high dips by the seismic-reflection method, by M. Jabiol; (22) Seismic-reflection survey in eastern England, by J. H. Jones; (23) Exploration by seismic reflection from an isolated station by R. Leleu; (24) Seismic methods of prospecting and their application in exploration for oil in Poland, by Z. A. Mitera; (25) Some problems of applied seismics, by W. v. zur Mühlen; (26) Seismic-reflection method in Germany, by F. Trappe; (27) Problems raised by the search for oil in Italy, by M. Gortani; (28) Anomalies in the horizontal gradient at the junction of the sub-Carpathians and the Rumanian Plain from the point of view of the search for oil, by I. Gavat.

4861. Fleming, J. A., Annual report of the Director of the Department of Terrestrial Magnetism: Carnegie Inst. Washington Yearbook, No. 37, pp. 1–62, 1938.

The report year July 1, 1937, to June 30, 1938, has been marked by energetic prosecution of experimental investigation and by continued coordination and integration of various researches that are paving the way for a more general formulation of geophysical facts. Much progress has been made on two major projects, that open new fields of investigation and promise important advancement. One of these is the completion of the Atomic-Physics Observatory and the progress in installing its electrical equipment; the other is the installation of automatic multifrequency equipment for ionospheric measurements at both the Huancayo and the Watheroo Magnetic Observatories.

The outstanding advances in magnetic investigations concern two distinct branches of the science: the rapidly varying external field and the slowly varying, so-called permanent field. The investigation of a positive relation of cosmic radiation with magnetic and other phenomena was continued. The rationale of the subject atmospheric electricity was improved in several respects. Isolation of the radio fade-out effect in a particular region of the ionosphere was accomplished by the use of powerful automatic multifrequency technique. Studies in the laboratory of primary particles of matter, which have magnetic properties as one of their very few attributes, were directed chiefly toward accurate measurements of the large attractive forces that operate inside the nuclei of all atoms. The coil of the new primary standard

for measuring, in absolute units, the earth's vector-magnetic field was completed; it is constructed with such accuracy that the magnetic field is calculated to about one part in a million; the alidade and mountings for the coil are now under way. The observatories at Huancayo, Peru, and at Watheroo, Western Australia, continued their extensive geophysical program and obtained continuous records of magnetic elements. Field work in Australasia and in the Pacific islands was continued. Papers published during the past year are listed.—*Condensed from author's summary by W.A.*

4862. Malamphy, M. C., de Souza, H. C. A., and do Amaral, I. C., Prospeccao magnetica no norte de Santa Catharina [Magnetic prospecting in the northern part of Santa Catharina]: Servico Geologico e Mineralogico, Bull. No. 85, 22 pp., 23 figs., Rio de Janeiro, 1933.

In the three parts of this book the authors describe (1) the region and the execution of the work, (2) anomalies and their interpretation, and (3) approximate calculations of depth.—*W.A.*

4863. Modriniak, N., and Marsden, E., Experiments in geophysical survey in New Zealand: Wellington Dept. Sci. Ind. Research Geol. Mem. No. 4, 92 pp., 30 maps, 1938.

The application of geophysical methods to problems in New Zealand was undertaken by the Department of Scientific and Industrial Research toward the end of 1927. Magnetic, seismic, and electric methods of prospecting were used for correlation of geophysical and geological observations on theoretical and practical problems. Seismic methods were developed especially in the study of shallow deposits associated with the occurrence of gold.

This book, which contains a collection of results showing examples of current practice, affords, to those interested, an opportunity to become acquainted with practical and economical possibilities of the methods of geophysical exploration. Brief reference is made to the principles of the above-mentioned three methods of prospecting. Locations of geophysical investigations in New Zealand are shown on a general map, and a detailed description is given of the results obtained in each of the areas investigated.—*W.A.*

4864. National Research Council, Transactions of the American Geophysical Union, 19th annual meeting, April 27–30, 1938.

Part 1 (pp. 1–584): Introduction, by J. A. Fleming, pp. 3–5; General assembly, pp. 7–44; Symposium on the physics of volcanic processes: (1) Introductory—applying physics to volcanoes, by A. L. Day; (2) Surface manifestations of volcanic activity, by E. G. Zies; (3) Structural development of volcanic cones, by T. A. Jaggar; (4) Rock structures associated with some ancient volcanoes, by Chas. B. Hunt; (5) The roots of volcanoes, by R. A. Daly; (6) Summary of symposium on the physics of volcanic processes, by L. H. Adams; (7) Discussion.

Section of geodesy, pp. 45–96, reports and papers: (1) Advanced surveying and geodesy in the curricula of engineering colleges today, by P. H. Underwood; (2) The improvement in time service and broadcasting, by J. F. Hellweg; (3) The sea-level datum of 1929, by H. S. Rappleye; (4) Errors—accidental and otherwise, by H. C. Mitchell; (5) A star zenith finder, by T. A. Jaggar; (6) Annual report of progress of the geodetic work of the United States Coast and Geodetic Survey, by C. L. Garner; (7) Progress of geodetic work in Mexico during the year 1937,

by Manuel Medina; (8) Astronomical determinations in Central America, by R. W. Woodworth; (9) Investigation of the vertical gradient of gravity, by Sigmund Hammer; (10) Formulas and tables for the deflection of the vertical, by W. D. Lambert; (11) Geologic interpretation of gravity anomalies in the northeastern United States, by C. R. Longwell; (12) The effect of geologic corrections on gravity anomalies, by G. P. Woolard; (13) A proposed investigation of Vening Meinesz anomalies, by Maurice Ewing and H. H. Pentz; (14) A study of certain reductions and adjustments in pendulum observations, by A. J. Hoskinson; (15) A method for introducing a new standard of length, by Philip Kissam.

Section of seismology, pp. 97–132, reports and papers: (1) Geophysical investigations of the geologic structure of the Coastal Plain, by G. P. Woollard, Maurice Ewing, and Meredith Johnson; (2) Microseisms recorded at Berkeley, by Perry Byerly and James T. Wilson; (3) Seismic phenomena as revealed by quarry blasting, by J. R. Thoenen and S. L. Windes; (4) The epicenter of *P* curve of the April 16, 1937, Fiji Island earthquake, by A. J. Westland; (5) Body waves of long path in the Banda Sea earthquake of February 1, 1938, by W. A. Lynch and Joseph Lynch; (6) Relations of traveltime curves to the seismic-wave velocities in the continental and suboceanic lithosphere, by H. Landsberg and H. Neuberger; (7) A simple seismoscope, by T. A. Jaggar; (8) The electromagnetic microbarograph and its performance, by J. B. Macelwane and J. E. Ramirez; (9) A seismograph for microseisms, by J. B. Macelwane and W. F. Sprengnether; (10) A contribution to the study of the seismicity of Missouri, by R. R. Heinrich; (11) Progress report in seismology for the United States Coast and Geodetic Survey and cooperating stations, by E. W. Eickelberg; (12) Some new phases appearing in a deep earthquake, by G. J. Brunner.

Section of meteorology, pp. 133–156, reports and papers: (1) Measurements of ultraviolet solar radiation in Puerto Rico, by G. W. Kenrick and H. Ortiz; (2) A year of ultraviolet measured with a dosimeter at Blue Hill, by D. L. Arenberg; (3) The meteorological aspects of certain radio transmission phenomena, by G. W. Kenrick and Gerard Lavergne; (4) Progress in compiling and summarizing ships' weather observations, by J. R. Tannehill; (5) Meteorological research contemplated for an expedition to north Greenland, by Max Demorest; (6) The velocity of sound waves from gunfire in southern California, by B. Gutenberg.

Section of meteorology and oceanography (joint meeting), pp. 157–184, reports and papers: (1) Recent observations from the Gulf Stream and neighboring waters, by C. O'D. Iselin; (2) Solenoidal circulations resulting from lateral mixing, by C. G. Rossby; (3) The intensity of lateral mixing in the atmosphere as determined from isentropic charts, by G. Grimminger; (4) Wave distribution in a homogeneous current, by C. L. Pekeris; (5) Mean monthly isentropic charts and their relation to departures of summer rainfall, by H. Wesler and J. Namias; (6) On the thermodynamic interpretation of isentropic charts, by H. R. Byers; (7) On the use of isentropic cross sections, by C. H. Pierce; (8) Analysis of the flow patterns on two surfaces of constant potential density in the southern North Atlantic, by R. B. Montgomery; (9) On the relative merits of dynamic topographies and isopycnic distributions for the study of ocean-current trajectories, by A. E. Parr; (10) Characteristics of the littoral water and weather along the Pacific coast of Colombia and Ecuador, by R. C. Murphy; (11) Oceanographic problems of the coast of California, by H. U. Sverdrup; (12) The forecasting significance of

anticyclonic eddies in the isentropic chart, by Jerome Namies; (13) Some relations between meteorology and coast-gradient currents off the Pacific coast of North America, by J. P. Tully.

Section of terrestrial magnetism and electricity, pp. 185–222, reports and papers: (1) An electromagnetic method of determining induction coefficients of magnetometer magnets, by J. H. Nelson; (2) Testing the orientation of a declination variometer by its temperature coefficient, by H. H. Howe; (3) Alternating-current method of measuring magnetic polarization of rocks, by E. A. Johnson; (4) The brightness of the twilight sky and the density and temperature of the atmosphere to about 60 km., by E. O. Hulburt; (5) Correlation of cosmic-ray geomagnetic effects, by T. H. Johnson; (6) On cosmic-ray effects associated with magnetic storms, by S. E. Forbush; (7) Latitude effect in electrical resistance of a column of atmosphere, by O. H. Gish and K. L. Sherman; (8) Ionospheric disturbances coincident with magnetic storms, by L. V. Berkner; (9) Heights of auroral-zone currents, by A. G. McNish; (10) Recent progress in the study of cosmic correlation with radio reception at the Massachusetts Institute of Technology, by H. T. Stetson; (11) The great sunspot of January 1938, by S. B. Nicholson; (12) Magnetization of sediments from the bottom of the Atlantic Ocean, by A. G. McNish and E. A. Johnson; (13) Preliminary report on measurement of magnetization of oceanic sediments, by A. G. McNish and E. A. Johnson; (14) Application of vertical variometer measurements to the study of secular magnetic variations, by Victor Vacquier; (15) Notes on horizontal pendulum observations in relation to certain phenomena, by F. N. Denison; (16) Superposition in interpretation of resistivity data, by Irwin Roman; (17) Ionospheric researches of the National Bureau of Standards during 1937, by J. H. Dellinger; (18) Report on solar-radiation research at the Institute of Optics, University of Rochester, by Brian O'Brien; (19) Geomagnetic investigations of the University of North Carolina, by Wm. F. Prouty; (20) Magnetic work of the United States Coast and Geodetic Survey, April 1937 to March 1938, by E. W. Eickelberg; (21) Progress report on researches in terrestrial magnetism and electricity at the Department of Terrestrial Magnetism, Carnegie Institution of Washington, for the year April 1937 to March 1938, by J. A. Fleming.

Section of oceanography, pp. 223–260, reports and papers: (1) Oceanographic activities of the Hydrographic Office and the United States Navy during 1937, and plans for 1938, by L. R. Leahy; (2) Oceanographic activities of the United States Coast and Geodetic Survey, by L. O. Colbert; (3) The oceanographic work of the United States Coast Guard in 1937, and plans for 1938, by F. M. Soule; (4) Research within physical oceanography and submarine geology at the Scripps Institution Oceanography from April 1937 to April 1938, by H. U. Sverdrup; (5) A promising theory concerning the causes and results of long-period variations in the strength of the Gulf Stream system, by C. O'D. Iselin; (6) The representation of suboceanic relief on maps of intermediate scale, by W. L. G. Joerg; (7) Deep-sea measurements without wires or cables, by Maurice Ewing and Allyn Vine; (8) An international program for collecting samples of surface water from the Columbia River to the Bering Sea, by P. E. Church; (9) Report on the work of the International Commission on Continental and Oceanic Structure, by R. M. Field; (10) Chemical characteristics of Seymour inlet, by K. T. Barkey and T. G. Thompson.

Section of volcanology, pp. 261–278, reports and papers: (1) Igneous activity in the Comstock district, Nevada, by F. C. Calkins; (2) Igneous sequence in southeastern Utah, by F. G. Wells; (3) Lavas of the African rifts, their chemistry and tectonic setting, by N. L. Bowen; (4) The clastic flow of 1932 at Fuego, in Guatemala, by E. G. Zies; (5) Volcanic activity at Magnet Cove, Arkansas, by C. S. Ross; (6) Diabase dikes of the Franklin Furnace quadrangle, New Jersey, by Charles Milton; (7) Primary banding in norite and gabbro, by H. H. Hess; (8) Stoping and assimilation in a granodiorite stock at Jamestown, Colorado, by E. N. Goddard; (9) High temperature and pressure-phase equilibria in the albite-water and orthoclase-water systems, by R. W. Goranson; (10) General considerations of the effect of pressure on solubility, by R. E. Gibson; (11) Temperatures in a sinking zenolith, by T. S. Lovering; (12) Notes on the Egersund anorthosite, Norway, by Robert Balk.

Section of hydrology, pp. 279–554. The first part of this section (pp. 281–392) contains annual reports of permanent research committees for 1937–38 and reports of special committees. The second part (pp. 393–553) contains the following papers: (1) Some of the factors influencing the behavior of perched water tables at the North Appalachian Experimental Watershed near Coshocton, Ohio, by W. D. Potter and M. V. Baker; (2) Experimental water spreading for groundwater storage in Salt Lake Valley, Utah, 1936, by A. J. Lazenby; (3) Ground water for air conditioning on Long Island, New York, by R. M. Leggette and M. L. Brashears, Jr.; (4) Ground-water underflow in Croton Valley, New York—a comparison of field and laboratory methods, by C. E. Jacob; (5) Determination of infiltration rates from surface run-off, by L. K. Sherman; (6) Some channel-storage studies and their application to the determination of infiltration, by W. B. Langbein; (7) Synthetic-unit graphs, by F. F. Snyder; (8) Modification of the index-area principle and the anticipated application of the principle to Muskingum River flood control, by W. E. Smith; (9) Probability distribution-curve for flood-control studies, by B. F. Kimball; (10) Contributions of the Water-Resources Committee to hydrological investigations, by Thorndike Saville; (11) The distribution of the average depth of snow-on-ground in New York and New England—method of study, by R. G. Stone; (12) Glacialogical research contemplated for an expedition to north Greenland, by Max Demorest; (13) Evaporation studies at Baton Rouge, Louisiana, by G. N. Cox; (14) Energy balance in stream flows carrying suspended load, by R. T. Knapp; (15) Notes on the formation of sand, by E. W. Lane; (16) Land use and flood flows, by W. C. Lowdermilk; (17) Investigation of velocities in a 12-foot rectangular flume, by C. H. Pierce; (18) A study of the variability of precipitation, by Edward Soucek and J. W. Howe; (19) A statistical method for estimating the reliability of a station-year rainfall record, by Katherine Clarke-Hafstad; (20) Progress report on the analysis of rainfall data, by C. F. Merriam; (21) Determination of the dependability of rainfall records by comparison with nearby records, by J. B. Kincer; (22) Wind shields for precipitation gages, by Ch. F. Brooks; (23) Results from experimental rain gages at Coshocton, Ohio, by H. S. Riesbol; (24) Monthly variation of rainfall intensities in Wisconsin, by A. T. Lenz.

Minutes (pp. 555–584): (1) Minutes of the General Assembly, and (2) Minutes of the sections.

Part 2 (pp. 585–744): Reports and papers, regional meetings, Section of Hydrology: (1) North Continental Divide Regional Meeting, Spokane, Washington, December 28 to 29, 1937; (2) South Pacific Regional Meeting, Davis, California, January 7 to 8, 1938; (3) South Continental Divide Regional Meeting, Denver, Colorado, June 21, 1937; (4) Western Interstate Snow Survey Conference, Davis, California, January 8, 1938.

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4865. Neumann, Frank, United States earthquakes, 1936: U. S. Coast and Geodetic Survey Serial No. 610, 44 pp., 10 illus., Washington, 1938. Price, 10 cents.

This publication is a summary for the calendar year 1936 of earthquake activity in the United States and the regions under its jurisdiction. Contents: (1) Introduction, (2) Instrumental results, (3) Noninstrumental results, (4) Miscellaneous activities, (5) Seismological observatory results, (6) Strong-motion seismograph results, (7) Tilt observations, (8) Additions and corrections to previous publications.—*W. A.*

4866. Tulsa Geological Society Digest, 41 pp., Tulsa, Oklahoma, 1938.

This digest contains detailed abstracts of the following geological and geophysical papers, most of them prepared by the authors: (1) Geology of the Moore Pool, by F. A. Bush; (2) Major division of Permian in Oklahoma and southern Kansas, by Darsie A. Green; (3) Colored moving pictures of Zion, Bryce, and Grand Canyons, by Louis Roark; (4) Subsurface geology of the north flank of the Wichita Mountains, by Clark Millison; (5) Life in Old Mexico, by Carroll H. Wegemann; (6) Rate and continuity of deposition, by W. H. Twenhofel; (7) Geology in the national parks, by Earl A. Trager; (8) Relation of production on the central Kansas uplift to structural and stratigraphic traps; by Edward A. Koester; (9) Dams on our large waterways, by E. G. Woodruff; (10) The lower Mississippian in the Mississippi Valley, by E. B. Branson; (11) Structural patterns in north-central Texas, by M. G. Cheney; (12) Some facts concerning the origin of the Dakota sandstone, by J. W. Stovall; (13) Stratigraphic prospecting by soilane and eltran, by E. E. Rosaire; (14) Structure of the middle Rocky Mountains, by Rollin T. Chamberlin; (15) Core analysis, by Howard C. Pyle and John E. Sherborne; (16) Colored moving pictures of Mexico, by R. H. Wood; (17) Clays and associated substances, by James H. Gardner; (18) Some frontiers of geology, by A. I. Levorsen; and (19) Chart showing the age and types of rock exposed in the national parks and monuments.

10. PATENTS

4867. Gravimeter; Archer Hoyt, Aspinwall, Pennsylvania, assignor to Gulf Research and Development Co., Pittsburgh, Pennsylvania, a corporation of Delaware: U. S. patent 2,131,737, issued October 4, 1938.

A gravimeter giving a direct angular deflection and comprising a coil spring suspended at one end and formed of a coiled metal band of width much greater than thickness, so that when the length of the coil spring is changed the unfixed end of the spring rotates, and a weight associated

with the unfixed end of the spring and adapted to change the length of the spring under influence of gravity. Claims allowed, 16.

4868. Gravitational instrument; Stephan Baron von Thyssen-Bornemisza, The Hague, Netherlands, assignor to Shell Development Co., San Francisco, California, a corporation of Delaware: U. S. patent 2,132,865, issued October 11, 1938.

A gravitation measuring-instrument comprising supporting means having a predetermined operating level, a plurality of opposite disposed levers mounted on said support and adapted to take inclined positions with respect thereto, a mass provided on each support subject to gravitational pull, whereby said levers take different angular positions with respect to said support depending upon the gravitational pull, whereby faulty increases or decreases in the measuring values of one lever, due to faulty positioning of the said supporting means outside its said predetermined operating level, are offset by a corresponding decrease or increase in the values given by a lever operating in a plane disposed at an angle with respect to that of said last-mentioned lever, all said levers contributing to one accurate measurement. Claims allowed, 4.

4869. Use of a distributed charge in seismic prospecting; Stuart Sherar, Tulsa, Oklahoma, assignor to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,133,484, issued October 18, 1938.

In seismic prospecting, the steps which comprise progressively creating explosive energy along a continuous line aligned with a receiving station and progressing toward the receiving station whereby a seismic wave front is created which is progressively reflected from a subterranean earth stratum, and receiving the wave front at the receiving station. Claims allowed, 3.

4870. Method of and apparatus for determining the dip of the earth's substrata. Jacob Neufeld, Tulsa, Oklahoma, assignor to Engineering Laboratories, Inc., Tulsa, Oklahoma, a corporation of Oklahoma: U. S. patent 2,133,786, issued October 18, 1938.

This invention relates to the method of electrically investigating inclination and dip of various formations traversed by a borehole containing an electrically conductive liquid, which comprises producing a current flow between an electrode suspended inside the borehole and an electrode ground at an appropriate distance from the borehole, and determining the distribution of the electrical potential inside the borehole for various positions of the grounded electrode. Claims allowed, 6.

4871. Gravity meter; Serge Alexander Scherbatskoy, Tulsa, Oklahoma: U. S. patent 2,136,219, issued November 8, 1938.

In an apparatus for determining variations of gravity, an elastic member, a gravity sensitive member attached to the elastic member, the said gravity sensitive member being subjected to a varying force of gravity, means responsive to the variation of gravity for applying an additional force maintaining the stress of the elastic member substantially uniform, and means for determining the magnitude of the said additional force. Claims allowed, 9.

4872. Apparatus for electrical exploration of subsurface; John Jay Jakosky, Los Angeles, California: U. S. patent 2,137,650, issued November 22, 1938.

An apparatus for use in determining the geologic nature and characteristics of the subsurface, which comprises: A pair of electrodes electri-

cally connected to the earth and spaced from one another by a known distance along the earth's surface, a source of unidirectional energizing current; conductors connecting said source to said electrodes; a resistor inserted in one of said conductors between one of said electrodes and said source, whereby a unidirectional potential is produced across said resistor which varies with the value of the energizing current flowing during the operation of said source; means for obtaining a unidirectional potential which varies with the value of said energizing current and the geologic nature and characteristics of the subsurface traversed by said current, including electrode means; an indicating instrument having two coils; and means associating one of said coils with one of said potentials and the other of said coils with a variable portion of the other of said potentials. Claims allowed, 2.

4873. Gravimeter; Carl A. Heiland, Golden, Colorado, assignor to Heiland Research Corporation, Denver, Colorado, a corporation of Colorado: U. S. patent 2,137,963, issued November 22, 1938.

In an instrument for measuring gravity, a normally vertically positioned tube reversible in positions about a horizontal axis, a fall body within the tube, a device in each end of the tube for releasably holding the fall body at the uppermost end of the tube, and for arresting the falling movement of the body at the lower end of the tube, means for operating the devices to release the body at the upper end, and to hold the body at the lower end after its motion has been arrested and during reversal to the tube position, and means for observing the rate of fall of the body from the upper to the lower end of the tube. Claims allowed, 10.

4874. Seismic well logging; Henry Salvatori, Hollywood, California, assignor by mesne assignments to Stanolind Oil and Gas Co., Tulsa, Oklahoma, a corporation of Delaware: U. S. patent 2,137,985, issued November 22, 1938.

A method of logging a well by means of seismic waves comprising disposing a group of at least two vertically spaced seismic-wave detectors in a well, the spacing between adjacent detectors being not substantially greater than the thickness of individual major geologic beds traversed by said well, generating seismic waves at a point substantially vertically aligned with said detectors, recording the times of arrival of seismic waves at each of said detectors on a common record in a single operation, determining the differences between said arrival times and preparing therefrom a seismic log of said well yielding information concerning abrupt changes in the lithologic character of the geologic formations opposite said detectors. Claims allowed, 6.

4875. Method of determining underground structure; John Jay Jakosky, Los Angeles, California: U. S. patent 2,138,818, issued December 6, 1938.

In a method of determining discontinuities in the materials below the earth's surface, the steps which comprise laying out more than two angularly spaced lines radiating from a common point on the earth's surface; placing grounded potential electrodes at points on each of said lines equidistant from said common point; placing grounded current electrodes at points on each of said lines equidistant from said common point but spaced from the locations of the potential electrodes; passing current through the earth between the two current electrodes located on two of said lines to produce a potential difference between the two po-

tential electrodes located on said two lines, and determining the relation of said current to said potential; and subsequently passing current through the earth between the current electrode located on one of said two lines and the curved electrode located on a third one of said lines to produce a potential difference between the two potential electrodes located on the last-mentioned two lines, and determining the relation of the last-mentioned current to the last-mentioned potential. Claims allowed, 3.

4876. Means and method for geophysical prospecting; Gennady Potapenko, Pasadena, California, assignor to Geo-Frequenta Corporation, a corporation of Delaware: U. S. patent 2,139,460, issued December 6, 1938.

This invention relates to a method of determining the presence of a substance having a selective effect with respect to frequency of an imposed electric field which includes simultaneously subjecting the same part of said substance to two electric fields of different frequency, and simultaneously measuring the effect of said substance upon said electric fields of different frequency, whereby are largely eliminated errors in the relative effect due to variable spurious factors. Claims allowed, 17.

4877. Electrical method and apparatus for determining the characteristics of geological formations; John Jay Jakosky, Los Angeles, California: U. S. patent 2,140,798, issued December 20, 1938.

This invention relates to the method of determining the nature of geologic formations, which comprises: Taking electrical measurements to determine an electrical characteristic of a formation in a direction substantially parallel to the bedding planes of the strata therein; and taking other electrical measurements to determine a comparable electrical characteristic of said formation in a direction transverse to the bedding planes of said strata, whereby the degree of anisotropy of said formation may be determined by comparing the measurements so obtained. Claims allowed, 20.

4878. Geological instrument: Francisco J. Cordova, near Sheffield, Alabama: U. S. patent 2,141,173, issued December 27, 1938.

This invention relates to a geological instrument for the measurement of the angle of dip and the direction of strike which comprises the combination of a pocket transit with a longitudinal bubble level, and a circular bubble level with a convex cover which registers in a plane of right angles to the plane of register of the longitudinal bubble; and a circular bubble level with a concave cover, which is in the same plane as the bubble level with the convex cover, and two indicia across the concave cover, in planes at right angles to each other with the plane of one of the indicia parallel to the plane of register of the longitudinal level. Claims allowed, 5.

4879. Gravity measuring instrument; Stephan Baron von Thyssen-Bornemisza, The Hague, Netherlands, assignor to Shell Development Co., San Francisco, California, a corporation of Delaware: U. S. patent 2,141,628, issued December 27, 1938.

A gravitational meter, comprising a base, a spring knee section rigidly mounted upright in said base and being under tension and curved to one side of the perpendicular and a rigid section forming an extension of the outer end of said knee section, and a mass carried by the rigid section and subject to gravitational pull to cause relative angular displacement of the knee section, whereby the center of gravity of said mass is later-

ally shifted with respect to the point of attachment of said knee section to the base, the lateral displacements of the said center of gravity indicating different gravitational values. Claims allowed, 8.

4880. Method and arrangement for the electrical survey of the strata traversed by a borehole; Conrad Schlumberger, Paris, France, Anne Marguerite Louise Doll, administratrix of said Conrad Schlumberger, deceased, assignor to Société de Prospection Électrique, Procédés Schlumberger, Paris, France, a corporation of France: U. S. patent 2,141,826, issued December 27, 1938.

This invention relates to the method of electrical survey of the strata penetrated by a borehole, in the part thereof not yet lined with casing but filled with water, which comprises the steps of continuously passing a direct current of known value and of high strength at various depths in the ground between a point in the borehole at the level of the formation to be investigated, and a point in the space comprising the borehole and the surrounding rocks; of measuring the potential difference between a point located in the borehole near the first point at which the current is supplied and a point in the space comprising the borehole and the surrounding rocks; and of deducing from the measurement and the value of the current the resistivity of the formation to be investigated, the current being of sufficiently high value for the potential difference produced by it between the points of measurement to be always large in comparison with the spontaneous potential difference existing between the said points. Claims allowed, 5.

4881. Device for distant firing of explosive charges; Marcel Schlumberger, Paris, France, assignor to Société de Prospection Électrique, Procédés Schlumberger, Paris, France, a corporation of France: U. S. patent 2,141,827, issued December 27, 1938.

In a device for successively firing a plurality of explosive charges at a distance through electrical means, a series of chambers each containing an explosive charge, a filament in each chamber surrounded by the explosive charge, the successive filaments being of a sensitiveness varying in the same direction from one filament to the next, means for connecting electrically the successive filaments in series, so as to form an electric circuit, and means for passing electric currents of progressively increasing intensities through the filaments. Claims allowed, 10.

4882. Arrangement for determining the orientation and value of dip of the beds traversed by a borehole; Marcel Schlumberger, Paris, France, assignor to Société de Prospection Électrique, Procédés Schlumberger, Paris, France, a corporation of France: U. S. patent 2,141,828, issued December 27, 1938.

This invention relates to apparatus for determining the orientation and value of the dip of the beds traversed by a borehole comprising a coring tool carrier, means for lowering the carrier into the borehole, a coring tool connected to the carrier, means for causing the coring tool to penetrate the rock surrounding the borehole, and means integral with the support for determining the orientation of the coring tool at the instant at which it is actuated to penetrate the rock. Claims allowed, 9.

4883. Automatic compensator for geophysical devices; Merle C. Bowsky and Arthur B. Winter, Los Angeles, California, assignor by mesne assignments to Lane-Wells Co., Los Angeles, California, a corporation of Delaware: U. S. patent 2,142,555, issued January 3, 1939.

The combination with means for generating an alternating electric field in a drill hole containing an electrically conductive liquid, means for indicating fluctuations in the relative value of the phase and amplitude of said field at different points in said hole, and a reversible motor controlling the last-mentioned means, of a motor control comprising: A pair of operating circuits adapted when closed to drive the motor in opposite directions; an electronic valve in each operating circuit; and a dual control circuit incorporating said electronic valve and normally maintaining a bias thereon whereby both of said operating circuits are held open, said control circuit incorporating means arranged to be actuated by fluctuations in said indicating means for removing the bias on either of said electronic valves and closing the corresponding operating circuit. Claims allowed, 16.

4884. Apparatus for determining gravity; Boliden's Gruvaktiebolag, a joint stock company registered and existing under the laws of Sweden, of 17, Västra Trädgardsgatan, Stockholm, Sweden: British patent 483,217, issued April 13, 1938.

This invention relates to an improved temperature-regulating mechanism for apparatus for determining gravity or variations in gravity with the aid of a movable body whose weight has been balanced by means of a spring mechanism or in some other way, characterized by the feature that the movable body with its suspension device is completely enclosed in a vessel having a high thermal capacity and formed of a material of high thermal conductivity, which vessel is in its turn completely enclosed in a vacuum flask. Between the inner vessel and the vacuum flask an electric heating device is arranged, preferably consisting of an electric resistance wound round the inner vessel, this device being regulated by an automatic temperature regulator intimately connected with the inner vessel. Claims allowed, 4.

4885. Gravity meter; Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij, of 30, Carel van Bylandtlaan, The Hague, Netherlands: British patent 489,689, issued August 2, 1938.

According to this invention in a measuring instrument for the determination of gravity acceleration, a spring, a hollow body suspended from said spring, liquid in said body, a liquid conduit connected to said body, and means whereby upon a change in the position of said body produced by a change in gravitational acceleration, a liquid flow alters the mass of said body increasing said initial change in position. Claims allowed, 7.

4886. Dispositif pour déterminer la perméabilité des terrains [Method for determining permeability of the ground]; Louis Georges Edouard Lefranc, residing in Tunis: French patent 825,443, issued March 3, 1938.

This invention relates to the method for determining the permeability of the ground. A cavity is made in the ground to be studied, an arrangement for conducting water into this cavity and a device for measuring the excess and the pressure of the water inside of the cavity. The cavity is limited by a perforated or very permeable wall, such as a flexible frame covered by trellis, metallic net, or gauze. A vertical tube connecting the cavity with the surface of the ground serves for conducting water to the cavity and for measuring the level of the water in the cavity by which the excess and the pressure of water can be established. Claims allowed, 5.

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