UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Bulletin 932-B

GEOPHYSICAL ABSTRACTS 105

APRIL–JUNE 1941

COMPILED BY

W. AYVAZOGLOU

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1942

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - - - Price 10 cents

CONTENTS

NOTE.—Geophysical Abstracts 1–86 were issued in mimeographed form by the Bureau of Mines; Abstracts 87–104 were published in bulletins of the Geological Survey.

GEOPHYSICAL ABSTRACTS 105, APRIL–JUNE 1941

Compiled by W. AYVAZOGLOU

1. GRAVITATIONAL METHODS

5993. Aerial, geological, and geophysical survey of northern Australia, Parliament of Commonwealth of Australia, 61 pp., 9 pls., L. F. Johnston, Commonwealth Government Printer, Canberra, 1940.

This is a report of the committee appointed to direct and control the aerial, geological, and geophysical survey of northern Australia for the period ended December 31, 1939 (for the previous report see Geophys. Abstracts 102, No. 5678). It describes the geophysical surveys in the Blair Athol coal field, Queensland, and in the Granite gold field, Northern Territory, where electrical, gravitational, and magnetic methods of prospecting were applied. Maps show the results of the surveys.—*W. A.*

5994. Corpaci, A., L'intensité de la pesanteur a la surface de la terre et la pendule gravimétrique Holweck-Lejay [Intensity of gravity on the surface of the earth and the Holweck-Lejay gravimetric pendulum]: Bucharest, math. et phys. Bull., vol. 10, No. 1/3, pp. 104–111, 1938–39.

A critical review is given of mathematical deductions made to the present time regarding the Holweck-Lejay pendulum. The alegbraic equation for the bending line is derived again. The differential equation of the movement of the elastic pendulum is calculated by introducing the center of either the gyration or the bending of the pendulum, and an integration is made.—*Schmerwitz's abstract in Physikal Ber., vol. 21, No. 22, 1940, translated by W. A.*

5995. Fischer, J. W., Limiting values of gravitational and magnetic anomalies due to a subterranean structure bounded by a single differential surface: Geophysics, vol. 6, No. 1, pp. 1–12, Menasha, Wis., 1941.

Calculations are made of gravitational and magnetic anomalies supposed to be due to local variations in the form of a single differential surface separating an overlying rock from an underlying one, the effective thickness of the latter being infinite. Both layers are homogeneous in density and magnetic susceptibility, and only those magnetic effects are considered which are due to induction in the earth's magnetic field. The maximum possible values of these anomalies and of their first and second horizontal derivatives are calculated under these simplified conditions, and it is pointed out that the numerical readings of these quantities, provided by survey results, may lead to useful estimates of the extreme depth and proportions of the structure responsible.—*Author's abstract.*

5996. Fotiadi, E. E., Some new data concerning the structure of the Volga-Emba oil-bearing region [in Russian]: Vostochnaia Neft, vol. 2, No. 9, pp. 21–26, Moscow, 1940.

An area of more than 200,000 sq. km. in the Volga-Emba oil-bearing region—the so-called near-Caspian depression—which was briefly described in a previous article (see Geophys. Abstracts 93, No. 4271), has been reinvestigated. Most of the salt domes of this region are associated with oil and gas deposits; and most of the region presents negative gravity anomalies. Local zones of relative maxima and minima of gravitation were established. According to data derived from pendulum determinations and from variometer surveys, the region is divided into a series of independent zones of gravitational anomalies. Schematic maps show the distribution of these anomalies, as well as of local anomalies, the latter of special interest in prospecting for oil.—*W. A.*

5997. Kohlschütter, E., Bemerkungen zu der Abhandlung "Die hydrostatische Reduktion der Schwerebeobachtungen," von Kurt Wegener [Remarks on Kurt Wegener's paper "Hydrostatic reduction of gravity observations"] Zeitschr. Geophysik, vol. 16, No. 5/6, pp. 233–244, Brunswick, 1940.

The writer calls attention to a series of errors in Wegener's paper entitled "Hydrostatic reduction of gravity observations" (see Geophys. Abstracts 104, No. 5888). He proves the untenability of the formula derived from this hydrostatic reduction and derives a formula for it by considering fully the convergence of the directions of the plummet.—*Author's abstract, translated by W. A.*

This article is followed by two other articles, (1) "Answer to Kohlschütter's remarks," by Kurt Wegener, and (2) "Reply to Wegener's answer," by E. Kohlschütter, in which the writers defend their points of view.—*W. A.*

5998. Kumagai, Naoiti, Studies in the distribution of gravity anomalies in northeastern Honsyū and the central part of the Nippon trench, Japan: Japanese Jour. Astronomy and Geophysics, Trans., vol. 17, No. 3, pp. 477–553, Tokyo, 1940.

The relief of land and sea bottom and also the distribution of free-air anomalies on sea and of Bouguer anomalies on land are treated as if in two dimensions, the curvature of the earth's surface being neglected. Based upon Pratt's hypothesis of isostasy, isostatic reductions are made for various depths of compensation, and the most probable depth is obtained. The isostatic gravity anomalies obtained for the most probable depth are very large; that is, the isostatic equilibrium is greatly disturbed—below the total areas of land and sea, the departure from a complete compensation with its signs disregarded is, on an average, in the neighborhood of 100 percent of the computed anomaly. These isostatic gravity anomalies are closely related to certain geologic facts, from which the anomalies are interpreted as the resultant effects of the deficient density of the sedimentary formations and the excessive densities of the batholith and the hidden batholith (cryptobatholith), both of which underlie the sedimentary formations. The vertical thicknesses of the formations and the depth to the bottom of the batholith below sea level are obtained from the distribution of the anomalies. What is remarkable is that strips of positive and

negative isostatic gravity anomalies, which are contiguous with one another, coincide with the zones in which earthquakes are very frequent; whence it would appear that the cause of these earthquakes is closely related to isostatic adjustment. It is also noticed that the isostatic anomaly field of gravity dealt with in this paper is markedly similar on various points to that found by Prof. F. A. Vening-Meinesz for the area comprising Java-Sumatra and the Java trench.

An isostatic reduction by Airy's hypothesis of isostasy, which is now in progress, will be published in the near future.—*Author's abstract.*

5999. Marcantoni, A., Sulla individuazione di una massa sotterranea isolata mediante misure con la bilancia di torsione di Eötvös [On the characteristics of an isolated subterranean mass as determined by Eötvös' torsion-balance measurements]: Riv. geomineraria, geologia e geofisica applicata, vol. 2, No. 1, pp. 37–39, Milan, 1941.

The author discusses mathematically a formula for the relation between gradients and Eötvös' curvature of an anomalous spherical body. He shows that the formula expresses analytically that, in this case, the curvature is either parallel or perpendicular to the gradient. He draws some conclusions for practical use.—*Author's abstract, condensed by W. A.*

6000. Mikhailov, N., Application of masses of the simplest geometric forms to geologic interpretation of gravitational observations [in Ukrainian]: Acad. sci. Ukrainian S. S. R., Jour. Geology, vol. 7, No. 1/2, pp. 181–234, Kiev, 1940.

The author describes a method of geologic interpretation of gravitational observations for a complex field under the assumption that every single object producing the disturbance may be represented by one of the following simple bodies: Bodies having zero measurements, a material point, and an infinite horizontal bar; one-dimensional bodies of infinite extent composed of parts of a material plane; and two-dimensional bodies of infinite extent. He uses values of gradients and curvatures for determining the elements of the body producing the disturbance. He discusses mathematically some examples.—*W. A.*

6001. Pepper, T. B., The Gulf underwater gravimeter: Geophysics, vol. 6, No. 1, pp. 34–44, Menasha, Wis., 1941.

A brief description of the Gulf underwater gravimeter is presented showing the salient design features whereby a regular Gulf gravimeter is incorporated in a device permitting precision gravity measurements in coastal waters several hundred feet in depth. The instrument is adapted to be lowered to the bottom on a cable, and through remote-control devices all necessary adjustments are made from the surface. The reading is obtained photographically on a continuously moving film, which permits accurate observations even when moderate seismic disturbances cause oscillation of the index point.—*Author's abstract.*

6002. Sanchez, P. C., La isostasia y las convulsiones terrestres [Isostasy and terrestrial undulations]: Acad. nac. cien. "Antonio Alzate," mem. y rev., vol. 55, Nos. 1–3, pp. 61–82, Mexico, 1940.

The writer discusses the importance of gravimetric observations for determining anomalies, methods of obtaining values of the intensity of gravity, and modern apparatus used in determining gravity.—*W. A.*

6003. Tsuboi, Chuji, Relation between gravity anomalies and the corresponding subterranean mass distribution, part 5, Isostatic anomalies and the undulation of the isostatic geoid in the United States of America: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 18, No. 3, pp. 384–400, 1940.

In a previous paper (see Geophys. Abstracts 100, No. 5311) the author discussed the geographical distribution of the Bouguer gravity anomalies observed in the United States of America, with particular reference to isostatic conditions of the earth's crust in that part of the world, and he proposed the double Fourier series method to reduce the labor of numerical computation. In this paper he uses the same method in computing the geographical distribution of the isostatic anomalies in the United States as well as the undulation of the isostatic geoid. He tries to obtain a connection between gravity anomalies and deflections of the vertical. According to Stokes, the undulation of the geoid, and consequently the deflections of the vertical, could be derived from the isostatic anomalies if the gravity anomalies were known for the whole earth. Unfortunately Stokes' method could not be applied because of the insufficient number of gravimetric points in the world and because no successful results could be obtained to connect gravity anomalies with observed deflections of the vertical.—*W. A.*

6004. von Thyssen, Stephan, Drehwaageregistrierungen unter gleichzeitiger Einwirkung elastischer Wellen [Torsion-balance records affected by elastic waves occurring at the same time]: Zeitschr. Geophysik, vol. 16, No. 5/6, pp. 210–213, Brunswick, 1940.

The writer determines empirically the working of a torsion balance affected by oscillations that have a frequency near the natural oscillation of the ground. He imposed elastic waves of 20 cycles per second on a torsion balance and observed the effect produced on the records. He describes the arrangement of the experiment and gives diagrams of the records. He concludes that regular oscillations of the ground may affect the records mainly with regard to the horizontal component, especially if the shocks or oscillations are interrupted and then suddenly resumed again.—*W. A.*

6005. Welch, G. J., A Galitzin-type gravity meter: Rev. Sci. Instruments, vol. 12, No. 4, pp. 179–182, Lancaster, Pa., 1941.

The writer outlines the general requirements involved in the design of a gravity meter and discusses the construction of a gravity meter developed by himself. He mentions the following main characteristics of the instrument: (1) The instrument will operate stably with a period of more than 30 seconds; (2) the error due to tilt does not exceed 1/10 milligal if the level error does not exceed 100 seconds; (3) data obtained by means of a pair of Helmholtz coils showed that ordinary changes of the vertical component of the earth's magnetic field will not produce any significant effect on the reading of the instruments; and (4) the probable error of a single reading of the instrument when used in the field is 0.06 milligal.—*W. A.*

6006. Wyckoff, R. D., The Gulf gravimeter: Geophysics, vol. 6, No. 1, pp. 13–33, Menasha, Wis., 1941.

Design features of the Gulf gravimeter (see Geophys. Abstracts 96, No. 4867) are presented, accompanied by a brief discussion of general

gravimeter design problems. In addition to the description of the unastatized instrument, which is the type finally selected for commercial development, brief consideration is given to two astatized instruments including a bifilar gravimeter the construction of which was carried to completion.—*Author's abstract.*

2. MAGNETIC METHODS

Aerial, geological, and geophysical survey of northern Australia, Parliament of Commonwealth of Australia. *See* Geophys. Abstract 5993.

6007. Brant, Arthur, Geophysical work at Steeprock Lake, 1938–39: Ontario Dept. of Mines 48th Ann. Rept., vol. 48, pt. 2, 1939, pp. 48–50, Toronto, 1940.

The writer describes the geophysical work of a surveying party of the Ontario Department of Mines under M. W. Bartley (see abstract 6060), which helped to determine the structure and to trace beneath overburden of certain of the rock types encountered. He briefly describes the results of the magnetic and electrical work and draws the following conclusions: "(1) It is apparent that where suitable differences in electrical properties exist, rock formations beneath lakes may be delineated by electrical resistance measurements. Waters of most lakes, owing to dissolved sulfides, carbonates, etc., will be sufficiently conducting to carry the currents well down into the underlying rock materials as desired; (2) from the magnetic work it is apparent that limestone-lava contacts, for example, can be traced and faults indicated if they are marked by less magnetic, leached, gouge material; (3) when the magnetic rock formations are roughly rectangular in cross section approximate calculations of their dip and depth below the surface may be made from a vertical-intensity profile curve."—*W. A.*

6008. Bronstein, K. G., Comparison of the petrographic composition of crystalline rocks with their magnetism [in Ukrainian]: Acad. sci. Ukrainian S. S. R., Jour. Geology, vol. 7, No. 1/2, pp. 167–178, Kiev, 1940.

In using magnetic maps for geological purposes many difficulties are encountered because the magnetic properties of rocks have been insufficiently studied and because they change greatly. Up to the present most authors have connected the rise and fall of magnetic power with the change in the depth of deposition of crystalline foundation. This thesis is, however, refuted by the example of the Ukrainian Socialist Soviet Republic, where we observe continuous belts of positive and negative magnetic anomalies in those areas where the crystalline rocks crop out on the surface, as well as in those places where they are found at a great depth. It would therefore be correct to compare the change in magnetic force with the change in the petrographic composition of the crystalline rocks. However, even here the problem is not sufficiently clear, as there are among the iron-bearing minerals both strongly ferromagnetic as well as paramagnetic ones. The chief bearer of the magnetic properties of rocks is magnetite, Fe_3O_4; it would therefore be more correct to compare the magnetism of the rocks with their magnetite content. However, magnetite is not a mineral determined quantitatively; chemical analyses give ordinarily the contents of FeO and Fe_2O_3. Proceeding from the fact that FeO is nonmagnetic, the

author attempts to compare the magnetism with the FeO and Fe_2O_3 contents by means of the equation:

$$K=\frac{Fe_2O_3}{FeO}(Fe_2O_3+FeO),$$

where Fe_2O_3 and FeO are respectively the percentages of the two oxides in the rock. We thus correct their ratio to the total iron content of the mineral. A good agreement is obtained in this way between the magnetism and the composition of the rocks. This relationship is applicable to those igneous rocks where one does not expect an accumulation of a large amount of ferric oxide by the oxidation of ferrous oxide. If the specimens have been subjected to weathering, the quantity of ferric oxide is increased, and the coefficient has an increased value and cannot be used.

It has been shown in many instances that by means of this relationship the connection between the magnetism and the petrographic composition of the rocks is fairly consistent, which furnishes grounds for recommending it with the limitations mentioned in the article.—*Author's English abstract.*

6009. Burger, A., Potsdamer erdmagnetische Kennziffern [Potsdam's magnetic index numbers]: Zeitschr. Geophysik, vol. 16, No. 5/6, pp. 247–249, Brunswick, 1940.

This is a continuation of the series of magnetic index numbers at Potsdam (see Geophys. Abstracts 103, No. 5760). Tables give the numbers for the months from May to September 1940.—*W. A.*

6010. Chapman, S., Notes on isomagnetic charts, part 3, The isogonic and *X*- and *Y*-charts for the centered dipole field: Terres. Magn. and Atmos. Electr., vol. 46, No. 1, pp. 7–14, Baltimore, Md., 1941.

Various forms of the equations of the isogonic lines are derived for the field of the centered magnetic dipole. The isogonic chart for this field is shown to have two singular points in addition to the four uniform ray poles (one at each magnetic or geographic pole); these singular points, which are situated at the intersections of the magnetic and geographic equators, are rectangular nodes. The equation and form of the nodal curves are discussed. The area over which the magnetic declination exceeds the obliquity of the magnetic axis is also considered; it is shown to cover more than a third of the whole area of the sphere, however small the obliquity may be. The *Y*- and *X*-isomagnetic charts are also briefly considered; the former has only two singular points, namely nonuniform ray poles at the geographic poles; these are also nonuniform ray poles of the *X*-chart, which in addition has two nodes at the same points as those of the *D*-chart; but in the case of *X* these nodes are not rectangular.—*Author's abstract.*

6011. Chapman, S., Notes on isomagnetic charts, part 4, Geomagnetic dip poles, their nature and that of the isomagnetic lines in their neighborhood: Terres. Magn. and Atmos. Electr., vol. 46, No. 1, pp. 15–26, Baltimore, Md., 1941.

Geomagnetic dip poles are singular points (on the terrestrial surface) of the magnetic equipotential lines, and vice versa. The dip poles of a uniformly magnetized sphere have many special properties not in general characteristic of dip poles. The principal geomagnetic dip poles are defined as the principal maximum and minimum of the sur-

face magnetic potential; the equipotential lines surrounding them are elliptic, not circular. The nature of the magnetic meridians and the isomagnetic lines for V, I, H, F, and Z near a dip pole is examined; dip poles are in general ordinary points as regards F and Z; for H they are principal minimum foci of a special conical type, and for I they are principal maxima of conical type. Dip poles are in general not isogonic ray poles. The isomagnetic lines near special types of dip poles are considered.—*Author's abstract.*

6012. Chapman, S., and Ferraro, V. C. A., The geomagnetic ring current, part 1, Its radial stability: Terres. Magn. and Atmos. Electr., vol. 46, No. 1, pp. 1–6, Baltimore, Md., 1941.

There are reasons for supposing that the world-wide average decrease in the earth's horizontal magnetic force during magnetic storms is due partly to a ring of neutral ionized gas surrounding the earth in the diametral plane normal to the geomagnetic axis, the radius of the ring being a small multiple of that of the earth. The ions travel westward and are followed by the electrons at a somewhat lower speed, so that an electric current flows westward round the ring. The stability of such a ring for variations of its radius about a mean equilibrium value is considered by the examination of an analogous "cylindrical" problem; the ring is replaced by a cylindrical current-sheet, in a unidirectional magnetic field parallel to the axis of the cylinder, the intensity of the field decreasing, like that of the earth's field, as the inverse cube of the distance. It is shown that the sheet is not stable for radial oscillations unless the intensity of the magnetic field which it produces, within the cylinder, is less than two-thirds the intensity of the permanent field at the cylindrical sheet itself. It seems likely that this conclusion is applicable also to the geomagnetic ring current, possibly with a moderate change in the factor 2/3. The period of the radial oscillations of a stable sheet is also considered, and it is suggested that similar oscillations of the geomagnetic ring current may account for some of the world-wide fluctuations of the earth's field during magnetic storms.—*Authors' abstract.*

6013. Egedal, J., and Bossolasco, Mario, The lunar-diurnal variation of the horizontal and vertical magnetic forces at the polar-year station Mogadiscio: Terres. Magn. and Atmos. Electr., vol. 46, No. 1, pp. 59–60, Baltimore, Md., 1941.

The writers have already published an article on the lunar-diurnal variation of the magnetic declination at Mogadiscio (see Geophys. Abstracts 91, No. 3951). In the present article they give the main results of a derivation of the lunar-diurnal variation of the horizontal and vertical forces at the same place. They obtained their data at the polar-year station Mogadiscio during the period from August 1932 to July 1933.—*W. A.*

6014. Hoyer, Max, Geophysical instruments—The magnetometer: Louisiana Cons. Rev., vol. 9, No. 4, winter 1940–41, pp. 47–51, New Orleans.

The writer describes briefly the development and application of horizontal and vertical magnetometers, and he gives typical maps of magnetic surveys.—*W. A.*

6015. Ivashchenko, V. N., Application of a detailed micromagnetic survey in prospecting for quartz veins [in Russian]: Razvedka Nedr, vol. 10, No. 8, pp. 32–34, Moscow, 1940.

The writer describes a successful application of a micromagnetic survey in prospecting for quartz veins in the region of Aldan (Yakutsk Province, in eastern Siberia). The connection between two known quartz veins could be established by narrowing the distance between the profiles to 1 m. if the survey with profiles of 10 m. between one another failed to give any result.—*W. A.*

6016. Johnson, W. R., Jr., and Straley, H. W., Geophysical tracing of pegmatite dikes: Pan-Am. Geologist, vol. 75, No. 3, pp. 161–165, Des Moines, Iowa, 1941.

In October 1934 the writers discovered small pegmatite dikes on the border between Franklin and Granville Counties, N. C. In 1935 they began a geomagnetic survey in which they used Askania vertical field balances of the Schmidt type, and which they continued during 1936 and 1937. As the magnetic contrast between pegmatitic granite and quartzose granite appears to be very slight, the writers could not obtain satisfactory results with magnetic methods; but in the southeast of the area, where they checked the magnetic methods by geologic observation, they considered that the accuracy of the magnetic work was satisfactory. They made earth-resistivity profiles by using the four-electrode porous-pot method, and they show that two of the electrical profiles are transverse to the general trend of the intrusion. They established boundaries at 1,300 and 5,000 feet by the decided difference in resistivity over the pegmatite and over the surrounding schist and granite. They think that electrical methods are reliable in areas in which the surrounding rocks are more resistant to water saturation than the pegmatitic zones at depths of a few tens of feet beneath the surface, but they doubt whether the methods can be applied under other conditions. They illustrate the article with six figures.—*W. A.*

6017. Johnston, H. F., and Heck, N. H., Geomagnetic 3-hour-range indices for the years 1937 and 1940: Terres. Magn. and Atmos. Electr., vol. 46, No. 1, pp. 95–117, Baltimore, Md., 1941.

Tabulations are given of 3-hour-range indices for five magnetic observatories for 1937 and for seven observatories for 1940, of the weighted average of reduced 3-hour-indices, and of daily indices derived from the weighted reduced indices. Graphs show the relation of the sums of weighted reduced indices with the American magnetic character-figure C_A and with the international magnetic character-figure *C.—Authors' abstract, condensed by W. A.*

6018. Orkisz, Henryk, Evaluating the relative magnetic measurements of the vertical component for very weak anomalies [in Polish]: Univ. Lwów Inst. Geophysics Comm., vol. 10, No. 127, pp. 80–92, 1939.

The author discusses a method by which a small area of about 6 sq. km. with a range of 30 γ in the vertical component may be investigated magnetically. He used a Schmidt vertical field balance to determine the structure of the area, and he states that the accuracy of measurement was 1 to 2 gammas. He draws the following conclusions from the analyses of the profiles: (1) Special significance must be attached to anomalies of small values; (2) profile curves must be compensated, and a method for their compensation is proposed; (3) to determine details of the structure, each evaluation must result in a profile with great distances of measurement, to which profiles at

small distances are added; (4) special significance must be attributed to the points of intersection of different profiles.—*A. Burger's German abstract in Physikal. Ber., vol. 21, No. 19, 1940, translated by W. A.*

6019. Patterson, W. D., New magnetic observatory at Sitka, Alaska: Terres. Magn. and Atmos. Electr., vol. 46, No. 1, pp. 87–94, Baltimore, Md., 1941.

The Sitka Magnetic Observatory, which was established by the United States Coast and Geodetic Survey in 1901, was placed in operation on January 1, 1902. A more suitable site was selected in 1938, and on this site a new observatory was completed in January 1940. A map shows the locations of the old and new Sitka magnetic observatories, the latter including the following seven buildings: (1) Variation building, (2) absolute building, (3) temporary variation building, (4) seismograph vault, (5) garage, (6) assistant observer's quarters, and (7) observer's quarters, with an office wing and a dark room in the basement.—*W. A.*

6020. Shaxby, J. H., Device for increasing the sensitivity of magnetic variometers: Jour. Sci. Instr., vol. 17, No. 11, pp. 257–259, London, November 1940.

A magnet auxiliary device is described, by means of which the gravitational controlling couple of a magnetic variometer is opposed by a weaker deflecting couple. The net restoring moment is thus diminished and sensitivity to variations in the earth's magnetic field correspondingly increased. This increase may be fivefold or sixfold in the field, greater at a base station. No opening of the instrument is involved, the device being simply clipped to the outer case when required. Its removal leaves the variometer with its former sensitivity. It is shown that change of temperature causes no appreciable error.—*Author's abstract.*

6021. Vestine, E. H., On the analysis of surface magnetic fields by integrals, part 1: Terres. Magn. and Atmos. Electr., vol. 46, No. 1, pp. 27–41, Baltimore, Md., 1941.

This paper forms part 1 of a series presenting a very general method of analyzing surface geomagnetic fields by means of surface integrals. In geophysical applications the method is free from some of the limitations common to spherical harmonic analysis. A practical means is afforded for separating a magnetic field observed over a closed regular surface into parts originating inside and outside the surface. Relations between the potential and its space derivatives in the immediate neighborhood of a closed surface are developed, especially for spherical and plane surfaces. The method of surface integrals may be used for complicated magnetic fields, such as those of magnetic storms, and in magnetic geophysical prospecting. It is naturally adapted to numerical and possibly machine procedures. The calculation of the field and current systems in regions of free space adjacent to a closed surface is considered in part 2 (to appear subsequently), along with certain applications of the method in part 3.—*Author's abstract.*

6022. Wienert, Karl, Fehleruntersuchungen an erdmagnetischen Feldwaagen [Investigation of errors in earth-magnetic field balances]: Archiv Deutschen Seewarte, vol. 59, No. 1, 29 pp., Berlin, 1939.

On the basis of his own observations and of the great amount of material collected by other observers, the author determined the values

of the following kinds of errors in earth-magnetic field balances: Those depending on (1) the determination of the value by the observer, (2) the adjustment of the instrument, (3) the inherent errors, and (4) the temperature. The maximum error in (1) is 0.2 pars, the mean error being equal to 0.1 pars. The error in (2) depends on the variations of the vertical distance of the center of gravity from the point of rotation as well as on the determination of the value by the observer. The values of both these errors may in practice be considered constant. Inherent errors (3) are those connected with the accuracy of the scale value (± 0.5%) and with the accuracy of the coil constant (±1%) in galvanic determinations. The behavior of the balance during changes of temperature (4) depends on heat processes within the instrument. Nonlinear reduction can hardly be made because the temperature gradient cannot be determined with sufficient accuracy during the field measurements. The author therefore recommends thermometers that have a corresponding lag. Errors also occur during the unlocking of the instrument, as a result of the relation of the knife edge to the bearing, and in accordance with the scale value.—*A. Burger's abstract in Physikal Ber., vol. 21, No. 16, 1940, translated by W. A.*

6023. Wuerker, R. G., Some observations of the vertical intensity of the earth's magnetic field in the Antipolo district (Rizal Province): Univ. Philippines, Nat. and Applied Sci. Bull., vol. 8, No. 1, pp. 1–28, Manila, 1940.

The object of the survey in the Antipolo district was to teach students of the course in advanced geophysics at the University of the Philippines how to handle the magnetometer in the field and how to gain information on the magnetic properties of formations common in the Philippine Islands. The Schmidt field balance was used. The readings taken in the field were tabulated, together with the corrections and results of computation. The magnetic differences of the geologic formations are shown clearly from the observations. The chief results are summarized as follows: (1) In quarrying of basalt, partings in good jointed basalt can be traced easily; (2) contact zones can be located easily; and (3) the gravity high discovered by Lejay at Antipolo can be interpreted as a basalt plug connected with the local basalt flows.—*W. A.*

3. SEISMIC METHODS

6024. Bancroft, Dennison, The velocity of longitudinal waves in cylindrical bars: Phys. Rev., vol. 59, No. 7, pp. 588–593, Lancaster, Pa., 1941.

The velocity of longitudinal waves in cylindrical bars may be expressed as the velocity at infinite wave length times a function of two variables—Poisson's ratio and the ratio of the diameter of the bar to the wave length. This function is computed over the domain of the arguments, which is of physical interest. Asymptotic values for the velocities at very short wave lengths are deduced, and the variation of the displacement as a function of the radius is discussed. It is found that a similar analysis can be applied to torsional and flexural waves.—*Author's abstract.*

6025. Beers, R. F., Resolution control in seismic surveys: Geophysics, vol. 6, No. 1, pp. 52–63, Menasha, Wis., 1941.

Development of the concept of velocity stratification by experimental means has revealed the origin of certain reflection horizons. Correla-

tion of these data with subsurface lithology suggests a method of attack, employing seismic means, on the problem of the stratigraphic trap. This paper outlines the problem and describes a method whereby stratigraphic relationships may be measured. It is suggested that a seismic wave may be fitted to the task by altering its wave length in accordance with the degree of resolution desired. Experimental examples of the procedure are given.—*Author's abstract.*

6026. De Lisle, J. F., On the epicenter of the North Pacific earthquake of November 10, 1938: New Zealand Jour. Sci. Technology, vol. 21, No. 1b, pp. 47b–49b, Wellington, 1940.

A careful investigation is made of the *P* residuals of the North Pacific earthquake of November 10, 1938, taking into account ellipticity corrections. It is shown that the epicenter as assumed by the Jesuit Seismological Association—viz., 55.6° N., 157.7° W.—is subject to an uncertainty probably not exceeding 0.3° in east-west and 0.1° in north-south direction, while the origin time of 20 hr. 18 min. 48 sec. G. M. T. probably needs a correction of —3 sec. This estimation is important on account of the value of the earthquake in the problem of the Pacific crustal structure.—*Author's abstract.*

6027. Earthquakes in New Zealand: Dominion Observatory, Bull. S. 56, 8 pp., Wellington, 1940.

The first section of this article, which was prepared by J. T. Henderson, Director of the Geological Survey of New Zealand, deals with geologic factors in New Zealand. The remaining sections were written by R. C. Hayes and contain the following discussions about New Zealand: (1) Seismicity, (2) deaths due to earthquakes, (3) investigation of earthquakes, and (4) earthquakes in 1938. Some particulars of the chief New Zealand earthquakes in 1938 are tabulated.—*W. A.*

6028. Finsen, W. S., and Wood, H. E., Witwatersrand local tremors: Nature, vol. 145, No. 3672, pp. 428–429, London, 1940.

In his article The Earthquake in Turkey (see Nature, vol. 145, January 6, 1940) Tillotson refers to the idea that violent earthquake shocks appear to be followed almost immediately by sympathetic shocks in various parts of the world. He points out that on the same day in which the earthquake occured in Turkey—December 27, 1939—25 earthquakes and earth tremors shook the gold-mining district of the Rand near Johannesburg, South Africa. The authors of this article disagree with Tillotson, for detailed investigations have proved that the primary cause of the tremors in the Witwatersrand region is its local instability which is due to mining operations. During 1939, 2,927 local tremors were recorded. The tremors, which apparently have a tendency to occur in groups, came in a group on December 27–28 and should not be considered as having any bearing on the question of sympathetic earthquakes.—*W. A.*

6029. Gutenberg, Beno, The structure of the Pacific Basin as indicated by earthquakes: Science, vol. 90, No. 2342, pp. 456–458, Lancaster, Pa., 1939.

The writer outlines the boundary to the true Pacific Basin by many earthquake epicenters. He gives some reasons for the tendency of the ground to move in this basin and describes briefly the earthquakes in it. Considering that there is no reason why the earthquakes around the Pacific belt should cease, he recommends that all work of construction in this belt should be made "earthquake proof."—*W. A.*

6030. Huang Si-Tang, Bestimmung der Geschwindigkeit, Dämpfung und Absorption von Kompressions und Scherwellen in Kautschuk [Determination of the velocity, damping, and absorption of compressional and shear waves in caoutchouc]: Zeitschr. Geophysik, vol. 16, No. 5/6, pp. 213–233, Brunswick, 1940.

The measured values of Young's modulus E, obtained by the statical-extension and dynamical-extension methods, differed from those that were obtained by direct measurements of the velocity. To find the reason for this difference, the author made a statical bending experiment for determining E, in which he obtained two values of E. One value answered to that obtained by the statical method and the other to that of the dynamical method. Velocities of the torsional waves obtained by five methods agreed well not only with one another but also with the measurements made by Ishimoto and Iida. The writer measured absorption K and damping β. Within the range of measurements and the accuracy of measurements he obtained: $K\lambda=\beta T$ or $v=\frac{\beta}{K}$, in which λ=length of the wave and T=period.—*Author's abstract, translated by W. A.*

6031. Kanai, Kiyoshi, and Sezawa, Katsutada, Effect of distribution of masses in a Rahmen floor on seismic structural vibration, and model experimental confirmations of that effect with a new vibration table: Tokyo Imp. Univ., Earthquake Research Inst., Bul., vol. 18, No. 3, pp. 370–383, 1940.

The writers attempt to ascertain mathematically the effect of differences in the distribution of masses in a floor of a Rahmen (frame) structure on seismic vibrations of the structure, with experimental confirmation of that effect by means of a model. They describe a new vibration table of their design and the results of its use in their investigations, including the solution of the present problem.—*W. A.*

6032. Kishinouye, Fuyuhiko, The unusually large microseisms of October 21, 1938, at Hongo, Tokyo: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 18, No. 3, pp. 401–418, 1940.

By recording microseisms simultaneously at two or three stations, German seismologists (Krug, see Geophys. Abstracts 93, No. 4326, and Trommsdorff, see Geophys. Abstracts 100, No. 5372) concluded that they are a combination of two progressive waves that are propagated in different directions, and, by supposing that they have succeeded in identifying certain phases of them at these stations, have deduced the propagating velocity of microseisms; but it is doubtful if their results explain the simultaneous existence of vibrations of 4 sec. and 6 sec. It is difficult to explain the facts described in this article with the aid of the hypothesis of German seismologists. On the other hand, the microseisms of Hongo are so large in amplitude that it is doubtful whether they are generated by the same causes as in Europe. The writer, who still holds to the opinion that microseisms are combinations of two stationary waves excited by oceanic waves in some manner yet unknown, intends, in order to answer the above questions, to continue his investigations by recording microseisms at a number of places simultaneously.—*Author's abstract.*

6033. McMurry, Howard, Periodicity in deep-focus earthquakes: Seismol. Soc. America Bull., vol. 31, No. 1, pp. 33–82, Berkeley, Calif., 1941.

Data were assembled for about 320 earthquakes, including nearly all those available for which determinations of epicentral location, time of occurrence, and focal depth were considered reliable. They were analyzed collectively and in selected geographical 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. None of the results could be interpreted as other than accidental. However, the Japanese group gave a slight indication of a correlation with twice the solar-hour angle, and the South American earthquakes with twice the lunar-hour angle. Many additional data must first be accumulated and tested before any special significance can be attached to these results. The manner whereby small fluctuations in stress might be expected to determine the exact time of occurrence of an earthquake was reviewed. A study was then made of three possible sources of trigger stresses which could be effective at great depth, namely, tidal stresses in the solid earth, stresses due to changes in sea level, and stresses due to variations in barometric pressure. Tidal stresses alone were considered in detail. It was concluded that tidal-stress variations approximate harmonic changes sufficiently well to warrant a search for lunar-hour-angle correlations by the method of periodogram analysis, but they are nevertheless too irregular to make the statistical results of such studies valuable in supplying information concerning the mechanics and environment of deep-seated earthquakes. Periodicity investigations of this type, even if successful, can be expected to do little more than indicate the causes which can influence earthquake occurrence times. The importance of other agencies in causing stress variations within the earth was studied. It was concluded that oceanic tidal loads, and to a much less degree erratic barometric fluctuations, are capable of producing stress changes comparable with those due to tides in the earth. The stresses from the earth tides in general dominate the others, although the effect of ocean tidal loading may be of primary importance under special circumstances. The irregularity of both ocean loads and barometric-pressure fluctuations renders them unsuitable subjects for study. For the reasons given, the only stress changes that appear to warrant study with reference to their effect in earthquakes are those due to earth tides. The best chance of finding a definite correlation would be from a study of data of a large number of earthquakes which had occurred within relatively small regions, as only then it is justifiable to assume that all the earthquakes had been similarly affected by the triggering stress. Data at present available are far from sufficient to provide a satisfactory basis for such a study.—*Author's summary and conclusions.*

6034. Parejas, E., and Pamir, H. N., Le tremblement de terre du 19 Avril, 1938, en Anatolie centrale [Earthquake of April 19, 1938, in central Anatolia]: Univ. Istanbul Fac. sci., Rev., vol. 4, No. 3/4, pp. 183–193, 1939.

A commission of the University of Istanbul investigated the earthquake of April 19, 1938, in central Anatolia, the shocks of which were felt from April 19 to about May 4. The writers discuss the phenomena of movements of the surface of the earth as applied to geologic and

water conditions. They interpret the isoseismal map and suggest that the cause of the earthquake was connected with the known geologic conditions of the surface without considering the depth of the focus.—*Schmerwitz's abstract in Physikal. Ber., vol. 21, No. 16, 1940, translated by W. A.*

6035. Peterson, R. A., A transformed wave-front chart: Geophysics, vol. 6, No. 1, pp. 74–80, Menasha, Wis., 1941.

In seismograph computations, assuming a uniform rate of velocity increase with depth, a "wave-front wave-path" chart consisting of sets of orthogonal circles is often used. The present paper describes a transformation by which the wave fronts become a set of concentric circles with the wave paths as radii, while the Cartesian coordinates representing vertical and horizontal distances in the ground become orthogonal circles.—*Author's abstract.*

6036. Sezawa, Katsutada, and Kanai, Kiyoshi, Dynamical absorption of the energy of Rayleigh waves and Love waves by weak surface layers: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 18, No. 3, pp. 345–357, 1940.

It was ascertained mathematically that a weak or dense surface layer serves as a dynamic damper to Rayleigh waves and Love waves transmitted along that layer. The attenuation coefficient of any surface wave, if the surface layer is viscous, is much greater than that where the subjacent layer is viscous. If the surface layer is viscous and the subjacent layer is nonviscid, the attenuation coefficient is maximum for an intermediate thickness of layer, but if the surface layer is nonviscid and the subjacent layer is viscous, the same coefficient is maximum for an intermediate wave length. This condition arises from the fact that a resonancelike feature exists in the transmission of the wave for an intermediate wave length or for an intermediate layer thickness. In Rayleigh waves particularly the attenuation coefficient of those waves of the second kind vanishes at such wave length as that in which the waves change from surface type to nonsurface type. The present investigation shows that, with increase in epicentral distance, seismic surface waves transmitted through a region covered with fairly thick loam would be damped to a certain extent, whereas the same waves transmitted through a rocky surface would scarcely be damped even should the amplitudes of the waves on such surface be originally rather small. Another problem of practical importance is how to avoid the seismic disturbances due to the working of machinery and to surface traffic. As these disturbances are almost surface waves (as shown by many authors) the best way to avoid them would be to cover the ground surrounding their source with a weak soil layer of certain thickness.—*Authors' abstract.*

6037. Ulrich, F. P., The Imperial Valley earthquakes of 1940: Seismol. Soc. America Bull., vol. 31, No. 1, pp. 13–31, Berkeley, Calif., 1941.

The Imperial Valley is one of the most active seismic regions in the United States. The writer summarizes in three tables the results of his investigations: (1) Principal earthquake shocks in the Imperial Valley prior to May 1940, (2) earthquake shocks felt in the Imperial Valley in May 1940, and (3) strong-motion seismograph records obtained in the series of earthquakes in May 1940. Photographs show some of the damage caused by the earthquakes.—*W. A.*

6038. Waters, K. H., A numerical method of computing dip data, using well-velocity information: Geophysics, vol. 6, No. 1, pp. 64–73, Menasha, Wis., 1941.

A method of computation for calculating steeply dipping strata is presented. It takes full advantage of the velocity information afforded by well shooting and is simple in application. Charts are derived from the velocity data, which will give depth and position of the reflecting point together with angle of dip and azimuth of dip immediately from the time and differential time of a reflection taken from a seismic record.—*Author's abstract.*

6039. West, S. S., The effect of density on seismic reflections: Geophysics, vol. 6, No. 1, pp. 45–51, Menasha, Wis., 1941.

By means of existing data on the density of rocks, it is shown that reflection coefficients of seismic waves, calculated from velocities alone, often differ greatly from the actual values. Data on a larger number of density discontinuities have been tabulated, and the true reflection coefficients calculated for six cases in which velocities are also known.—*Author's abstract.*

4. ELECTRICAL METHODS

Aerial, geological, and geophysical survey of northern Australia, Parliament of Commonwealth of Australia. *See* Geophys. Abstract 5993.

6040. Bowsky, M. C., Electrical logging: Mines Mag., vol. 31, No. 3, pp. 115–116, Denver, Colo., 1941.

The writer emphasizes the necessity for testing the insulation resistance of the cable, cable head, and electrode in the electrical logging of deep wells, owing to the high pressures and extreme temperatures encountered in them. He mentions the influence of mud on electrical measurements at great depths and discusses the need for developing a method to standardize the measurements of the resistivity of the mud so that a great source of error in comparing the actual intensities of electrical logs may be minimized.—*W. A.*

Brant, Arthur, Geophysical work at Steeprock Lake, 1938–39. *See* Geophys. Abstract 6007.

6041. Fritsch, Volker, Die Anlage von Erdern und die Messung ihres Widerstandes [Installing a ground and measuring its resistance]: Elektr. Nachr.-Tech., vol. 17, No. 4, pp. 77–85, Brünn, 1940.

Electrical installations must be properly grounded. The writer discusses questions about methods of grounding from the viewpoint of the geoelectrician and partly also from the viewpoint of the radio geologist. General considerations concerning grounding, homogeneous and heterogeneous subsoil, and characteristics of their qualities are followed by a discussion of the electrical properties of geologic conductors and their dependence on such factors as frequency, season, and saturation. He discusses viewpoints for selecting suitable places for grounding, and he gives examples dealing with paths of a lightning discharge that passes through a heterogeneous subsoil, a house, and a poorly grounded rod placed over a subsoil that was partly traversed by a good geologic conductor. A flash discharge will occur or the point of striking will shift in such cases. He offers a scheme of grounding, critically discusses methods of measurement by using direct

current or low-frequency alternating current, and shows that high-frequency measurements give the best results. He explains the method of measurement by using a high-frequency measuring instrument.—*Hohle's abstract in Physikal. Ber., vol. 21, No. 22, 1940, translated by W. A.*

6042. Fritsch, Volker, Zur Frage des Widerstandes von Blitzableitererdern in gebirgigem Gelände [On the question of the resistance of lightning-rod grounds in mountainous regions]: Elektrotech. Zeitschr., vol. 61, No. 32, pp. 739–741, Brünn, 1940.

The writer separates theoretical resistance into three component resistances: (1) Variable resistance, (2) constant resistance, and (3) rock resistance. These component resistances change differently, depending on the atmospheric influence. As they must be determined by the methods used in applied geophysics, the writer proposes the method of high-frequency measurements. He gives resistances of several samples of the ground taken from the Saxonian Mountains and their changes during 1930–37.—*Hohle's abstract in Physikal Ber., vol. 21, No. 22, 1940, translated by W. A.*

Johnson, W. R., Jr., and Straley, H. W., Geophysical tracing of pegmatite dikes. *See* Geophys. Abstract 6016.

6043. Leliavin, M. G., Electrical method of prospecting under the conditions of the Maineft Trust [in Russian]: Razvedka Nedr., vol. 10, No. 10/11, pp. 40–45, Moscow, 1940.

A schematic map of the Maineft region shows the areas of the region that have been prospected by electrical methods. Despite the contrary opinion of Schlumberger that resulted from the previous geophysical work in this region, the writer proves that electrical methods of prospecting may be successfully applied, and he recommends them for the detailed exploration in that region. He gives profiles that were obtained by vertical electrical sounding.—*W. A.*

6044. Swartz, J. H., Geophysical investigations on Lanai: Territory of Hawaii, Div. Hydrography, Bull. 6, pp. 97–115, Honolulu, 1940.

After discussing briefly the theory of the resistivity methods, the writer tabulates the results of resistivity measurements made at 23 stations on Lanai Island. He concludes: "It has proved possible in the geophysical surveys on the Islands of both Lanai and Maui to locate by resistivity measurements the top of salt water of approximate sea-water salinity and thus to determine the depth to salt water below sea level. From these data the elevations of the basalt fresh-water table above sea level have been calculated on the basis of the Ghyben-Herzberg principle. Where subsequent tests have been made of such resistivity predictions in drill holes, wells, shafts, and the like, on both Lanai and Maui, the observed depths to salt water and elevations of the basal fresh-water table have been in close agreement with the values obtained by the resistivity measurements. It appears feasible to determine in suitable places the depths to salt water where not too deep and the altitude of the basal fresh-water lens in the Hawaiian Islands by means of resistivity measurements made with the Lee partitioning method. It is believed that this method will prove applicable to other areas where fresh water floats on salt water in permeable rocks."—*W. A.*

6045. Swartz, J. H., Resistivity survey of Schofield Plateau: Territory of Hawaii, Div. Hydrography, Bull. 5, pp. 56–60, Honolulu, 1940.

The resistivity measurements made in the Schofield Plateau show an area underlain by a zone of high-level ground water several thousand feet thick extending from near Kaukonahua Camp on the north to a point a short distance south of the Schofield shaft on the south. North of Kemoo Camp the normal basal water table extends to the north coast of the island, reaching a minimum elevation at Waimea Bay. South of Kipapa Junction the normal basal water table extends to the south coast of the island. A zone of transitional water-table elevations extends from the area of basal water near Kemoo Camp to the area of high-level ground water near Kaukonahua Gulch.—*Author's summary.*

5. RADIOACTIVE METHODS

6046. Bricard, Jean, and Jung, Jean, Mesures de l'intensité de la radiation pénétrante tellurique en Auvergne [Measurements of the intensity of terrestrial penetrating ratiation in Auvergne]: Acad. sci. Paris Comptes rendus, vol. 209, No. 12, pp. 485–488, 1939.

The writers tabulate the results of measurements of terrestrial penetrating radiation made at various places in Auvergne by using Kolhörster's apparatus. The values, which are almost of the same order (average, 16 ions per cubic centimeter per second), show that the intensity of this radiation does not depend much on the geologic structure of the subsurface. The writers observed an exception in the Oligocene sediments, which produced a weaker radiation (average, 13 ions) than the sediments of the volcanic and eruptive rocks. They obtained very high values of intensity from mineral sources (average, 25 ions), which could be attributed to the strong radioactivity, as well as from old boreholes of Martres d'Artieres as deep as 20 m. (over 100 tons). They observed that with increasing depth the number of ions dropped to 22 at a depth of 30 m., but they could give no reason for the sudden drop.—*W. A.*

6047. Conference on applied nuclear physics [editorial]: Jour. Applied Physics, vol. 12, No. 4, pp. 296–302, Lancaster, Pa., 1941.

A general conference on applied nuclear physics, sponsored by the American Institute of Physics in cooperation with the Massachusetts Institute of Technology, was conducted during the week of October 28–November 2, 1940, at the Massachusetts Institute of Technology, Cambridge, Mass. The purposes of the conference were to bring together investigators and to provide a forum for assembling and correlating present knowledge and difficulties and for directing attention toward fundamental types of research that should be the subject of future investigations.

Abstracts of the papers presented at this conference are classified under the following headings: (1) Techniques and standards in terrestrial radioactivity measurements; (2) Geochemical applications of radioactivity; (3) Radioactive methods of geologic-age determination; (4) Geophysical applications of nuclear physics; and (5) Production of radioactive and stable isotopes and of penetrating radiations.—*W. A.*

6048. Curtiss, L. F., Goodman, Clark, Kovarik, A. F., Lind, S. C., Piggot, C. S., and Evans, R. D., Radioactive standards: Phys. Rev., vol. 57, No. 5, p. 457, Lancaster, Pa., 1940.

The writers report briefly on the preparation of radium standards, thorium standards, and standards of rock samples that were analyzed for radium and thorium content. The rock samples may serve as units for determining radioactivity. The standards are kept in the National Bureau of Standards in Washington.—*W. A.*

6049. Evans, R. D., Applied nuclear physics: Jour. Applied Physics, vol. 12, No. 4, pp. 260–269, Lancaster, Pa., 1941.

Following the discovery of artificial radioactivity and the rarer stable isotopes of the light elements, the 50-year-old field of applied nuclear physics has found a greatly increased domain of usefulness in chemistry, metallurgy, radiology, geology, physiology, and medicine. Isotopic tracer atoms, whether stable or radioactive, provide a powerful method for observing the behavior of complicated biological, chemical, or physical systems under equilibrium conditions. Atom-smashing machines, when slightly modified, are useful in metallurgical and clinical radiology, while other techniques and results from the field of nuclear physics find important applications in geology and astrophysics.—*Author's abstract.*

6050. Evans, R. D., and Goodman, Clark, Radioactivity of rocks: Geol. Soc. America Bull., vol. 52, No. 4, pp. 459–490, Washington, D. C., 1941.

Although many previous measurements of the radioactivity of terrestrial materials have been made, most of them are of qualitative value only in their application to geology, geophysics, and cosmology because of inadequate recognition of the analytical care necessary to obtain reliable results. In the present study a systematic program of standardization, calibration, and interchecking has been followed throughout. The results of several hundred radioactivity measurements represent the most reliable collection of radioactivity determinations that have yet been made within the range of concentrations involved. By combining these newer measurements with the limited number of well-authenticated earlier analyses available, the writers have obtained average values, which are substantially lower than those obtained by Jeffreys in a compilation of most of the measurements reported prior to 1936. The present averages show a more marked decrease of radioactivity with increasing basicity, the Th/U ratios are considerably greater than those compiled by Jeffreys, and they are in better agreement with those to be expected from geochemical considerations. Two ultrabasic rocks were found to have radioactivities comparable to the low values for iron meteorites. Specific inaccuracies in earlier investigations have been discovered. Estimates, based on the average values for the different rock types mentioned above, are made of the rate of production of heat by radioactive decay.—*Authors' abstract, condensed by W. A.*

6051. Goodman, Clark, and Evans, R. D., Age measurements by radioactivity: Geol. Soc. America Bull., vol. 52, No. 4, pp. 491–544, Washington, D C., 1941.

The radioactive methods of geologic-age determination involve the four basic requirements: (1) A known systematic rate of disintegration of the radioactive elements, (2) accurate measurement and

sampling, (3) absence of a disintegration product as a primary constituent, (4) no addition or subtraction of the disintegration product or its source during the history of the material. A critical review is presented of our knowledge of the fulfillment of these requirements by the various radioactive methods. Emphasis is placed on the helium method because of its possible wide applicability, because no adequate review has heretofore appeared, and because considerable confusion exists concerning the present status of this method.

Following a discussion of the necessity for completely discarding all of Urry's helium age measurements, a summary of the remaining data shows that (1) with only a few exceptions the helium age ratios lie in the proper geologic sequence when the results for acidic rocks and for basic rocks are considered separately, (2) the age ratios for acidic rocks are consistently lower than the age ratios for corresponding basic rocks, and (3) the helium age ratios, even for basic rocks, are substantially lower than corresponding lead ages on radioactive minerals. These general inconsistencies stimulated the present reinvestigation of fundamental requirements underlying the radioactive methods. The retentivity of rocks for helium has been found to be the major source of uncertainty in the present application of this method. A review of the lead method indicates that only comparatively few ages can be considered as possible fixed points in the lead time scale. The uncertainty in the isotopic constitution of ordinary lead is seldom an important source of error, but the need for isotopic analysis in all lead-age measurements is emphasized by the relative insensitivity of atomic weight determinations. Further work needs to be done on the effects of leaching and weathering of radioactive minerals. Brief reviews of the isotopic-ratio, rubidium-strontium, and possible potassium methods of age determination are included for the sake of completeness.—*Authors' abstract.*

6052. Hurley, P. M., and Goodman, Clark, Helium retention in common rock minerals: Geol. Soc. America Bull., vol. 52, No. 4, pp. 545–560, Washington, D. C., 1941.

In the helium method of age determination the age of the material to be tested is given by the ratio of the content of helium to the content of radioactive elements in the material. In an unaltered igneous rock, where presumably the minerals are of the same age, it would be expected that the distribution of helium in the various minerals should correspond to the distribution of the radioactive elements. In each mineral the ratio of helium to radioactivity should be the same. This was found to be not the case. Pyroxene and feldspar were separated from six samples of Triassic diabase. Age measurements on each sample yielded mean age ratios of 103 million years for the pyroxene samples and 36 million years for the feldspar samples. Six samples of late Triassic magnetite from ore occurrences in West Virginia, Pennsylvania, and Nova Scotia all gave age ratios closely grouped about a mean value of 134 million years. The constant age ratio, despite widely varying contents of radium and thorium, suggests that the magnetite has retained most of its helium. Additional evidence on the high helium retentivity of magnetite is shown by further work on magnetic specimens of various geologic ages. These age ratios appear to show a sequence and spacing compatible with geological knowledge, and the results are in

fair agreement with corresponding age ratios given by the lead method.—*Authors' abstract.*

6053. Piggot, C. S., and Urry, W. D., Radioactivity of ocean sediments, part 3, radioactive relations in ocean water and bottom sediment: Am. Jour. Sci., vol. 239, No. 2, pp. 81–91, New Haven, Conn., 1941.

For parts 1 and 2, see Geophys. Abstracts 51, No. 868, and 100, No. 5390, respectively.

Since its beginning, the ocean has been the repository of materials removed from the continents. All but radioactive atoms have a continuous existence and may go into and out of the ocean many times. Because radioactive substances change with time, their presence in the ocean is transitory and of peculiar interest. There is much less radium in the ocean water and much more in the bottom sediment than is appropriate to the uranium present in each place. Studies of core samples of deep-ocean sediments, several meters long, reveal that some mechanism exists which removes radium and its immediate parent, ionium, from the water and leaves most of the uranium behind. The ionium produces more radium, and the excess of these two elements, unsupported by uranium, eventually disappears, leaving an equilibrium based on the small uranium content—which is of the same order of magnitude as is found in ordinary sedimentary rocks. It is now apparent that the high radium content of the ocean sediments is transitory and of no great geophysical significance. Several mechanisms for this separation and concentration are discussed.—*Authors' abstract.*

6054. Urry, W. D., The radioactive determination of small amounts of uranium: Am. Jour. Sci., vol. 239, No. 3, pp. 191–203, New Haven, Conn., 1941.

The determination of small amounts of uranium of the order of a few parts per ten million has usually been carried out by indirect radioactive measurements. Such measurements cannot be employed except when the radio elements are known to be in equilibrium. The separation of the uranium and its isotopes in such small amounts, and in a radioactively pure state, is accomplished with the use of coprecipitators, the iron (and aluminum) of the sample itself being the final carrier agent. The alpha-particle activity of the uranium is determined as a measure of its concentration. The method is tested by determining the ratio of the alpha-particle activity of the uranium—238—to that of the radium in geological specimens older than 10^9 years, where this ratio should be unity. A mean value of 0.98 ± 0.06 for this test substantiates the validity of the method.—*Author's abstract.*

6. GEOTHERMAL METHODS

6055. Slichter, L. B., Cooling of the earth: Geol. Soc. America Bull., vol. 52, No. 4, pp. 561–600, Washington, D. C., 1941.

The problem of the cooling of a radioactive earth has been reviewed. It is probable that the mantle solidified from the bottom up, beginning at the boundary of the core. More exhaustive studies of the surface-heat flow, of the structure and composition of the crust, and of the mean heat generation in crustal layers, all in the same regions, are desirable. The surface-heat flows fix definite upper limits for the amount of radioactivity which may exist within 100 or 200 km. of the surface. But thermal

observations and theory seem incapable of furnishing information about the thermal state of the earth at depths greater than 200 or 300 km. Little correlation exists between the radioactivity at depth and observed surface-heat flux. Heat generation of the order 10^{-14} cal./cc. sec., or 10 percent of that observed in plateau basalts, may exist at all depths, to the center, without producing effects contrary to the facts of observation. It is unknown whether the earth is heating or cooling at depth. No need is found for a drastic rate of decrease of radioactive substance with depth. The oft-expressed idea that the indicated amounts of radioactivity in the earth are embarrassingly large and greatly exceed the amounts to be expected from observed surface-heat flows is fallacious. Hoskins (1839) summarized the thermal problem in these words, "investigation of the earth's refrigeration . . . still leaves us in a state of perfect uncertainty as to the actual condition of its central parts . . . from want of the experimental determination of values which it must ever be found extremely difficult, if not impossible, to attain with accuracy."—*Author's summary and conclusions.*

7. GEOCHEMICAL METHODS

6056. Mogilevski, G. A., Bacteriological method of prospecting for oil and natural gases [in Russian]: Razvedka Nedr, vol. 10, No. 12, pp. 32–42, Moscow, 1940.

In his previous work, "Microbiological investigations in connection with gas surveys" [see Geophys. Abstracts 95, No. 4705], the writer discussed the possibility of using data obtained from bacteriological observations for disclosing and determining the boundaries of the centers of gas emanations. Since that time he has investigated more than 3,000 samples of soil. On the basis of his investigations, he describes in this article (1) the principles of a bacteriosurvey and its significance, (2) the regularities in the spreading of methane-oxidizing and cellulose-destroying bacteria with regard to the profile of the soil, (3) the technique of conducting bacteriological investigations of the subsoil, and (4) the results of his experimental work. Maps show bacteriological surveys conducted in the Maineft oil-bearing region, and a diagram compares a gas survey with a bacteriological survey in the same region.

The writer concludes: "The regularity in the spreading of methane-oxidizing bacteria over gas and oil deposits is established by bacteriological investigations of the subsoil. Practical utilizaton of these investigations is summarized as follows: (1) Bacteriological analysis of the subsoil made in connection with the gas survey makes it possible to distinguish more accurately the zones of gas anomalies and better to determine the character of single gas manifestations, (2) the simplicity of the field and laboratory methods of bacteriological survey may serve for determining the haloes of gas accompanying the gas and oil deposits, and (3) the improvements of the method must be made in the direction of (a) elaborating the quantitative interpretation, (b) studying bacteria indicators with regard to ethane, propane, and other heavier hydrocarbons, and (c) establishing optimum depths for selecting samples as well as other conditions of standardization of field and laboratory operations.—*W. A.*

6057. New advances broaden use of geochemical prospecting [editorial]: Oil Weekly, vol. 101, No. 6, pp. 34–40, Houston, Tex., 1941.

Sufficient data have been obtained by geochemical work to verify the frequent occurrence of microscopic leakage near underground oil and gas accumulations. The writer considers two classes of geochemical manifestations of a petroleum accumulation: (1) The near-surface effects as revealed by soil analysis, and (2) the near-deposit effects as established by geochemical well logging. Well logging has progressed so fast recently that the accumulation can be estimated for 500 to 1,000 feet of undrilled sediment beneath the bit. The writer discusses in detail geochemical well logging and uses charts that show geochemical logs of discovery wells and of a nonproductive well.—*W. A.*

6058. Pirson, S. J., Measure of gas leakage applied to oil search: Oil and Gas Jour., vol. 39, No. 41, pp. 21 and 32, Tulsa, Okla., 1941.

To remove the difficulties that arise from measuring the rate of leakage from concealed accumulations of gas and oil by the existing geochemical methods, the writer proposes a new method—the geodynamic process—which measures the rate at which gas escapes into the atmosphere. He therefore introduced a time factor into his measurements. He selectively measured the rate of pressure in a shallow borehole of measured volume for each of the significant gases that leak from the accumulation of oil and gas sought. Knowing the rise of pressure over a period of time for each of the gases in a vessel of known volume, he could measure the results. He mentions ways in which these results can be expressed. He adopted the piezometric method after experimenting with geodynamic-prospecting types of field technique, and he obtained favorable results by applying the new method in the so-called Music Mountain or Sliverville pool in northern Pennsylvania. He concludes with suggestions for using the method.—*W. A.*

6059. Rosaire, E. E., Geochemistry in prospecting for petroleum [abstract]: Inst. Petroleum Jour., vol. 27, No. 207, p. 5A, London, 1941.

The author of this paper accentuates the importance of recognizing a petroleum accumulation as a dynamic entity rather than a static condition. Visualized thus, it is not difficult to trace the origin of significant hydrocarbons, such as ethane, propane, and butane, in near-surface soil. Even though the actual petroleum deposit is buried under tons of waterlogged sediments, proximate rock pressures and concentration gradients are continuously forcing component hydrocarbons into and through its sedimentary environment. Such continuous leakage over a protracted period results in chemical and physicochemical modifications of the surrounding and overlying sediments. The essence of geochemical prospecting lies first in detecting these manifestations of a petroleum accumulation, and, secondly, in their proper interpretation. As a rule, structural evidences of petroleum accumulation manifest themselves over or around the center of the deposit. In the case of geochemical manifestations, however, they reach their maximum intensity around the edges of the petroleum accumulation. In other words, significant hydrocarbons which have escaped into surrounding or overlying sediments in the manner described form a halo or annular pattern in the soil. Thus it follows that soil analysis for the significant saturated hydrocarbons and detection of halo is destined to play

a vital part in geochemical-prospecting technique. Examples of the successful application of this method of petroleum exploration are already at hand. The importance of these achievements, however, lies not so much in the actual discoveries made but in the knowledge that petroleum accumulations in stratigraphic traps are potentially capable of discovery by means other than the drill.

There is another aspect of geochemical prospecting which may have far-reaching results, and that is geochemical well logging. Its successful application has already prevented the abandonment of wells as "dry" on the grounds that contract depth has been reached and none of the usual indications of petroleum possibilities were present. The geochemical well log should therefore be carefully assessed before any decision is taken to abandon a hole. If it is favorable, it is more than likely that drilling to a greater depth will transform what appears on other evidences to be a dry well into a discovery well.—*H. B. M.*

8. UNCLASSIFIED METHODS AND TOPICS RELATED TO GEOPHYSICS

6060. Bartley, M. W., Iron deposits of the Steeprock Lake area: Ontario Dept. Mines 48th Ann. Rept., vol. 48, pt. 2, pp. 35–47, Toronto, 1940.

A survey party of geologists and geophysicists has investigated the locality, genesis, structural relations, and economic possibilities of the iron deposits of the Steeprock Lake area (see abstract 6007). The writer describes the geology in the vicinity of these deposits and summarizes the development work to March 1939. He concludes: "It appears that the iron deposits are closely related to zones of fracture that have been filled with ferrodolomite. These are usually close to ash rock (lava) and limestone but not necessarily so in all cases. The ash rock is fissile and weathers easily, with the result that it forms depressions. Hence conditions favorable for the formation of hematite deposits similar to those at Steeprock Lake are most likely to be found in depressions underlain by ferrodolomite breccia and ash rock."—*W. A.*

6061. Belluigi, Arnaldo, Il problema del petrolio nell Africa Orientale Italiana [The oil problem in Italian East Africa]: Rev. geomineraria, geologia e geofisica applicata, vol. 2, No. 1, pp. 21–36, Milan, 1941.

The writer discusses the "indications" caused by hydrocarbons at the surface of the soil in Somaliland (Berbera-Dagah Shabell). He discusses further two typical structures, which he calls the "Abessomalian" and "Erythradian" structures, and he considers particularly the latter, which he describes from a geologist's standpoint and after the results of gravity measurements. He proposes a program for further geophysical investigations to be carried out in the area before any drilling is done, suggests gravity meters and apparatus for electromagnetic measurements for investigating intermediate depths in certain places, and mentions a very simple apparatus for electromagnetic measurements, which he first suggested in 1932. He believes that greater depths should be investigated with gravimeters and magnetometers.—*Author's abstract, condensed by W. A.*

6062. Clayton, H. H., A persistent solar-rotation period of 27.26 days: Terres. Magn. and Atmos. Electr., vol. 46, No. 1, pp. 71–77, Baltimore, Md., 1941.

This paper attempts to show (1) the persistence of sunspot outbreaks in the same longitudes of the sun for long intervals of time and the mean

length of the solar-rotation period derived therefrom; (2) that the solar-rotation period, as shown by the spots, varies in length with the mean latitude of the spots; the period is longest after sunspot minimum when the spots are in high latitudes and shortest a year or two before the next minimum when the spots are in low latitudes, in agreement with findings of Bartels, using other methods; the mean length is 27.26 days—slightly shorter than the value of 27.28 days found by Carrington—and the period seems to return in the same phase in the same part of the 11-year period in the case of data here used; (3) there is also evidence suggesting solar periods differing from 27 days.—*Author's abstract.*

6063. Cuyler, R. H., Many benefits expected from Texas well-logging project: Oil Weekly, vol. 101, No. 6, pp. 26–28, Houston, Tex., 1941.

Logs of approximately 120,000 oil wells in Texas are being collected and placed in a permanent file. The writer describes in detail a project known as the well-logging project. The file contains (1) a card catalog that indexes every well in Texas on which data are available, (2) a collection of electrical logs, (3) a collection of geochemical logs, (4) a collection of sample and paleontological logs, and (5) a collection of plotted drillers logs. The project is sponsored jointly by the Work Projects Administration and the University of Texas. The information thus collected is available to research workers, students of geology, and the general public, provided the work is done in Austin.—*W. A.*

6064. Fleming, J. A., Summary of the year's work, Department of Terrestrial Magnetism, Carnegie Institution of Washington: Terres. Magn. and Atmos. Electr., vol. 46, No. 1, pp. 43–50, Baltimore, Md., 1941.

The Department of Terrestrial Magnetism of the Carnegie Institution in previous years has been active chiefly in obtaining field and observatory data, but during the year ended June 30, 1940, it continued also an intensive study of the results previously obtained and developed its experiments in the laboratory. Geomagnetic investigations, terrestrial electricity, ionosphere, nuclear physics, cosmic radiation, and observatory work are the subjects under which the work of the department is described in this summary.—*W. A.*

6065. Inglis, D. R., Motion of the earth's fluid core: A geophysical problem: Phys. Rev., vol. 59, No. 2, pp. 178–188, Lancaster, Pa., 1941.

The earth's core may be assumed to have a very low viscosity, such as is characteristic of molten metals. The angular acceleration of the earth is sufficiently large, and the radius of the core is sufficiently great, to raise the question whether the rotation of the central part of the core lags appreciably behind the rotation of the solid mantle. The angular acceleration of the mantle, which is known astronomically, consists of a gradual deceleration and a more pronounced change of direction of the angular velocity, the 27,000-year precession. These two aspects are discussed separately. Three types of force might accelerate the core, the viscous force in laminar flow, the resistance caused by turbulent flow, and the force of induction associated with the earth's magnetic field. The viscous force is so weak that the interior would be practically unaccelerated if the flow were laminar, and the magnetic induction is expected to be weak enough to permit a large lag between the rotation of the mantle and interior of the core; but the core is so large that the flow should be turbulent. Reasonable assumptions on the nature of the flow in this case, based on empirical data on turbulence

near a flat boundary, are used to estimate the lag. It is concluded that the axis of rotation of the interior of the core may be expected to lag behind the axis of the mantle in the precession by an angle of the order of magnitude of a few degrees. Apart from the superposed eddies, points rather near the surface of the core would then move relative to the mantle around horizontal closed paths, approximately a hundred kilometers across, with a period of a day. This would cause a diurnal variation of the earth's magnetism much larger than observed if it were not for the shielding of metallic layers above the core.—*Author's abstract.*

6066. Karcher, J. C., Exploration by geophysical methods—Elements of the petroleum industry, edited by Everette DeGolyer: Am. Inst. Min. Met. Eng. Trans., pp. 63–89, New York, 1940.

The writer discusses the geophysical methods of exploration now in use in the order in which they were introduced into the field of petroleum geophysics, that is, (1) the magnetic method, (2) the gravitational method, (3) the electrical method, (4) the seismic method (refraction and reflection methods), and (5) soil analysis. The last part of the article deals with electrical logging—measurement of the electrical resistivity of the formations and measurement of the differences of potential that spontaneously exist in drill holes. He gives typical diagrams.—*W. A.*

6067. Kislov, A. L., Geophysical knowledge of western regions of the Ukrainian and White Russian Socialist Soviet Republics [in Russian]: Razvedka Nedr, vol. 10, No. 6, pp. 50–55, Moscow, 1940.

The writer describes briefly the results of the geophysical work in the Ukrainian and White Russian Socialist Soviet Republics up to 1939—work that included gravimetrical, magnetic, electrical, seismic, and radioactive methods of prospecting. Maps illustrate the results.—*W. A.*

6068. Lerici, C. M., La geofisica applicata nel momento attuale [Applied geophysics at the present time]: Rev. geomineraria, geologia e geofisica applicata, vol. 2, No. 1, pp. 5–20, Milan, 1941.

In all the countries affected by the war, either directly or indirectly, the events of today have a prevailing influence on the development of applied geophysics. In Europe the prospecting activity has been included in the various Governments' plans concerning the development and consistency of war industries. Mining laws are being either waived or revised, and the general trend is leading to the subordination of the private to the national interest—probably a step forward in the horizon of the future world's economy. In the technical field new tendencies and new possibilities are recorded: the static gravimeters appear on the scene and the electrical methods continue their progress and development and are now being used as general field procedure. Geochemical prospecting is coming of age, and radioactive measurements are taken again into consideration.—*Author's abstract.*

6069. Piersol, R. J., Workman, L. E., and Watson, M. C., Porosity, total liquid saturation, and permeability of Illinois oil sands: Illinois Geol. Survey, Report of investigations, No. 67, 72 pp., Urbana, 1940.

In this investigation, covering a period of 8 years, studies were made of the porosity, saturation, and permeability of 45 cores, representing 10 oil sands in Illinois. The authors describe fully the methods and procedure, give logs of cores and experimental results, and discuss the results.—*W. A.*

6070. Rosaire, E. E., Prospecting principles [abstract]: Inst. Petroleum Jour., vol. 27, No. 207, pp. 4A–5A, London, 1941.

The author of this paper traces the development of prospecting and notes three "revolutionary" advances that have been made: (1) Geological prospecting, from which was evolved the anticlinal theory and which formed a platform for all structural prospecting during the past 25 years, (2) geophysical prospecting, which enabled the prospector to explore below the surface of the earth by means other than the drill, and (3) a new science of prospecting, the principles of which are based on recognition and measurement of geochemical manifestations of petroleum accumulations, the trap within which such deposits occur being of secondary importance to the actual petroleum itself. The author compares the principles of prospecting with the principles of war. Although certain adjustments in viewpoint are necessary to translate these principles of war into principles of prospecting, it is possible to apply them to petroleum exploration. Thus he suggests that the prospecting chief of staff, his superiors, and his subordinates might well discard rule-of-thumb methods in favor of definite principles of prospecting such as he has outlined.—*Abstract by H. B. M., condensed by W. A.*

6071. Sezawa, Katsutada, and Kanai, Kiyoshi, Thermodynamic origin of the earth's core, part 1: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 18, No. 3, pp. 359–369, 1940.

The writers attempted to solve the problem of polytropic gas within the core. They assumed the density distribution in the rocky shell to be uniform in one case and to be that of Jeffreys in another. As the pressure was very high, the effect of ionization was neglected in the present problem. It is impossible for any metallic core to condense immediately from the gas within the core. If the earth's core is metallic liquid, the metals must have condensed from a large gaseous sphere; in which case, disregarding the theory of nuclear transformation, the elements corresponding to the metals must have existed in a mixture in the gaseous sphere. For the metallic core of the earth to be condensed in accordance with the theory of nuclear transformation, the primitive gaseous earth should have once passed a stage of very high temperature and then greatly cooled with its body gaseous as a whole—a condition rather difficult of realization.—*Authors' abstract, condensed by W. A.*

6072. Zagarmistr, A. M., Results and perspectives of applying geophysical methods of prospecting in the oil and coal industries of the Union of Soviet Socialist Republics [in Russian]: Razvedka Nedr, vol. 10, No. 10/11, pp. 29–40, Moscow, 1940.

The writer gives a general description of the geophysical work in 1938 and 1939 in the Union of Soviet Socialist Republics, particularly in the oil-bearing regions of the second Baku (Kama River), Ukraine, Kerch Peninsula, Caucasus, and western Siberia, and in the coal regions of the southern Urals, Moscow Basin, and Don Basin. In all, 62 parties with 78 detachments were engaged in this work, which included electrical and seismic methods. The writer highly recommends further development of geophysical methods of prospecting in all the region investigated.—*W. A.*

9. NEW PUBLICATIONS

6073. American Institute of Mining and Metallurgical Engineers, Elements of the petroleum industry, edited by Everette DeGolyer and sponsored by the Seeley W. Mudd Memorial Fund, 1st ed., 519 pp., illus., New York, 1940. Price, $5.

The present book describes the techniques that have been developed in the American petroleum industry. Contents, by chapters: (1) Introduction; (2) Physical and chemical properties of petroleum and its products; (3) Direct indications of the occurrence of oil and gas; (4) Essentials for oil pools; (5) Exploration by geophysical methods; (6) Land tenure and leasing; (7) Trading and promotion; (8) Royalties; (9) Oil-well drilling machinery and practices; (10) Drilling, testing, and completion; (11) Production practice; (12) Conservation; (13) Secondary methods for increasing oil recovery; (14) Oil pipe-line transportation; (15) Marine transportation; (16) Petroleum refining; (17) Marketing; (18) Oil accounting; (19) The natural-gas industry; (20) Economics of the petroleum industry; and (21) Introduction to the literature of oil and gas.

6074. American Institute of Mining and Metallurgical Engineers, Geophysics, vol. 138, 489 pp., illus., New York, Institute, 1940. Price, $5.

The introduction to this volume traces the changing emphasis that has been placed on the various methods of geophysical prospecting since the previous volume appeared. It contains papers and discussions presented at meetings held at New York in February of 1935, 1936, 1937, 1938, 1939, and 1940. Contents: *Geophysics education:* (1) A perspective of geophysics; (2) Place of geophysics in a department of geology; (3) Organization of a department of geophysics; (4) Teaching of geophysics in a department of physics; (5) Geophysics education and exploratory geophysics as a career; (6) Discussion in Technical Publication 945 and on papers in Technical Publication 950; (7) Summary of reports by committee on geophysics education, Mineral Industry Education Division, 1939 and 1940. *General:* (1) Research needed in economic geology; (2) Geophysical geological study of the Sao Pedro area, Brazil; (3) Symposium on geophysical prospecting. *Magnetic methods:* (1) Magnetic anomalies and igneous rocks; (2) Magnetic survey of the Ivry Ilmenite deposit; (3) Tracing a basic dike by geoelectrical and geomagnetic methods; (4) An instance of abnormal magnetic polarization in South Africa, together with a graphic method for determining effects of magnetic pole distribution; (5) Polar charts for interpreting magnetic anomalies; (6) Survey of methods for determining depth of magnetic ore bodies; (7) Reference datum for magnetometer surveys; (8) Observations on compensated magnetometer systems. *Gravitational methods:* (1) Gravimeters, their relation to seismometers, astatization, and calibration; (2) Use of astatized pendulums for gravity measurements; (3) A new gravimeter for ore prospecting; (4) Gravity at sea by pendulum observations. *Seismic methods:* (1) Seismograph prospecting for oil; (2) Problem of inclined layers in seismic reflection methods; (3) Formula for calculation of slope of reflection horizon in seismic reflection prospecting; (4) Continuous profiling method of seismographing for oil structures; (5) Application of the seismic reflection method of subsurface exploration to flood-control projects; (6) Geophysical study of soil dynamics; (7) Geophysical investigations concerning the

seismic resistance of earth dams; (8) Measurement of ordinary house vibrations. *Electrical methods:* (1) Correlation of earth resistivity with geological structure and age; (2) Interpretation of earth resistivity curves; (3) New method of depth determination in earth resistivity measurements; (4) New theory of apparent resistivity of horizontally stratified soils; (5) Application of rapid current surges to electric transient prospecting. *Electromagnetic methods:* Phase measurements in electrical prospecting. *Radioactive methods:* Radioactivity tests of rock samples for the correlation of sedimentary horizons. *Index.*

6075. Daly, R. A., Strength and structure of the earth, 434 pp., 85 illus., New York, Prentice Hall., Inc., 1940. Price, $3.50.

Contents, by chapters: (1) Introductory: The problem; vocabulary; discontinuities in the earth; calculated internal densities; figure of the earth (geoid, ellipsoid, spheroid); (2) Development of the idea of isostasy; (3) Testing isostasy with the plumb line; (4) Measurement of gravity—Comparison of intensities; (5) Gravimetric tests of isostasy in the United States; (6) Later gravimetric tests of isostasy in North America; (7) Testing isostasy in Europe; (8) Testing isostasy in Africa and Asia; (9) Testing isostasy at sea; (10) Nature's experiments with ice caps; (11) Retrospect; (12) Strength of the earth shells. Index. The book has been reviewed in detail by W. W. Rubey (Am. Assoc. Petroleum Geologists Bull., vol. 25, No. 5, pp. 902–904, 1941).—*W. A.*

6076. Earthquake notes, J. H. Nelson, editor, vol. 12, No. 4, 11 pp., Seismol. Soc. America, Eastern Section, Washington, D. C., 1941.

This issue contains the following notes: (1) 1941 meeting at Washington, D. C.; (2) New committees of the Eastern Section; (3) Advisory committee in seismology; (4) Report of committee on methods and operations; (5) Recent inspection trip of N. H. Heck; (6) The larger earthquakes of 1940; (7) Structural design; (8) Extended New England curves; (9) New recorder and clock for Sitka; (10) No more time signals from Arlington; (11) Seismograms from Greenland; (12) Progress in British seismology; (13) Does performance of pendulum indicate change of gravity?; (14) Earthquake in Great Britain; (15) New Britain; (16) Earliest estimation of focal depth; (17) In retrospect; (18) An unusual series of seismographic oscillations; (19) Epicenters; and (20) Officers of the Eastern Section, Seismological Society of America.—*W. A.*

6077. Goldie, A. H. R., and Joyce, J. W., Transactions of Washington meeting, September 4–15, 1939, Assoc. Terres. Magn. and Electr., Internat. Union Geodesy and Geophysics, Bull. 11, 556 pp., illus., Edinburgh, Neill & Co., Ltd., 1940.

The material in these "Transactions" is presented in six parts, namely: (1) Agenda and minutes; (2) National reports; (3) Special reports; (4) Communications; (5) Proposals on various subjects; (6) Resolutions, committee, and reporters.

The six parts were reviewed in some detail by H. D. Harradon (see Terres. Magn. and Atmos. Electr., vol. 46, No. 1, 1941).—*W. A.*

6078. Hyslop, R. C., Field method of determining the magnetic susceptibility of rocks: Am. Inst. Min. Met. Eng. Tech. Pub. 1285, 4 pp., 1940.

A method of determining the magnetic susceptibility of shaped specimens of rock, using a vertical-intensity magnetometer, is described. The sample is placed on top of the magnetometer case near one pole

of the magnetic system, and the deflection caused is proportional to its dimensions and susceptibility. The instrument is calibrated with known volumes of iron chloride solution of determined susceptibility.—*Author's abstract.*

6079. Jameson, M. H., Effect of dipping strata on determination of potential-drop ratio: Am. Inst. Min. Met. Eng. Tech. Pub. 1294, 5 pp., 1940.

Herein is discussed a theoretical investigation of the potential-drop ratio in the vicinity of a source located in the boundary of air and another medium, which in turn is underlain by a dipping stratum of different conductivity. Results were combined into a set of curves.—*Author's abstract.*

6080. Joesting, H. R., Magnetometer and direct-current resistivity studies in interior Alaska: Am. Inst. Min. Met. Eng. Tech. Pub. 1284, 20 pp., 1940.

Magnetometer and resistivity measurements were made to determine their value in locating buried placers, in determining thickness and distribution of thawed and frozen overburden, and in locating water-bearing ground. Results indicate that the magnetometer should be useful in prospecting approximately half of the placers in interior Alaska.—*Author's abstract.*

6081. Lambert, W. D., Report on earth tides, U. S. Dept. Commerce, Coast and Geodetic Survey, Special Pub. 223, 24 pp., Washington, D. C. Price, 10 cents.

Contents, by chapters: (1) Deflections of the vertical referred to the adjacent ground; (2) Deflections referred to the earth's axis; (3) Variation in the value of gravity at one place; (4) Tides in wells as a manifestation of earth tides; (5) Miscellaneous; (6) Theoretical developments; (7) Conclusions; and (8) Appendix, note on tides in wells.

In chapter 7 the author writes: "In previous reports the reporter was inclined to minimize the effect of local geological structure on observed earth tides. It now seems to him the local structure may be important and that observations of earth tides may be made to yield information about such structure. Before this happens, however, our ability to interpret must grow with study and experience. The difficulties in the way of a direct calculation of the effects of the shifting load of tidal water remain substantially as before. The Liverpool Tidal Observatory has, however, found an ingenious way to dodge the difficulty to a certain extent. The assumptions on which the method is based are plausible and probably valid, or nearly enough so, for many parts of the earth. The method requires an analysis of the record for several tidal components. This is the first report of this series of reports to say anything about tides in wells remote from the sea. It is a fascinating subject, perhaps because of the very difficulties in the way of a quantitative explanation. It is to be hoped that the subject will be studied further."—*W. A.*

6082. Milne, John, Earthquakes and other earth movements, 244 pp., 83 figs., revised and rewritten by A. W. Lee, Philadelphia, P. Blakiston's Son & Co., 1939. Price, $3.50.

The first 50 pages describe the observed earthquake phenomena. The succeeding pages deal with seismographs, elastic waves in solids, records

of earthquakes, and their analyses. Seismic methods of prospecting are among other topics treated.—*W. A.*

6083. Neumann, Frank, United States earthquakes, 1938, 58 pp., illus., U. S. Coast and Geodetic Survey, serial 629, Washington, D. C., 1940. Price, 15 cents.

This publication is a summary of earthquake activity in the United States and the regions under its jurisdiction for the calendar year 1938. Contents: (1) Instrumental results, (2) Noninstrumental results, (3) Miscellaneous activities, (4) Seismological observatory results, (5) Strong-motion seismograph results, (6) Tilt observations, and (7) Additions and corrections to previous publications.—*W. A.*

6084. Paterson, R. G., Determination of magnetic susceptibilities of rock in situ: Am. Inst. Min. Met. Eng. Tech. Pub. 1298, 9 pp., 1940.

Measurement of the magnetic susceptibility of rock in place by means of a portable instrument is described. The instrument consists essentially of a flat coil containing 1,000 turns of fine wire of known inductance, which is connected with a sensitive alternating-current inductance bridge. The coil is placed flat on the rock whose susceptibility is to be measured.—*Author's abstract.*

6085. Tables of sine, cosine, and exponential integrals, vol. 1, 444 pp., Federal Works Agency, Work Projects Administration, New York, 1940.

Contents: Introduction, bibliography, and the following four tables: 1. $Si(x)$, $Ci(x) - \log_e x$, $Ei(x) - \log_e x$, $-Ei(-x) + \log_e x$ [0.0000 (0.0001) 0.0100; 9] $Si(x)$, $Ci(x)$, $Ei(x)$, $-Ei(-x)$ [0.0000 (0.0001) 1.9999; 9]. 2. $Si(x)$, $Ci(x)$, $Ei(x)$, $-Ei(-x)$ [0.0 (0.1) 10.0; 9]. 3. Values of $1/6p(1-p^2)$ [0.000 (0.001) 1.000; 6]. 4. Values of $p(1-p)$ [0.000 (0.001) 0.500; 6].

Note.—The figures in the brackets give the range and interval of the argument and the number of decimal places. In table 2, for instance, the range is from 0.0 to 10.0 at intervals of 0.1 to nine decimal places.—*W. A.*

10. PATENTS

6086. Method of and apparatus for magnetically exploring earth strata; Charles B. Aiken, West Lafayette, Ind., assignor by mesne assignments to Schlumberger Well Surveying Corporation, Houston, Tex., a corporation of Delaware: U. S. patent 2,220,070, issued November 5, 1940.

This invention relates to an apparatus for electromagnetically exploring a drill hole, comprising means for creating a varying magnetic field in the earth strata surrounding the drill hole; a receiving circuit for picking up a signal from the magnetic field at different positions of the magnetic field along the drill hole; means for avoiding the pick-up of a signal by parts of the receiving circuit removed from said positions; and means for observing differences in phase and amplitude of the field at the said different positions. Claims allowed, 21.

6087. Clamping device for force responsive element; John L. Bible, Tulsa, Okla., and Robert H. Ray, Houston, Tex., assignors to Stanolind Oil & Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,220,199, issued November 5, 1940.

This invention relates to a clamping device for a gravity meter of the type in which an elongated mass is suspended by spaced filaments

and swings through a very small arc, which comprises a base; two movable members, one disposed on either side of said mass; means associated with said base for supporting said two movable members; means for driving said two movable members; and a plurality of spaced clamping members mounted on each of said movable members on opposite sides of and adjacent to said mass, said driving means and said movable members being constructed and arranged to cause said clamping members to move simultaneously and only in opposite directions. Claims allowed, 5.

6088. Method of locating detectable cement in a borehole; Stuart E. Buckley, Houston, Tex., assignor to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,220,205, issued November 5, 1940.

The present invention relates to a method for determining the location of cement in a borehole, which comprises adding a radioactive material to the cement, placing the cement in the borehole, and then logging the borehole with a device which is sensitive to rays emitted by the radioactive material. Claims allowed, 10.

6089. Process and apparatus for exploring geological strata; Folkert Brons, Kilgore, Tex., assignor to Shell Development Co., San Francisco, Calif., a corporation of Delaware: U. S. patent 2,220,509, issued November 5, 1940.

In a method of geophysical exploration, the steps of generating neutron rays; causing said rays to pass through a ground formation; allowing said rays to undergo diffusion by interaction of the neutrons with low atomic weight elements present in the formation; causing the diffused neutrons to act on an element disintegrating under the effect of neutrons, whereby said element is disintegrated; and determining the amount of the disintegration products formed by the action of the neutrons on said elements. Claims allowed, 11.

6090. Method and apparatus for investigating subterranean strata by means of electromagnetic measurements; Ralph W. Lohman, South Pasadena, Calif., assignor by mesne assignments to Schlumberger Well Surveying Corporation, Houston, Tex., a corporation of Delaware: U. S. patent 2,220,788, issued November 5, 1940.

This invention relates to the method of investigating the physical characteristics of subterranean formations adjacent a borehole, which includes artificially creating a magnetic field of force within the borehole; influencing an electromagnetic coil, positioned in said borehole in vertically spaced relation with the zone in which said magnetic field is created with lines of force in said field, which have traversed strata surrounding a predetermined length of the borehole; and electrically indicating the result of such influence at the surface of the ground. Claims allowed, 13.

6091. Gravity measurements; Gustaf Adolf Ising, Djursholm, Sweden: U. S. patent 2,221,480, issued November 12, 1940.

This invention relates to an arrangement for carrying out gravity measurements, comprising in combination a tiltable support; an astatized pendulum mounted on said support; a time mechanism; an automatic operating mechanism adapted to tilt said support periodically under the control of said time mechanism so as to cause the pendulum to

swing over through its vertical position; and means for determining the deflections of said pendulum. Claims allowed, 3.

6092. Making electrical measurements; Whitman D. Mounce and William M. Rust, Jr., Houston, Tex., assignors to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,221,951, issued November 19, 1940.

In an apparatus for logging a well, in combination, a pair of spaced electrically conductive exposed surfaces adapted to be moved up and down the well; means for causing an alternating current to flow through the earth between said surfaces; a measuring circuit for indicating the impedance of the earth between said surfaces, and means for matching the impedance of the earth between said surfaces to the impedance of the measuring circuit. Claims allowed, 10.

6093. Electrical-prospecting method and apparatus; Charles B. Bazzoni, Willingford, and Joseph Razek, Llanerch, Pa., assignors to Sperry-Sun Well Surveying Co., Philadelphia, Pa., a corporation of Delaware: U. S. patent 2,222,136, issued November 19, 1940.

This invention relates to the method of determining the location and character of strata penetrated by a borehole, comprising lowering a detecting device in the borehole; recording by variable exposure of a moving sensitized film variations in the properties of the strata traversed by the detecting device; developing the film to provide a variable density trace corresponding to said variable exposure; and providing by scanning said trace by a recording photosensitive apparatus a record in the form of a curve corresponding to said variable density trace. Claims allowed, 11.

6094. Method and apparatus for logging wells; Edward Lipson, Houston, Tex., assignor to Casolog, Inc., a corporation of Texas: U. S. patent 2,222,149, issued November 19, 1940.

This invention relates to a method of determining the nature of formations penetrated by a cased borehole, comprising the steps of moving an electrode within the borehole; passing an electric current through the earth between said electrode and an electrode grounded at a point in spaced relation with the mouth of the borehole; passing said current through a resistor connected to each of said electrodes; and measuring the variations in the potential between a point on the resistor and an electrode grounded at a point in spaced relation with the first-mentioned electrode and the mouth of the borehole. Claims allowed, 8.

6095. Earth impedance-measuring device; Whitman D. Mounce and William M. Rust, Jr., Houston, Tex., assignors to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,222,182, issued November 19, 1940.

This invention relates to apparatus for measuring small changes in impedance, comprising a vacuum-tube oscillator; a coupling circuit between the grid and plate circuits; means for introducing the impedance to be measured in series in the coupling circuit whereby the coupling is varied by changes in the impedance, thus varying the direct current component of the oscillator plate current; and means for measuring the direct current component of the plate current. Claims allowed, 7.

6096. Electrical surveying in drill holes; Raymond D. Elliott, Long Beach, Calif., assignor by mesne assignments to Schlumberger Well Surveying Corporation, Houston, Tex., a corporation of Delaware: U. S. patent 2,222,608, issued November 26, 1940.

This invention relates to an apparatus for electrical earth exploration in drill holes, comprising two spaced-apart electrodes adapted to be positioned in a drill hole; a cable comprising a pair of insulated conductors connected at their lower ends with said respective electrodes; means for winding up said cable to raise said electrodes in a drill hole and unwinding the cable to lower the electrodes; means for producing a flow of alternating current through one conductor, the electrode connected thereto, and into the formation surrounding that electrode; means connected with said other electrode at the surface for indicating changes in the potential of the upper end of said other conductor; and means connected in circuit with said indicating means for adding a potential to said indicated potentials to compensate for the effects on said indicating means resulting from changes in the electrical characteristics of said cable produced by winding and unwinding said cable. Claims allowed, 29.

6097. Prospecting for oil; Edward B. Peck, Elizabeth, N. J., assignor to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,223,183, issued November 26, 1940.

This invention relates to a method for locating subsurface oil deposits, which comprises collecting samples of soil gas at different points in an area under investigation; passing each sample through a combustion chamber maintained under conditions suitable for the combustion of the hydrocarbon content of the sample; measuring the temperature rise in the combustion chamber due to the combustion of the sample; comparing the combustion effects of the several samples to determine thereby the points at which samples having the greatest combustion effects were obtained; and subjecting gases from these points to examination for hydrocarbons higher than methane. Claims allowed, 3.

6098. Gas-sampling system; Gerald L. Hassler, Berkeley, Calif., assignor to Shell Development Co., San Francisco, Calif., a corporation of Delaware: U. S. patent 2,223,785, issued December 3, 1940.

In a gas-sampling system, two concentric envelopes, one wholly within the other, said envelopes being sealed from each other and from the atmosphere, at least the inner envelope being made of flexible material; a conduit in communication with the inside of the inner envelope; a second conduit in communication with the inside of the outer envelope; and means for selectively applying to the other ends of said conduits a gaseous pressure, whereby either envelope may be filled by applying a vacuum to the other envelope and may be emptied by applying a positive pressure to the other envelope. Claims allowed, 3.

6099. Alternating-current method and apparatus for logging wells; Edward Lipson, Houston, Tex., assignor to Casolog, Inc., a corporation of Texas: U. S. patent 2,224,635, issued December 10, 1940.

The invention claimed is: In a device for determining the nature of formations traversed by a borehole the combination of a well bore having a casing therein; an electrode movable within said casing whereby said

electrode traverses the formations penetrated by the well bore; a second electrode embedded in the earth in spaced relation with the well bore; means for passing an alternating electric current through the earth between said electrodes; and means for measuring the variations in rectified current flowing between the casing and said second electrode as indications of the stratigraphy of the area penetrated by the well bore. Claims allowed, 7.

6100. Earth exploration; James A. Lewis and William L. Horner, Dallas, Tex., assignors to Core Laboratories, Inc., Dallas, Tex., a corporation of Delaware: U. S. patent 2,225,248, issued December 17, 1940.

This invention relates to the method of measuring the oil-gas-water producing characteristics of substrata sands containing naturally imprisoned gas, comprising the steps of cutting successive core samples from the sands; lifting such core samples uncased from the well; testing the permeability of the successive core samples to determine whether the sands are sufficiently permeable for practical production purposes and recording the results; testing the oil saturation of the successive core samples in terms of the amount of oil per unit volume of core sample to determine whether the sands are sufficiently oil bearing for practical production purposes and recording the results; measuring the free-gas content of the successive core samples in terms of the amount of free gas per unit volume of core sample and recording the results; measuring the total water content of the successive core samples in terms of the amount of water per unit volume of core sample and recording the results; dividing the results of the gas measurements by the results of the water measurements; and converting the quotients of said divisions into fluid-production indices by co-relating said quotients with the known fluid-production indices of wells the producing performance of which in relation to their indices has been previously demonstrated. Claims allowed, 2.

6101. Gravity meter; John McDonald Ide, Houston, Tex., assignor to Shell Development Co., San Francisco, Calif., a corporation of Delaware: U. S. patent 2,225,566, issued December 17, 1940.

The invention claimed is: In a gravity meter, a suspended casing adapted to be filled with a liquid; a thread horizontally clamped within said casing between two supports; at least one rigid body clamped to the thread, said body being immersed in the liquid filling the casing and having a weight substantially equal to the weight of the liquid displaced, the center of buoyancy of said body being located on an axis coincident with the thread, and the center of gravity of said body being radially offset with regard to the thread; and means to move the center of gravity of said body against the action of the gravitational force by twisting the thread. Claims allowed, 5.

6102. Gravity-meter clamp; John L. Bible, Tulsa, Okla., assignor to Stanolind Oil & Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,225,582, issued December 17, 1940.

This invention relates to a clamping device for a force-measurement instrument of the type including a force-responsive element and a suspension thereof, which comprises a first clamping member carrying three clamping points and a second clamping member carrying a single clamping point arranged symmetrically with respect to said three clamping points,

said three clamping points and said single clamping point being arranged on opposite sides of a portion of said force-responsive element, and means for moving said two clamping members selectively into clamping and nonclamping positions with respect to said portion of said force-responsive element. Claims allowed, 4.

6103. Method and apparatus for logging drill holes; Philip Subkow, West Los Angeles, and Lyle Dillon, Los Angeles, Calif., assignors to Union Oil Co. of California, Los Angeles, Calif., a corporation of California: U. S. patent 2,225,668, issued December 24, 1940.

This invention relates to a method for transmitting indications of physical conditions within an uncased borehole containing conductive fluid such as drilling mud through the earth surface, comprising generating an oscillating electric current within the borehole; impressing said oscillating electric current upon a pair of electrodes spaced longitudinally with respect to the axis of the borehole in contact with the fluid in said borehole whereby an oscillatory potential gradient is induced in the surrounding formations which extends to the earth surface; and detecting said oscillatory potential gradient at the earth surface. Claims allowed, 15.

6104. Core-taking apparatus and method of exposing cores; Charles S. Piggot, Washington, D. C., assignor by mesne assignments to Schlumberger Well Surveying Corporation, Houston, Tex., a corporation of Delaware: U. S. patent 2,227,198, issued December 31, 1940.

This invention relates to a core-taking apparatus comprising a gun and a core-taking projectile projectible from the gun upon explosion of a charge in the gun, lifting and lowering means for the gun and projectile including means operative to retrieve the projectile after the latter has been shot from the gun, and means for automatically exploding said charge when the gun and projectile reach a suitable lowered position relative to the formation to be sampled. Claims allowed, 31.

6105. Geochemical prospecting; George S. Bays, Tulsa, Okla., assignor to Stanolind Oil & Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,228,223, issued January 7, 1941.

This invention relates to a method of geochemical prospecting, comprising wetting a soil sample while in place in the ground, inserting a pair of closely spaced electrodes in said wetted soil sample while in place in the ground, and measuring by means of said electrodes the conductivity of said wetted soil sample while in place in the ground. Claims allowed, 19.

6106. Electrical logging; Daniel Silverman, Tulsa, Okla., assignor to Stanolind Oil & Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,229,604, issued January 21, 1941.

This invention relates to a method of electrical logging, comprising passing an alternating current between at least one well electrode and at least one additional electrode in electrical communication with the earth; obtaining in an electrical circuit an alternating-current voltage, resulting from the passage of said alternating current between said electrodes; converting said resultant alternating-current voltage into a second alternating-current voltage indicative of both the magnitude of said resultant alternating-current voltage and the phase rela-

tionships of said resultant alternating-current voltage to said alternating current; rectifying said second alternating-current voltage; and applying said rectified voltage to a recorder. Claims allowed, 8.

6107. Electrical-prospecting method and apparatus; John M. Pearson, Swarthmore, Pa., assignor to Sperry-Sun Well Surveying Co., Philadelphia, Pa., a corporation of Delaware: U. S. patent 2,230,502, issued February 4, 1941.

This invention relates to the means for determining the location and character of formations penetrated by a borehole, comprising an exploring unit, said exploring unit including a generator of high-frequency oscillations; means for establishing thereby an electromagnetic field penetrating formations in the vicinity of the borehole, said last-named means forming a part of the generator circuit; means responsive to variations in operation of the generator circuit due to change of impedance of the field-establishing means resulting from different materials in the vicinity thereof, the generator including an impedance variable through a value determining a limit, dependent upon the impedance of the field-establishing means, of the operative condition of the generator; means for varying the variable impedance, said responsive means comprising a device indicative of the existence or nonexistence of oscillations; and means for supporting said unit for movement within and lengthwise of the borehole. Claims allowed. 21.

6108. Method of indicating spontaneous potentials in shallow wells; Henri Georges Doll, Paris, France, assignor to Schlumberger Well Surveying Corporation, Houston, Tex., a corporation of Delaware: U. S. patent 2,230,999, issued February 11, 1941.

This invention relates to the method of determining the nature of earth strata containing liquid of relatively low ion concentration traversed by a shallow borehole containing liquid of relatively low ion concentration, which comprises the steps of increasing the ion concentration of the liquid in the borehole above that of the liquid in the earth and obtaining indications at different depths of the spontaneous potentials existing in the borehole thereafter. Claims allowed, 7.

6109. Electrical prospecting with alternating current; Paul W. Klipsch and Samuel S. West, Houston, Tex., assignors to Esme E. Rosaire, Houston, Tex.: U. S. patent 2,231,013, issued February 11, 1941.

This invention relates to the means of geophysical prospecting, comprising means for generating an alternating current of known amplitude, means for causing said current to flow in a region of the earth's crust, means for detecting the potential between points subject to the influence of said current, and means for measuring the transmission loss between said generating and detecting means. Claims allowed, 5.

6110. Process or method of geophysical prospecting; Clarence C. Beacham, Somerset, Ohio: U. S. patent 2,231,043, issued February 11, 1941.

This invention relates to the method of electrical prospecting, which comprises causing at different times a flow of electric current through the earth between each of two spaced-apart electrodes at the approximate location at which prospecting is desired and an area remote therefrom, and the separate measurement, between two other spaced-apart grounded electrodes for each of a desired number of positions, of the

potential difference caused to exist therebetween by each of the said flows of electric current through the earth. Claims allowed, 9.

6111. Method of and means for analyzing and determining the geologic strata below the surface of the earth; Roland F. Beers, Dallas, Tex.: U. S. patent 2,231,243, issued February 11, 1941.

This invention relates to the method of seismically determining the characteristics of geologic strata traversed by a borehole, which includes generating sound and directing the same through the subsurface stratum under investigation, whereby the sound waves travel through said stratum; receiving said waves after they have traveled through the formation; and determining the difference between the frequency of the transmitted waves to determine the elapsed time of travel of said waves, whereby the velocity of propagation of said waves is obtained. Claims allowed, 15.

6112. Seismograph prospecting; Louis W. Gardner, Pittsburgh, Pa., assignor to Gulf Research & Development Co., Pittsburgh, Pa., a corporation of Delaware: U. S. patent 2,231,575, issued February 11, 1941.

In seismograph prospecting, a method of determining average seismic-wave velocities in stratified rock covered by a weathered layer with compensation for error due to nonhorizontality of strata and error due to the weathered layer, which comprises the operations of setting up detectors at two positions laterally spaced from each other; firing a shot at a position relatively close to one detector position and firing another shot at a position relatively remote from the other detector position, said shot-firing positions being so related to the detector positions that a line joining the first shot and first detector positions bisects and is bisected by a line joining the second shot and second detector positions at a common center point; firing at least one additional shot at a position in the earth such that a line joining the third shot and one of said detector positions is substantially longer than and bisects and is bisected by a line joining the other of said detector positions and one of the shot positions at a second common center point spaced from first; and recording the seismic waves received at said detectors. Claims allowed, 11.

6113. Locating cement; Donald G. C. Hare, Houston, Tex., assignor to Texaco Development Corporation, New York, N. Y., a corporation of Delaware: U. S. patent 2,231,577, issued February 11, 1941.

This invention relates to the method of locating the upper level of the cement placed in the annular space between the walls of a borehole and a string of casing, which comprises mixing with the cement before it is placed in the hole a quantity of a substance capable of strongly absorbing slow neutrons; placing the treated cement in the hole so that it will fill part of the annular space between the formation and the casing; lowering an instrument containing a source of fast neutrons and a detector of slow neutrons through the uncemented portion of the hole; and noting the change in the number of neutrons registered by the detector when the instrument reaches the cemented portion of the hole. Claims allowed, 3.

6114. Recording seismic waves; Paul W. Klipsch, Houston, Tex., assignor of 50 percent to E. E. Rosaire, Houston, Tex.: U. S. patent 2,232,612, issued February 18, 1941.

This invention relates to the method of exploring geologic formations, which comprises creating a center of seismic disturbance in the

crust of the earth; receiving the seismic waves at a group of horizontally spaced detector points; spacing such points to form an array length determined from the minimum surface velocity of reflected waves and the maximum surface velocity of noise waves until the length is less than a maximum value equal to one-fourth of the apparent surface wave length of the reflected wave and is greater than a minimum value equal to one-half wave length of the surface noise waves; and recording the algebraic sum of the impulses received at all the points in the group. Claims allowed, 8.

6115. Seismic prospecting; Paul W. Klipsch, Houston, Tex., assignor of 50 percent to E. E. Rosaire, Houston, Tex.: U. S. patent 2,232,613, issued February 18, 1941.

This invention relates to the method of exploring geologic formations, which comprises creating a plurality of spaced centers of disturbance in the earth's crust, said points being horizontally spaced to form a disturbance array length S_1; receiving the seismic waves at detector points arranged in a plurality of spaced groups of several points each, said points within each group being spaced in the earth's crust to form an array length S_2, which added to the disturbance array length possesses a value $S=S_1+S_2$, intermediate maximum and minimum values expressed by the equations:

$$S_{max}=\frac{V}{\sin\phi}\cdot\frac{1}{4F}$$

$$S_{min}=\frac{v}{2f},$$

wherein:

S_{max} = maximum permissible array length;
S_{min} = minimum permissible wave length;
V = minimum longitudinal seismic velocity of the reflected waves;
v = maximum longitudinal seismic velocity of the refracted noises to be reduced;
F = maxmium frequency to be recorded;
f = minimum frequency to be recorded;
ϕ = maximum emergence angle of reflected waves measured from the vertical;

and simultaneously recording for each detection array the algebraic sum of the impulses received at the points within such array. Claims allowed, 6.

6116. Method and apparatus for exploring drill holes; Eugene Gilbert Leonardon, Houston, Tex., assignor to Schlumberger Well Surveying Corporation, Houston, Tex., a corporation of Delaware: U. S. patent 2,233,420, issued March 4, 1941.

This invention relates to a method of exploring a drill hole not containing a column of conductive liquid, that comprises creating an alternating electromagnetic field in the earth in the neighborhood of the drill hole, measuring the alternating potential of the field between different points along the wall of the drill hole and a ground, and measuring the direct potential between different points along the wall of the drill hole and the ground. Claims allowed, 19.

6117. Method and apparatus for surveying wells; Ralph D. Wyckoff, Houston, Tex., assignor to Gulf Research & Development Co., Pittsburgh, Pa., a corporation of Delaware: U. S. patent 2,233,992, issued March 4, 1941.

This invention relates to a method of making stratigraphic surveys in earth bores, comprising the steps of generating a pulse of sound at one level in the bore so as to cause propagation of a sound wave through the surrounding rock, detecting sound waves at a level different from said level, causing the detected sound waves to generate a second pulse of sound at said first level, and repeating the steps, the number of pulses emitted per unit of time being a measure of the velocity of sound through the rock between said two levels. Claims allowed, 7.

6118. Arrangement for measuring the terrestrial magnetic field; Gustaf Adolf Ising, Djursholm, Sweden, assignor to Aktiebolaget Elektrisk Malmletning, Stockholm, Sweden, a company of Sweden: U. S. patent 2,234,123, issued March 4, 1941.

This invention relates to an arrangement for measuring variations in terrestrial magnetic field components, comprising in combination a suspended coil having a fixed axis of rotation; means for supplying alternating current to the coil; means for producing an adjustable auxiliary magnetic field in the space around the coil; and means for observing the small vibrations of the coil, remaining as a differential effect after compensating, by means of the auxiliary field, the effect of that terrestrial field component, which is perpendicular to the axis of rotation and parallel to the winding plane of the suspended coil. Claims allowed, 3.

6119. Oil-prospecting method; Millard S. Taggart, Jr., Houston, Tex., assignor to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,234,637, issued March 11, 1941.

This invention relates to a method for prospecting for subterranean petroleum deposits, which comprises inoculating soil samples with hydrocarbon-consuming bacteria, planting these samples at spaced intervals in the area under investigation, allowing the planted samples to remain in place a sufficient period to permit propagation of the bacteria by naturally occurring hydrocarbons, then collecting the soil samples, and examining them for evidence of further reaction between the originally contained bacteria and hydrocarbons. Claims allowed, 1.

6120. Improvements in or relating to electromagnetic apparatus for determining location of concealed bodies; British Western Union, Ltd., a company organized under the laws of Great Britain, of 22 Great Winchester Street, London, E. C. 2, England: British patent 528,568, issued November 1, 1940.

This invention relates to apparatus for producing an indication of the location of a body having a distorted magnetic field associated therewith, comprising a plurality of coils or a plurality of sets of coils at least some of which have their axes spaced apart and so arranged that the curve of voltage response generated in one of said coils or sets of coils does not coincide with the curve of voltage response generated in another coil or set of coils, as relative movement is effected between said apparatus and said body whereby the ratio of the resultant of the generated voltage responses varies in accordance with the distance and direction of the body from the apparatus. Claims allowed, 19.

6121. Arrangements for measuring distance between two objects, particularly for depth sounding; Standard Telephones & Cables Ltd., a British company, and Leslie Turner Hinton, a British subject, both of Connaught House, 63, Aldwych, London, W. C. 2, England: British patent 530,326, issued December 10, 1940.

This invention relates to equipment for measuring the distance of one object from another object, utilizing a pressure wave motion the frequency of which is cyclically varied according to a linear law from a lower frequency to a higher frequency limit, comprising a wave collector for receiving the reflected pressure waves and converting said waves into electrical waves; arrangements for combining said electrical waves with a further electrical wave whose frequency is equal or substantially equal to that of the pressure wave leaving the transmitter contemporaneously with the reception of the reflected pressure wave; a device to which the two electrical waves are applied and from which the difference in low frequency is obtained for example; a suitable filter; a constant amplitude device to which the said low frequency is applied and a frequency-measuring arrangement with an indicator to give a quantitative indication of said frequency difference. Claims allowed, 12.

6122. Soil-gas sampling device; Shell Development Co., San Francisco, assignee of Gerald L. Hassler, Berkeley, both in California, United States of America: Canadian patent 392,224, issued October 29, 1940.

In a device for obtaining soil-gas samples, two spaced expansible packers adapted to be placed above each other within a borehole, a first gaseous conduit passing through the two packers and opening to the outside below the lower packer, a second gaseous conduit passing through the upper packer and opening to the outside between said two packers; means to expand the packers into contact with the walls of the borehole; means comprising said first gaseous conduit to reduce the pressure in the space formed by the lower packer and the walls of the formation to a value below that of the atmosphere; and means comprising said second gaseous conduit to reduce the pressure in the space formed by the two packers and the walls of the borehole to a value below that of the space formed by the lower packer and the walls of the borehole. Claims allowed, 12.

6123. Geophysikalisches Messverfahren zur Feststellung des Aufbaus der äusseren Erdrinde, insbesondere zum Aufschluss von Bodenschätzen [Method of geophysical measurements for determining the formation of the outer earth's crust, especially for disclosing ore deposits]; Hans Paul in Hannover and Dr. Martin Paul in Berlin-Lankwitz: German patent 683,308, issued June 8, 1940.

This invention relates to the method in which temperature measurements are made at determined depths at stations arranged in groups distant one from another, each group containing several (at least three) measuring stations. From the results of measurements made at these stations the horizontal temperature gradient may be determined with regard to its direction and magnitude. Claims allowed, 1.

6124. Elektrode für die elektrische Untersuchung des ein Bohrloch umgebenden Gebirges durch Messung der Änderung des Übergangswiderstandes [Electrode for electrical investigation of rocks surrounding a borehole

by measuring the change in transition resistance]; Dr. Oscar Martienssen und Gesellschaft für nautische und tiefbohrtechnische Instrumente m. b. H. in Kiel: German patent 690,915, issued May 10, 1940.

This invention relates to the measurement of the change in transition resistance of an electrode during its movement along the borehole, the electrode being designed in such a way that the current may enter into the surrounding medium only through a cylindrical surface, the height of which is almost equal to the diameter of the cylinder, and the cylindrical surface of which runs in the direction of the borehole. Claims allowed, 2.

6125. Schweremesser [Gravity meter]; Askania-Werke Aktiengesellschaft in Berlin-Friedenau, Dr. Anton Graf in Berlin-Steglitz, inventor: German patent 691,695, issued June 3, 1940.

This invention relates to apparatus for measuring gravitation, in which a gas volume or a liquid volume is displaced by the effect of change in gravity of a mass, this displacement being shown in a capillary tube. Claims allowed, 14.

6126. Einrichtungen an ortsbeweglichen Feldmessgeräten [Arrangements on portable field measuring instruments]; Askania-Werke Aktiengesellschaft in Berlin-Friedenau, Dr. Anton Graf of Berlin-Steglitz, Hermann Imhof of Berlin-Friedenau, and Dipl.-Eng. Paula Valet of Wilhelmshorst, inventors: German patent 692,754, issued June 26, 1940.

This invention relates to an arrangement on geophysical field instruments made for their transportation and their mounting without removing them from the instrument car. The floor of the car is provided with an opening into which the instrument, being elastically suspended above the opening, may be lowered. Claims allowed, 9.

INDEX

[The figure in parentheses refers to the class in which the entry stands; see list in table of contents]