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

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Bulletin 895–A

GEOPHYSICAL ABSTRACTS 88

JANUARY–MARCH 1937

COMPILED BY

W. AYVAZOGLOU

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1937

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

CONTENTS

GEOPHYSICAL ABSTRACTS 88, JANUARY–MARCH 1937

Compiled by W. AYVAZOGLOU

PREFATORY NOTE

The geophysical section of the Bureau of Mines was transferred to the Geological Survey July 1, 1936. Prior to that date mimeographed abstracts of geophysical literature numbered 1 to 86 had been published monthly by the Bureau of Mines. No. 87, containing abstracts for the period July to December 1936, and an index to abstracts 81–87, January to December 1936, was published as Geological Survey Bulletin 887. Beginning with the present number, which covers the period January to March 1937, it is planned to issue the abstracts as separate chapters, each chapter covering 3 months, and four chapters forming a complete bulletin for the calendar year.

1. GRAVITATIONAL METHODS

3525. Ansel, E. A., Schwereanomalien in Beziehung zu der Form der Störung des Schichtenverbandes in der Erdkruste [Gravity anomalies with regard to the form of disturbance of strata in the earth's crust]: Beitr. angew. Geophysik, vol. 6, no. 2, pp. 141–167, Leipzig, 1936.

Gravity anomalies arise from a deviation of the normal state of the density distribution, and therefore they must be due either to a mechanical action or to a thermochemical dissociation within the different strata. Instead of analyzing gravity anomalies from the observed field with regard to their potential source, which usually involves an estimate of doubtful foundation, the author proposes to begin with the reversed problem by working out the field of anomalies belonging to definite ridges or troughs at various depths. The most simple representation of the field is, then, its profile across a normal section of the adopted prism, the plane of reference being the sea level. Profiles of anomalies corresponding to the assumed density disturbances are presented as examples. The results are shown in diagrams.—*Author's abstract.*

3526. Das "Thyssen-gravimeter" in der Ölprospection [The "Thyssen-gravimeter" in prospecting for oil] [editorial]: Petroleum, vol. 32, no. 44, pp. 18–20, Berlin, 1936.

The success of the Thyssen gravimeter since its application about 2 years ago is briefly outlined. The possibility of measuring ten or more stations during one day with a mean error of not over ± 0.25 milligal

makes the apparatus very valuable. A number of these instruments are already in use in Germany, North and South America, Rumania, and other countries. Photographic pictures of various types are added. (See also Geophys. Abstracts 74, 77, 79, and 87).—*W. A.*

3527. Gassmann, Fr., Modifikation des Verfahrens von Haalck zur Berechnung von Geländekorrektionen bei Drehwaagenmessungen [Modification of Haalck's method for calculating the terrane corrections in torsion-balance measurements]: Beitr. angew. Geophysik, vol. 6, no. 2, pp. 202–203, Leipzig, 1936.

A series of corrections in diagrams "Gradient" and "Curvature" shown on page 166 of Haalck's article published in Zeitschrift für Geophysik, vol. 4, pp. 161–178, 1928, "Ein graphisches Verfahren für Drehwaagenmessungen zur Berechnung der Geländewirkung und der Wirkung beliebig gestalteter Massenkörper", is proposed.—*W. A.*

3528. Gravity measurements in Sweden [editorial note]: Nature, vol. 138, no. 3499, pp. 889–890, London, 1936.

The communication published in this number of Nature reads as follows:

"Part 2 of vol. 25 of Archives of Mathematics, Astronomy, and Physics of the Swedish Academy of Sciences contains two communications which show that progress is being made in the geophysics of Sweden. The first, by Drs. G. Ising and T. Eeg-Olofsson, gives an account of the measurements of the gravitational acceleration in the extreme south of the country by a modified form of the quartz-fiber torsion method used by Threlfall in Sydney, 40 years ago. The horizontal quartz fiber is supported at its ends by the lower forked end of a rod suspended like a pendulum from a support at its upper end. The center of the fiber has attached to it one end of a small rod of quartz 1.6 centimeters long, and the fiber is twisted until the rod is nearly horizontal, when a very small change of gravity makes a considerable change in the position of the free end observed by a microscope. The torsional constant of the fiber is kept constant by surrounding the apparatus with ice. The results show that the variations of gravity with latitude and height are nearly normal over limestone districts, but over the higher districts of Cambrian and Silurian rocks gravity exceeds the normal value by 0.04 or 0.05 C. G. S. unit."

The second communication, by Dr. G. S. Ljungdahl, on the magnetic anomalies, shows that they are much greater in Sweden than in France and that over the Baltic depression of 400 meters southeast of the island of Uto the normal deviation of the compass to the west (about 5°) is reduced by 1°. The author hopes, as more results for gravity throughout Sweden become available, to trace further relations between regional anomalies of gravitation and the earth's magnetism.

3529. Haalck, H., Bericht über den gegenwärtigen Stand der Entwicklung des statischen Schweremessers [Report of the present condition of the development of the statical gravity meter]: Zeitschr. Geophysik, vol. 12, no. 7–8, pp. 356–360, Braunschweig, 1936.

The results obtained with the improved field instrument built in 1934–35 by the Geodetic Institute and used in the geophysical prospecting of the Reich are briefly described. Technical improvement of the statical gravity meter consists mainly in having all the glass connections replaced by stable pipes and taps, thus excluding the possibility of any damage without affecting the accuracy of the instrument; temperature

regulation is automatic, and the necessity of using ice is excluded; the instrument is provided with a barometric altitude-measuring device; the same instrument may be used for measuring at sea by changing the reading device and inserting a damping device; special attention is given to the temporal change of the zero position, which is still affected sometimes. It would be possible to measure 340 new points of the second order during a month by working 7 hours a day. The accuracy of first-order points is ±0.5 milligal, and of second-order points 1 milligal. Higher accuracy may be obtained by repeating the measurements several times.—*W. A.*

3530. Ising, G., and Eeg-Olofsson, T., Gravity measurements in southern Sweden with astatic quartz pendulum: Arkiv f. Mat., Astron. och Fysik, 25A, no. 13, 22 pp., Stockholm, 1936.

Several small alterations (six of which proved to be improvements and two the reverse) in the astatic pendulum are described; and the use of the revised instrument, which with the 4 kilograms of ice required weighs in all about 30 kilograms and enables gravity to be determined at the rate of about 100 stations a month, is illustrated by a series of determinations in the extreme south of Sweden and (for checking) at Copenhagen. The results show close agreement with ordinary pendulum observations. The slight differences and possible sources of error are discussed, as also the variation in gravity with geological formation.—*C. A. S., Sci. Abstracts, vol. 39, no. 468, 1936.*

3531. Longwell, C. R., Geological interpretation of gravity anomalies in Connecticut and Massachusetts [abstract]: Geol. Soc. America Preliminary list of titles and abstracts of papers to be offered at the 49th Ann. Meeting, Cincinnati, Dec. 29–31, 1936.

The United States Coast and Geodetic Survey has established 61 gravity stations in Connecticut and Massachusetts, at points chosen with regard to the geology. Nearly half the stations are within the area of Triassic rocks; the others are on the older formations. Specific gravities of rock specimens collected near all stations have been determined. Systematic differences in the gravity anomalies correspond only in part to known variations in lithology and structure. A west-east gravity cross section in Connecticut shows a gradual and persistent change from large positive to large negative anomalies, with minor fluctuations related to the local geology. An isoanomaly map constructed from all data in southern New England indicates a large gravity "syncline" plunging southward through Rhode Island and a broad "anticline" in western Connecticut and Massachusetts. Hypothetical warping of heavy crustal layers at considerable depth, as suggested by Glennio for India, is offered as a logical explanation of the regional distribution of the anomalies.—*Author's abstract.*

3532. Mader, K., Gradient and curvature of a segment of an infinite horizontal cylinder: Gerlands Beitr. Geophysik, vol. 48, no. 4, pp. 417–427, 1936.

A mathematical discussion of the gravitational effect of a cylinder of given density, lying horizontally, is given.—*W. A.*

3533. Numerov, B., Grundsätze der Methodik der Bestimmung des Geoids auf Grund gravimetrischer und astronomisch-geodätischer Beobachtungen [Principles of the method for determining the geoid based on gravimetrical and astronomic-geodetical observations]: Acad. sci. U. R. S. S. Comptes rendus (Doklady), vol. 3, no. 6, pp. 269–270, Moscow, 1936.

Two single problems are considered. The first is the determination of the geoid in general having a regular mathematical form. This can be solved by the development of the radius according to spherical functions. The second problem is the determination of local "undulations" of the geoid with reference to the figure in general. If the gravity anomalies with regard to the geoid in general are known, the astronomical observations at the points of first-class triangulation for the local anomalies or "undulations" of the geoid may be corrected according to the integration formulas.—*W. A.*

3534. Numerov, B., and Khramov, D., Figure of the geoid and gravity measurements: Gerlands Beitr. Geophysik, vol. 48, no. 2–3, pp. 193–208, Leipzig, 1936.

The application of the usual linear relations between the coefficients of the spherical development of the radius vector of the geoid and of gravity involving errors of the order of the square of flattening is emphasized. Formulas 56 and 57 of the original paper give developments of the radius vector of the geoid and of gravity to spherical functions of the fourth order, and to quantities of the order of the square of flattening, inclusive. Some methods of deriving the figure of the geoid are suggested.—*Authors' abstract.*

3535. Numerov, B. V., and Khramov, D., Über die Bestimmung der Figur des Geoids aus Schweremessungen [On the determination of the figure of the geoid from gravity measurements]: Acad. sci. U. R. S. S. Comptes rendus (Doklady), vol. 3, no. 6, pp. 265–268, Moscow, 1936.

For determining the figure of the geoid from the values of gravity established on its surface the problem may be solved best by developing the gravity g and the radius vector R of the geoid in series according to the functions of latitude and longitude. The developments of the radius vector of the geoid and of gravity are mathematically discussed, taking into consideration the values of the order of the square of flattening.—*W. A.*

3536. Pekár, Desider, Die Eötvösche Drehwage im französischen Limagne [Eötvös torsion balance in the French Limagne]: Ungar. Akad. Wiss. Math. Naturwiss. Anz., vol. 54, part 1, pp. 117–134, Budapest, 1936.

A small torsion balance of old construction and the new Eötvös-Pekár field instrument called the "small original Eötvös made in Hungary" were used. Measurements at 144 stations were made during 2 years, covering an area of 198 square kilometers. The results are presented in tables and graphically in two maps. Although structures for possible large accumulations of oil were not detected, the conclusion is drawn that there are sufficient indications that larger oil bodies may be found if the measurements are extended over a greater region of the Limagne plain.—*W. A.*

3537. Prey, A., Moving continents: Gerlands Beitr. Geophysik, vol. 48, no. 4, pp. 349–387, Leipzig, 1936.

The force driving a continent toward the pole is calculated. It is found that there are small movements of translation and rotation. The effect is very small, and the conclusion is made that the continent does not move at all.—*W. A.*

3538. Sorber, Heinz, Über ein zweifedern-Gravimeter [On a two-spring gravimeter]: Physikal. Zeitschr. vol. 37, no. 16, p. 599, 1936.

The bifilar gravimeter has two great disadvantages: the work must be done close to the changing point, and the deflection is not proportional to the change of gravity. These disadvantages disappear when one spring of the bifilar gravimeter is replaced by two spiral springs, each provided with a mirror. In order to obtain the required sensitivity the registering light ray strikes the two mirrors several times successively. A sensitivity of 5.10^{-8} g/mm was obtained with the experimental instrument provided with temperature protection and temperature compensation. It could be shown that the variation of gravity equal to 10^{-6} g, as stated by Courvoisier, did not occur.—*W. A.*

3539. Uspensky, D. G., Test work performed by the gravimetrical method on the iron-ore deposits of the Kola Peninsula [in Russian]: Inst. mines à Leningrade Annales, vol. 9, no. 2, pp. 27–39, 1936.

The results of tests in the iron-ore deposits of the Kola Peninsula are discussed. According to the results the gravitational method of prospecting was applicable and economical. The conclusion is drawn that, combined with the magnetic method and drilling, the method is suitable for the survey of deposits of the hematite type. A detailed description of the method, accompanied by 9 figures, is given. Of the data obtained by observation 97 percent were proved to be reliable. This was due mainly to careful preliminary testing of all the instruments used, as well as to the system of work adopted.—*W. A.*

3540. von Thyssen, St., and Schleusener, A., Vorführung von Messungen mit dem Thyssen-Gravimeter in einem Personenwagen [Measurements with the Thyssen gravimeter in a passenger automobile]: Oel und Kohle, vol. 12, no. 42, pp. 904–905, Berlin, 1936.

The simplicity of making measurements with the Thyssen gravimeter is illustrated by a numerical example. The gravimeter installed for use in an ordinary automobile and the spring suspension provided for transportation are shown in pictures.—*W. A.*

3541. von Zwerger, R., Der Wert der regionalen Gravimeter-Messungen als Vorstufe für die weitere Erforschung des Untergrundes mit Hilfe geophysikalischer Sonderuntersuchungen [The importance of regional gravimeter measurements as a first step in the further subsurface exploration by geophysical methods]: Oel und Kohle, vol. 12, no. 42, pp. 897–901, Berlin, 1936.

The results of regional gravimeter measurements in the tablelands around the Lower Saxonian Basin are outlined in connection with the tectonics of salt domes, with reference mainly to oil geology. The relationship between the regional gravity picture and the structure of salt domes near Hannover and in Schleswig-Holstein is examined, and the influence of salt structure on the configuration of the regional gravity picture in particular is discussed.—*W. A.*

2. MAGNETIC METHODS

3542. Aschenbrenner, Hans, and Goubau, Georg, Eine Anordnung zur Registrierung rascher magnetischer Störungen [A device for registering quick magnetic disturbances]: Hochfrequenz-Technik und Elektroakustik, vol. 47, no. 6, pp. 177–181, Leipzig, 1936.

If an iron core is placed in an earth's magnetic field and is magnetized by a sinusoidal alternating current, an alternating flux of double the frequency of the exciting current is developed, the amplitude of which changes with the change of the intensity of the exciting current. The alternating flux induces voltage in a coil which is amplified and then rectified. The resulting current is recorded; it represents a proportional reproduction of the temporal course of disturbances. The arrangement reacts to field fluctuations of less than 0.3 γ.—*Author's abstract, translated by W. A.*

3543. Bartels, J., Aufschlüsse über die Ionosphäre aus der Analyse sonnen- und mondentägiger erdmagnetischer Schwankungen [Information on the ionosphere from analyzing the diurnal earth-magnetic variations caused by the sun and the moon]: Zeitschr. Geophysik, vol. 12, no. 7–8, pp. 368–376, Braunschweig, 1936.

Conclusions on ionization and movement in the ionosphere can be drawn from diurnal earth-magnetic variations. The lunar diurnal variations L are especially suitable for this information because their origin is physically much simpler than that of the solar variations S. From the observed ratio of the intensity of L to S it seems that the diurnal variations of the temperature occurring in the layers below the ionosphere are not as great as sometimes accepted. On the basis of observations of the horizontal intensity made during 12 years in Huancayo, Peru, the L and S are examined in their relation to season, conditions of sun spots, and the conditions of the earth-magnetic disturbances. The lunar variation L at this station was found to be the highest in summer for any existing observatory, not only with regard to its absolute value but also in comparison with the solar variation S; therefore it is the most suitable one for making further analysis.—*Author's abstract, translated by W. A.*

3544. Dick, James A., Progress in magnetometer exploration leads to resurvey of many areas: California Oil World, vol. 29, no. 15, Los Angeles, 1936.

Improvements in the magnetometer method of geophysical prospecting made during recent years are classified under three headings—(1) equipment, (2) technique, and (3) interpretation. (1) The instrumental error of ± 2 γ is obtained and the accuracy of reading correspondingly increased (8 to 10 years ago the minimum error was 8 to 10 γ). The error caused by the effect of changes in temperature is almost entirely eliminated. (2) Additional accuracy resulted from taking readings at shorter intervals, checking into the base station from 4 to 6 times a day (previously twice a day) and frequently checking stations previously taken. The leveling is carried on more carefully. (3) Certain improved methods of dealing with maps have been developed, one of which has been the elimination of regional gradients. An attached map, made from an actual survey, shows the contour lines before and after making the regional correction.

Much progress has been made in understanding the problem of polarization, as it was impossible for many years in a polarized area to know whether a magnetic high represented a structural high or low, and the same uncertainty existed with magnetic lows. In view of the improvements outlined, the author thinks that it might be worth while for California oil operators to turn their attention to the magnetometer method of geophysical prospecting.—*W. A.*

3545. Gassmann, Fr., Störung des Erdfeldes durch induktiv magnetisierte Einlagerungen [Disturbance of the earth's field by deposits magnetized by induction]: Beitr. angew. Geophysik, vol. 6, no. 2, pp. 204–205, Leipzig, 1936.

The earth's magnetic field changes if a homogeneous paramagnetic or diamagnetic body is included in it, owing to the magnetism induced on this body. The change of the field has been calculated for various simple forms of such bodies, always under the assumption that the undisturbed earth's field is homogeneous. The calculations were usually based on the assumption that the field induced in the body was homogeneous. Such an assumption resulted naturally in an approximate solution only and was not satisfactory, because the degree of the approximation was not known. A mathematical solution by using a linear integral equation having only one meaning is given—*W. A.*

3546. Katō, Yosio, Magnetic disturbance in the seismic area of the semidestructive Siduoka earthquake of July 11, 1935: Imp. Acad. Proc., vol. 12, no. 4, pp. 91–92, Tokyo, 1936.

In connection with earthquakes in Siduoka and Simidu on July 11, 1935, magnetic measurements of inclination were made in July, August, and November 1935 and January 1936. The values measured have shown different variations, the maximum of which is about 1°. From these measurements the conclusion is drawn that the center of the magnetic disturbances coincides with the center of the earthquake and lies at a depth of only a few kilometers.—*W. A.*

3547. Kelly, S. F., Magnetic prospecting: Science Today, vol. 6, no. 1, pp. 15 and 19, 1936.

Owing to the various effects exerted by rocks on the earth's magnetic field, differences in intensity may be measured with magnetic-field balances, making it possible to outline the formations below and to detect valuable deposits. As an example, the discovery of the extension of the famous gold "reefs" of the Rand in South Africa by magnetic work is mentioned.—*W. A.*

3548. Koenigsberger, Johann, Magnetische Susceptibilität von zentral schweizerischen Gesteinen und Arealsusceptibilität der Alpinen Strecke von Flüelen bis Bellinzona [Magnetic susceptibility of rocks from the Swiss Central Alps and the areal susceptibility of the region from Flüelen to Bellinzona]: Schweiz. Min. pet. Mitt., vol. 16, pp. 209–214, 1936.

The magnetic volume susceptibility K of about 200 metamorphic, intrusive, and sedimentary rocks on a profile through the Swiss Central Alps from Flüelen to Bellinzona was measured. A part of K of each eruptive rock is paramagnetic, owing principally to biotite and amphibole; the remaining larger part is ferromagnetic, owing to magnetite, pyrrhotite, ilmenite, and hematite. The natural residual magnetism of these rocks is weak but measurable, though sometimes zero. The Aare granite has an average $K=4.5.10^{-5}$. The whole complex of crystalline schists, etc., of the Aaremassiv, calculated by taking account of the areal extension of the different rocks, has $K=4.10^{-5}$, of the Gotthard 5, of the Pennin overthrust to Bellinzona 8.10^{-5}; the average of all is 6.10^{-5}, while G. Grenet has found for 14 metamorphic rocks values which give an average $K=5.10^{-5}$.—*Author's abstract.*

3549. Kolomietz, K. W., Examination of the needle declinometer [in Russian]: Central Geophys. Obs. Trans., no. 11, pp. 81–90, Leningrad, 1936.

M. Hildebrandt's no. 68230 declinometer, in which the magnet is placed on a needle and is not suspended on a fiber, is examined. The conclusion is drawn that the needle declinometer, by which the same accuracy may be obtained as with the declinometer having the magnet suspended on a fiber, has considerable advantages with regard to the convenience of observation and shortening of time. Under favorable conditions an accuracy of 0.5′ may be attained easily. A brief description of the declinometer and the method of using it is given.—*W. A.*

3550. Malkin, On the magnetization of two infinite cylinders [in Russian]: Central Geophys. Obs. Trans., no. 11, pp. 59–66, Leningrad, 1936.

A mathematical discussion based on Poisson's theory is given on the question of magnetization of bodies limited by two infinite, non-intersecting cylindrical surfaces with parallel axes which are situated in a given two-dimensional field perpendicular to the direction of the axes, or in any homogeneous field. As a special case, the author examines two single cylinders in a homogeneous field. A numerical example is given.—*W. A.*

3551. McNish, A. G., An induction variometer to measure magnetic anomalies: Rev. Sci. Instruments, vol. 7, pp. 336–338, Lancaster, Pa., 1936.

A new type of variometer to record continuously time changes in the earth's vertical magnetic force has been developed during the past year at the Department of Terrestrial Magnetism of the Carnegie Institution of Washington for use at magnetic observatories. Certain modifications are necessary to develop the variometer as a field instrument. The difficulties encountered in earlier designs, especially the frequent rupture and distortion of knife-edges, are eliminated in the new instrument by a proper selection of material and by features of design. A description of the variometer, accompanied by figures, is given. One outstanding advantage is increased reliability of performance, so that greater significance can be attached to each observation, and repeat observations, which are frequently necessary with the present type of balance, owing to damage to the knife-edges, may be eliminated.—*W. A.*

3552. McNish, A. G., Magnetic effects associated with bright solar eruptions and radio fade-outs: Nature, vol. 139, no. 3510, p. 244, London, 1937.

From observations of disturbances of the earth's magnetism accompanying hydrogen eruptions in the sun, McNish infers that magnetic disturbance may be attributed to a sheet of current in the electrical layer of the upper atmosphere (ionosphere), together with oppositely directed currents in the earth.—*Editorial abstract.*

3553. Nikologorsky, A., The magnetic field of a homogeneously magnetized lens (in Russian): Central Geophys. Obs. Trans., no. 11, pp. 22–31, Leningrad, 1936.

Expressions for the potential and the field components of a homogeneously magnetized lens are given. The direction of magnetization is assumed to be perpendicular to the surface of the foundations of the segments forming the above-mentioned body. The expressions of the components are given in the form of simple integrals, the integrating functions of which depend with sufficient simplicity on Legendre's full elliptical integrals of the first and second kind. This fact makes the application of the method of mechanical quadratures for the calculation

of components possible. It is proved that both the components show logarithmic singularities on the line of the juncture of the lens.—*Author's abstract, translated by W. A.*

3554. Poisson, Charles, Sur quelques roches magnétiques des environs de Tananarive (Madagascar) [On some magnetic rocks in the vicinity of Tananarive]: Acad. sci. Paris Comptes rendus, vol. 203, no. 26, pp. 1483–1485, 1936.

Magnetic anomalies were studied, samples were examined, and data concerning their susceptibility and magnetization are given in a table.—*W. A.*

3555. Popoff, A. I., Magnetic field of an oblique fault [in Russian]: Central Geophys. Obs. Trans., no. 11, pp. 32–58, Leningrad, 1936.

The author examines a two-dimensional problem on the magnetization of a body the normal section of which has the form of two similar parallelograms adjoining one another and slightly displaced one with respect to the other. The problem is discussed under two special assumptions with regard to the magnetic capacity—namely, for a small magnetic susceptibility (K) and for the case in which $K = \infty$. The article treats the solution of the problem under the assumption of a small K. The problem was solved for the special case of a semi-infinite fault.—*Author's abstract, translated by W. A.*

3556. Royce, Stephen, Some applications of magnetic surveying to exploration: Min. Cong. Jour., vol. 22, no. 12, pp. 24–26, 48, Washington, 1936.

A few specialized applications of magnetic work on the Lake Superior iron ranges are discussed. In addition to the common dip needle, the Hotchkiss superdip and the magnetometer were used. Graphic illustrations of the magnetic pictures of various formations are presented with comments on their interpretation and use in exploration. After a brief description of the methods in general, a few illustrations of magnetic surveying in the solution of special problems are given. Figure 1 shows the use of closely detailed magnetic surveying in tracing an ore-bearing bed in the Upper Huronian of Iron County, Mich., around a fold. Figures 2 and 3 show comparative magnetic profiles taken with the magnetometer. Figure 4 is a superdip profile. Figure 5 is a profile and cross section with the common hand dip needle. Figure 6 illustrates a typical cross section along the strike of a specular hematite Middle Huronian iron-formation of the Menominee ranges. The illustrations have been selected to show the usefulness of the different types of instruments.—*W. A.*

3557. Sluchanovsky, A., The mutual potential of two arbitrary magnets and its expression in the form of a function of six elements by which the position of the two bodies is characterized [in Russian]: Central Geophys. Obs. Trans., no. 11, pp. 67–80, Leningrad, 1936.

A formula, based strictly on mathematical theory, by which the mutual potential of two arbitrary magnets is expressed by a function of five angles and one length, is given. Several questions connected with this problem are discussed.—*W. A.*

3558. Smith, A. J., Geophysical prospecting at the Windpass mine: Miner, vol. 10, no. 1, pp. 28–29, Vancouver, 1937.

A geophysical survey of the Windpass mine, Mount Olie, British Columbia, commenced July 18 and completed August 20, 1936, com-

prised a detailed geologic survey and a magnetic survey supported by an electrical survey when the magnetic indications showed zones of concentration. Three zones of magnetic concentration were found, as follows: (1) At the present Windpass workings; (2) about 2,100 feet east of the Windpass workings, on the Brenda and Signe fractions and in the line of strike of the present deposit now being worked; (3) on the Belfast, Bonegal Fifty M. C. and Fifty-one M. C. fractions, in the southeastern part of the property. The cost of the survey was approximately $8,000 and adding the cost of the diamond-drilling program, this will represent the entire charge for prospecting and exploring the 38 Windpass claims, as contrasted with about $88,000 required for prospecting the 2 claims at present producing.—*W. A.*

3559. Stroganov, V., and Svetlov, A., On the solution of the Robin-Poincaré problem for a rectangle [in Russian]: Central Geophys. Obs. Trans., no. 11, pp. 5–21, Leningrad, 1936.

The authors treat the Robin-Poincaré magnetic problem for the case of a two-dimensional rectangle and find the harmonic function sought for outside of the rectangle, with the aid of a function by which the outside area is transformed into a circle with a radius equal to 1. The function to be found is represented analytically in the form of a potential series whose coefficients are found from an infinite system of linear equations that are derived from an integral equation for the function. An approximate solution of the infinite system is found according to the method of abbreviated systems. The proposed method of the solution of the magnetic problem is convenient for any value of the magnetic permeability μ. If μ is about equal to 1, the proposed solution is in conformity with the solution obtained when the integral equation is solved according to the method of the successive approximations. On the other hand, if $\mu = \infty$, the above-mentioned solution is changed into the well-known solution of the electrostatic problem obtainable with the aid of Green's function.—*Authors' abstract, translated by W. A.*

3560. Toperczer, Max, Zur Kenntnis des erdmagnetischen Feldes nach den Ergebnissen der magnetischen Landesaufnahme von Österreich 1930.0; Verbesserung einiger Werte der Vertikalintensität [On the knowledge of the earth's magnetic field from the results of the magnetic survey of Austria 1930.0; Correction of some values of the vertical intensity]: Akad. Wiss. Wien, Math.-naturwiss. Kl., Sitzungsber., vol. 145, no. 5, pp. 347–356, 1936.

The existence of some errors in the values of the vertical intensity determined indirectly from the horizontal intensity and inclination was proved for 12 stations of the survey by comparison with the measurements made with the vertical field balance. At 8 stations this error reached 15 γ. At the remaining 4 stations the errors were much greater, at one more than 100 γ. There are no other practical and convenient means for the verification of the values of the vertical intensity obtained from the magnetic survey than checking them by measurements with the vertical field balance.—*W. A.*

3561. Torreson, O. W., Scott, W. E., and Stanton, H. E., A solar eruption and simultaneous disturbances at Huancayo magnetic observatory: Science, new ser., vol. 83, no. 2159, pp. 463–464, 1936.

An unusual solar eruption was observed at the magnetic observatory near Huancayo, Peru, on April 8, 1936, which produced simultaneous disturbances in terrestrial magnetism and earth currents.—*W. A.*

3. SEISMIC METHODS

3562. Bastings, L., Some seismological aspects of the Buller earthquake, II, The P waves in the distant hemisphere: New Zealand Jour. Sci. and Tech., vol. 18, no. 4, pp. 396–409, Wellington, 1936.

In an earlier paper on the subject of the Buller earthquake of 1929 (New Zealand Jour. Sci. and Tech., vol. 15, p. 128, 1933) it was shown from the evidence of 34 stations in the nearer hemisphere that the earthquake consisted of a triple disturbance in dynamic connection. In this paper a detailed account is presented of the primary waves from the Buller earthquake as recorded in the distant hemisphere. These appear distinctly in the shadow zone, for which a travel-time table has been deduced for both the direct P (diffracted) and PKP, which has traversed the earth's core (refracted). Beyond the shadow zone two branches of PKP have been followed almost to the antipodes. The details of these phases provide material for travel-time tables and also confirm the opinion previously reached that the Buller earthquake consisted of a triple disturbance.—*Author's abstract.*

3563. Bois, Charles, Sur l'importance des ondes longues et la profondeur du foyer des tremblements de terre [On the effect of long waves and the depth of the focus of the earthquake]: Acad. sci. Paris Comptes rendus, vol. 203, no. 9, pp. 948–949, 1936.

Qualitative examination of 212 seismograms selected from a great number of those recorded in Strasbourg with 12 sec. period Galitzin apparatus during the years 1923 to 1929 shows that when the focal depth is less than 80 kilometers the *L* waves are, as a rule, normal—that is, their amplitude observed in the seismogram is greater than the amplitude of the longitudinal and transversal waves—and when the focal depth is greater than 200 kilometers the *L* waves are always minor ones. At intermediate depths the *L* waves are sometimes normal, sometimes minor. Therefore, if the amplitude of superficial waves is a function of the depth of the focus of an earthquake, other factors must interfere, such as nature of the course of the wave (sea or land), geologic structure of the subsoil, at the focus and at the station of observation. The criterion of the depth of a focus based on the relative consequence of long waves and preliminary waves should be abandoned.—*W. A.*

3564. Bullen, K. E., On near earthquakes in the vicinity of New Zealand: New Zealand Jour. Sci. and Tech., vol. 18, no. 6, pp. 493–507, Wellington, 1936.

A numerical analysis of certain New Zealand earthquakes from a series recently investigated by Hayes suggests that the following improvements could most usefully assist future investigations of crustal structure in New Zealand regions:

(*a*) Absolute time to at least the nearest second is needed for at least five and preferably ten stations in order to produce direct evidence as to the velocity of P_n. The velocity of about 8.10 km./sec. given in the article was inferred from circumstantial evidence, and it is very necessary to have direct confirmation.

(*b*) Systematic late readings of subsidiary pulses of earthquakes whose intensity is less than 9 on the Rossi-Forel scale indicate the desirability of having more sensitive instruments at some stations, as, fortunately, earthquakes of maximum intensity 9 or 10 are comparatively infrequent.

(*c*) The apparent absence of P_n at Christchurch suggests the desirability of setting up a good station at about the same distance as Christ-

church from most epicenters, which is not liable to be affected by microseisms and will be capable of detecting the onset of P_n.

(*d*) The fact that even at a distance of 5° an error in reading of 1 second will cause an error of 0.1 km./sec. in the velocity of P_n makes it desirable to have at least two or three good stations at fair distances from the epicenters—for example, in the north of the North Island and in the south of the South Island of New Zealand.—*Author's conclusions.*

3565. Bullen, K. E., The variation of density and the ellipticities of strata of equal density within the earth: Monthly Notes, Geophys. Suppl., vol. 3, no. 9, pp. 395–401, London, 1936.

According to the new seismic investigations at a depth of about 400 kilometers there is a layer of discontinuity with a density of about 4. From this figure the following distribution of density is calculated: Mean density of masses lying outside of the core, 4.45; density at 400 kilometers of depth, 4.077; at 2,900 kilometers of depth above the border of the core, 5.47; at 2,900 kilometers of depth below the border of the core, 9.93; mean density of the core, 10.89; density at the center of the earth 12.26. The core consists, according to its density, of iron with little or no heavy metals. The oblateness of the level surfaces increases from 1:297 at the surface to 1:391 at the center.—*W. A.*

3566. Bungers, R., Neuere Untersuchungen über Schwingungsformen in der angewandten Seismik [Recent investigations on the forms of oscillations in applied seismics]: Zeitschr. Geophysik, vol. 12, no. 7/8, pp. 347–349, Braunschweig, 1936.

The purpose of these investigations, carried out by the Geophysical Institute in Göttingen during recent years, consisted of determining not only the initial oscillations but also the whole movement of the ground as caused by shock-shaped and sine-shaped impulses in order to obtain data for drawing conclusions on subsurface structure. The three components of the amplitudes and phases of the ground were to be recorded. Two methods by which conclusions on the structure of the underground based on the measured amplitudes could be drawn are examined. The first method relates to the blasting seismics, or more exactly to the determination of the inclination of the layers in the subsoil solely by amplitude measurements. This method, as developed and applied in practice by the Geophysical Institute, is described. The second method relates to the investigation of the underground by means of mechanical oscillations (Maschinenschwingungen). The sinusoidal variable elastic energy is introduced into the ground by means of an oscillation machine with an eccentric.—*W. A.*

3567. Carder, D. S., Observed vibrations of buildings: Seismol. Soc. America Bull., vol. 26, no. 3, pp. 245–278, 1936.

Results of comprehensive observations on the vibration of a series of selected buildings are discussed from the data compiled in numerous tables and vibrograms.—*W. A.*

3568. Davies, R., The use of reversed refraction arcs in seismic surveying: Inst. Petroleum Technologists Jour., vol. 23, no. 159, pp. 31–39, London, 1937.

In the refraction arc method, as described in detail by J. H. Jones in his article "A seismic method of mapping anticlinal structures" (World Petroleum Cong., 1933, Proc., vol. 1, p. 169), the seismometers are arranged on an arc of a circle, at the center of which is located the shot point. The travel times of the pulses initiated at the shot point are

recorded at the seismometer stations and plotted against the arcual distances of the observation points. This time profile gives a qualitative picture of the structure of some underlying medium.

This article describes the adaptation of this method to the exploration of an area that presented certain difficulties to the ordinary application of the method. In this area the uncertainty of the strike of the underlying structure rendered the shooting of linear traverses for the purpose of obtaining the necessary velocity data highly speculative. The problem was simplified, however, by the fact that, at about 15 miles from the area to be explored, the underground structure had been well defined by drilling. The method by which the information on the known section was utilized in the seismic exploration of the new area by means of reversed refraction arcs is illustrated in a figure, which shows the layout of the "datum" and exploratory arcs. In another figure is shown the time profile of the exploratory arc, which covered a span of 9 miles. The profile, interpreted as a qualitative picture of the underlying structure, indicates the presence of an anticline with one point on the axis, located about 13,000 feet northeast of the pole of the arc.—*W. A.*

3569. Fukutomi, Takaharu, Some statistical problems concerning initial earthquake motion: Earthquake Research Inst. Bull., vol. 11, no. 3, pp. 510–529, Tokyo, 1933.

The similarity of "push" or "pull" of initial motions due to earthquakes occurring at nearly the same place was ascertained in the Kwanto district from the data of earthquakes occurring during about 18 years, from 1914 to 1931. On the assumption that the mechanism of the earthquake is that the forces of equal magnitude and of opposite direction act in a line at the hypocenter, it is easy to see that the "pull-push" distribution of initial motion on the earth surface has nodal curves of second degree—namely, ellipse or hyperbola in general and parabola in special case, according to the inclination of the axis of the double force to the earth surface. The relation between the nodal curves and the focal depths of the earthquakes is examined statistically, as a first step in examining the relation between the inclination of the axis of double force and the focal depth. The result was that the earthquakes of nodal hyperbola are frequent in the uppermost layer (depth 10 to 25 kilometers), and those of nodal ellipse in the middle layer (depth 25 to 50 kilometers)—*Author's abstract.*

3570. Gutenberg, Beno, Structure of the earth's crust and the spreading of the continents: Geol. Soc. America Bull., vol. 47, no. 10, pp. 1587–1610, 1936.

Investigations concerning the propagation of earthquake waves have led to the conclusion that the part of the earth's crust covered by sial comprises the continents, the Atlantic and the Indian Oceans, and the main part of Polynesia. The sialic crust under the continents has, in general, a thickness of 40 to 50 kilometers. It decreases toward the oceans and probably has about half that thickness in the bottom of the Atlantic and Indian Oceans. This fact contradicts the theory of Wegener, for there is so much sial between the continents that they never could have been as close together as Wegener assumed. The Fliess theory, however, in a simple way explains many other facts; therefore the writer assumes that the continents have changed their distances and positions by plastic flow, but that, otherwise, the history of the continents and oceans corresponds roughly to the sketch given by Wegener. The movements in the regions covered by ice during the ice

age present an example of such a flow and indicate the speed to be expected in such a flow. Calculations by Haskell provide more detailed data and show that stresses not only affect the region at the depth where they occur but also produce flow at depths extending over hundreds of kilometers. Deep-focus earthquakes have properties similar to the shallow shocks in the same region. In the region surrounding the Pacific Ocean they usually occur inland of the shallow shocks, probably because, at the surface, the load of the continents produces a flow toward the Pacific, but at depth there is a compensating movement in the opposite direction. The details of the movements of the continents in time and space must be found by special geologic and paleontologic investigations. The illustrations given are a first approximation and could be extended to earlier periods by using the findings concerning these periods. Theoretical speculation, based on the acting forces, is not yet possible, for the forces that disturb the equilibrium of the earth's crust are not yet known. Possibly they are due to thermodynamic processes, which are maintained by heat from radioactivity.—*Author's conclusions.*

3571. Gutenberg, B., The amplitudes of waves to be expected in seismic prospecting: Geophysics, vol. 1, no. 2, pp. 252–254, Houston, Tex., 1936.

A method of calculating the amplitudes of bodily waves in earthquakes is applied to a study of the amplitudes of longitudinal waves produced by an artificial explosion. Formulas are given for calculating the energy of the reflected longitudinal wave arriving at the surface. The percentage of energy reflected at a discontinuity increases rapidly after the angle of incidence exceeds the critical refraction angle. However, no corresponding large amplitudes are recorded by the instruments. Instead, the maximum amplitudes of reflected waves are found near the shot point. This is because the ground movement is due both to the arriving wave and to the wave reflected downward from the ground. The amplitude of this movement depends, besides, on the rate of change of the angle of incidence with distance. It is pointed out that the same methods can be applied to a dipping bed, and that the amplitudes of the reflected waves are in general slightly larger in the up-dip than in the down-dip direction.—*Author's abstract.*

3572. Gutenberg, B., On some problems concerning the seismic field methods: Beitr. angew. Geophysik, vol. 6, no. 2, pp. 125–140, Leipzig, 1936.

The periods of longitudinal waves produced by explosions increase with distance in a similar way to earthquake waves. The amplitudes of waves depend not only on the amount of energy reflected or refracted at discontinuities, but also on the angle of incidence at the instruments and its rate of change with distance. Calculations on the relative amplitudes of direct, reflected, and refracted waves are in agreement with the observations. Formulas are given to calculate the approximate dip of discontinuities using either the distance at which the travel time of the reflected wave is a minimum or the difference in travel time between two instruments, especially at two opposite sides of the shot point, or the direction of the travel-time curve at the shot point. The surface waves (ground roll) recorded from explosions can hardly be pure elastic waves; their velocity is too small for either Love or Rayleigh waves.—*Author's abstract.*

3573. Gutenberg, B., and Richter, C. F., Materials for the study of deep-focus earthquakes: Seismol. Soc. America Bull., vol. 26, no. 3, pp. 341–390, 1936.

Travel times of normal earthquakes are made the basis for calculated travel times for shocks at depths down to 800 kilometers. These are presented in tabular form, together with certain auxiliary data. Theoretical discussion is given for the critical distances at which pP and PP, sP and SP, etc., coincide and below which these phases should not occur. The distances are not focal points (caustics). Methods are given for determining epicenter, depth, and origin time and are applied to a selected group of shocks. The results of different methods agree very well with one another and with the calculated travel-time data. A preliminary report is given on certain characteristics of the shocks studied. The mechanism of deep-focus earthquakes is discussed briefly, and it is concluded that normal and deep-focus earthquakes are probably brought about by the same forces.—*Author's abstract.*

3574. Hayes, R. C., Intensity distribution in New Zealand earthquakes. Relative intensity in various localities: New Zealand Jour. Sci. and Tech., vol. 18, no. 6, pp. 508–511, Wellington, 1936.

In 14 major New Zealand earthquakes during the period 1929–34 the intensity of earthquake motion in some localities appears to have been relatively high, while in other localities it was relatively low. These variations of intensity appear to be due mainly to differences in geologic formation.—*Author's abstract.*

3575. Heck, N. H., The earthquake problem: Scientia, vol. 59, pp. 136–142, Milan, 1936.

The earthquake may be considered a menace or a useful tool for investigation of the interior of the earth. The immediate cause—slipping between rock surfaces—is known, but not the ultimate cause. For this reason and because a small force may set off an earthquake, prediction is impracticable. A promising line of investigation is crustal movement, which can be accurately measured by geodetic methods and tilt observation. Accurate location of earthquakes makes it possible to associate earthquakes with geological formations, and in turn the formations affect the passage of the earthquake waves. This makes it possible to use the earthquake wave to prove that the earth consists of a series of shells outside of a central core which is probably liquid. The crust itself is made of several shells. Recognizing the earthquake as a menace, the engineer is finding out how to design structures to resist damage. This requires measurement of strong earth motion and determination of natural periods of buildings and of the earth. Structures have to resist acceleration, resonance, the complex movements with change of direction, and the duration of the motions. The problems are being solved as part of a plan to make cities less vulnerable to earthquake damage.—*Author's abstract.*

3576. Heck, N. H., Seismological investigations in the western mountain region [abstract]: Geol. Soc. America Preliminary list of titles and abstracts of papers to be offered at the 49th Ann. Meeting, Dec. 29–31, 1936, Cincinnati.

Recent rapid growth of earthquake investigation in the United States has, for economic reasons, come from those interested in the design of safer structures rather than from the geologist. Because many of the

problems are geological; because with more precise knowledge earthquakes have become important tools for investigating the earth's crust and interior, and because earthquakes are the best evidence that changes in the past are still going on, the geologist will have to take an increasingly active part in earthquake investigation. The problem can best be attacked through regional investigation like that conducted in southern California, though investigation in the western mountain region cannot be as comprehensive. A map of all earthquake epicenters since 1868 is shown, and an appraisal of their accuracy is made. The seismicity is high enough in certain parts of the regions to warrant special investigation.

There are only six seismograph stations in the entire region, a totally inadequate number. Instruments for recording strong earth motion have been and are being installed. Triangulation and leveling now make possible study of crustal movements. Much more detailed geological investigation is needed. The use of seismic and other geophysical methods in tracing buried geological formations, especially faults, has important possibilities. Gravity observations in increasing numbers may solve problems of earthquake cause. An appraisal of seismicity and methods of attack is made for each State in the region.—*Author's abstract.*

3577. Herrmann, H., Stöcke, K., and Udluft, H., Ground pressure and plate statics; Tests on the elastic properties of coal-measure rocks from Upper Silesian mines, part 2: Beitr. angew. Geophysik, vol. 6, no. 2, pp. 206–240, Leipzig, 1936.

In the first part of this paper (see abstract 3446) the writers dealt with plate effects and their application to seam working. In this second part they describe experiments on plates and rocks with a view to gain a more complete knowledge of ground pressure in mines, to establish more fundamental principles, and to record constants to be used in future work. Tests were made on large slabs and on plates and beams resting on broad elastic supports. Conclusions are drawn referring to bending resistance, time effect, strength of rocks, pressure relief, and pressure wave, as well as to geophysical and geologic phenomena.—*W. A.*

3578. Jones, J. H., A method of testing reflection seismographs: Inst. Petroleum Technologists Jour., vol. 23, no. 159, pp. 26–31, London, 1936.

To remove the difficulties experienced in the interpretation of reflection seismograms recorded with the mechanical instrument, Jones devised a method of simulating the actual reflection experiment under conditions that could be easily controlled. In addition to a shot point 0 located at about 7,500 feet from the nearest recording instrument, the author introduced an "image" shot point I located at 9,000 feet on the perpendicular line 0I. The operations required for obtaining the records and the time-distance graphs constructed from the seismograms of both the shot points are described and shown in figures. The disturbances reaching the seismographs thus consisted of the normal movements due to the refracted waves set up by the explosion at 0, and of the quasi-reflections from the imaginary surface set up by the explosion at I. Examples of the compound seismograms are shown, and the corresponding time-distance graphs are plotted.—*W. A.*

3579. Kamel, M., and Faltas, F., Seismische Bestimmung der Lage einer geneigten ebenen Grenzschicht aus Laufzeiten und Amplituden [Seismic determination of the position of an inclined plane border layer from travel times and amplitudes]: Zeitschr. Geophysik, vol. 12, no. 7–8, pp. 383–395, Braunschweig, 1936.

Travel times have been used so far mostly for determining the direction of the dip and the inclination of plane border layers. R. Bungers examined recently (Zeitschr. Geophysik., vol. 11, pp. 326–328, 1935; see abstract 3104) a method in which, by using the three components for registering the movement of the ground, he succeeded in determining the direction of the reflected and refracted rays and in applying these results for the establishment of the position of border layers. In this article, which serves as a continuation of Bungers' work, M. Kamel derives formulas for two-layer and three-layer problems. The formulas may be applied for determining the direction of the strike and the dip of an inclined border surface from amplitude observations. F. Faltas gives a graphic method for the two-layer problem as derived from travel times and amplitudes of the horizontal component. As a rule satisfactory results were obtained from the experimental application of these methods at the Göttingen Geophysical Institute.—*W. A.*

3580. Kamel, Mostafa, Seismische Bestimmung des Einfallens und Streichens aus Amplituden [Seismic determination of dip and strike from amplitudes]: Neue deutsche Forschungen, Abt. Meteorologie u. Geophysik, vol. 115, 28 pp., Berlin, 1936.

Formulas that can be used for determining the strike and dip from amplitude observations are derived for two-layer and three-layer problems (with a horizontal cover layer). Various possibilities are examined. Satisfactory results were generally obtained by the application of the formulas to the explosion tests made by the Göttingen Geophysical Institute. An arrangement of the test by which the position of the border surface may be determined in a simple way is described.—*W. A.*

3581. Kawasumi, H. and Kinosita, Z., Initial motion of seismographs: Tokyo Univ., Earthquake Research Inst., Bull., vol. 14, no. 3, pp. 319–353, 1936.

The motions of seismographs of ordinary type and of those of Galitzin caused by ground motion $\sigma = 3 \sin pt - \sin 3\,pt$ are calculated. Thence a method for reducing the first impulse of an earthquake with fair accuracy is deduced. The results are tested experimentally by comparing them with seismograms as recorded by an Ishimoto acceleration [seismograph] and Hagiwara velocity and displacement seismographs on a shaking table.—*Authors' abstract.*

3582. Lee, F. W., Thoenen, J. R., and Windes, Stephen L., Earth vibrations caused by quarry blasting: U. S. Bur. Mines Rept. Inv. 3319, 19 pp., 1936.

This paper outlines briefly the results of seismic measurements made in the vicinity of blasts in a mine and in open-quarry operations. It endeavors to examine the amplitude and frequency of such vibrations as influenced by the loading, geology, and distance from the source and includes comments on factors that may index the destructiveness of a vibration and on a method for measuring the stresses produced. There seems to be no simple mathematical analysis of the transmission of seismic energy through the ground, and experimental observations are at present most feasible. From the conclusion of the authors we read:

"A definite limit for vibrations and their effect on buildings is still to be determined from the results of the experimental investigations. The factors that cause damage are at present too indefinite, and there is no definite criterion of seismic destructiveness. Each quarry differs from all others in its vibration characteristics, and these can be found only

by experiment on the ground. A careful study of the natural vibrations of buildings around a quarry and the natural ground vibrations will give information as to possible resonance between them. A vibration that may not harm one building may harm another. There are indications that the observation of ground vibrations artificially produced and those occurring spontaneously may bear a relation to the degree of loading or stress in columns, arches, faults, etc., and may offer a means for predicting dangerous conditions in the ground."

Thirteen figures accompany the article.—*W. A.*

3583. Mainka, Karl, Einige Ergebnisse der geophysikalischen Gebirgschlagforschung [Some results in the geophysical investigation of bumps]: Beitr. angew. Geophysik, vol. 6, no. 2, pp. 241–258, Leipzig, 1936.

Examines 2,800 records obtained within 6 years by seismographs installed in the "Aussenstelle Beuthen der Oberschlesischen Landeswarte in Ratibor." All the shocks recorded originated in Upper Silesia. Most of them occurred on week days between 5 and 6 p. m. From the tables and comparative data questions of the relation between the changes in pressure and shocks and between the shocks and amount of coal hauled were examined, and the conclusion was drawn that in the first case a relation seems to exist, but that no definite relation could be established for the second case.—*W. A.*

3584. Martin, H., Die Grundlagen zur Beurteilung von Verkehrserschütterungen [The foundations for the determination of oscillations caused by traffic]: Zeitschr. Geophysik, vol. 12, no. 7/8, pp. 322–338, Braunschweig, 1936.

The fundamental factors in determining the harm caused by traffic oscillations are discussed. Reference to the nonconformity of the values of the intensity in the dynamic earthquake scales is made; after this the author examines man's sensibility limits with respect to oscillations within 0.3 to 100 Hertz as determined by measurements conducted with the aid of shocking tables. Galitzin's dynamic scale for estimating macroseismic movements is extended by the author's experiments. The influence of the proper oscillations of the ground and of the resonance oscillations of buildings is mentioned. An attempt is made to find a diagram which may serve for determining both the earthquake oscillations and the traffic oscillations. The course of the curves showing the corresponding intensity values answers approximately that of the sensitivity limits of oscillations. The interval of the single curves and the intensity value of an oscillation connected with it must be determined from the reliable old results and corresponding new investigations. The determination of the curve from which the harm produced by oscillation in buildings may be established is considered to be sufficient. This curve will be different for different subsoil and for buildings of different construction.—*Author's abstract, translated by W. A.*

3585. Martin, H., Untersuchungen am Schütteltisch [Investigations on a shaking table]: Zeitschr. Geophysik, vol. 12, no. 7/8, pp. 339–346, Braunschweig, 1936.

An attempt is made to realize the original conditions of the processes of initial oscillations as required by the theory. Figures show (*a*) the record of an oscillation produced suddenly, obtained by means of an oscillation meter; (*b*) the record of an oscillation produced suddenly, obtained by means of an acceleration meter; (*c*) theoretical and experimental initial curves obtained by means of acceleration meters with various damping. The recording of the resonance curve of horizontal

seismometers with the aid of tilting oscillations is shown in a schematical arrangement of the experiment, and the resonance curve obtained is given.—*W. A.*

3586. McComb, H. E., and Wenner, Frank, Shaking-table investigations of teleseismic seismometers: Seismol. Soc. America Bull., vol. 26, no. 4, pp. 291–316, 1936.

Shaking-table tests are described to determine experimentally the responses of different types of teleseismic seismometers when the motion of the pier or other support upon which they are mounted is impulsive, irregular, or harmonic. Four different types of seismometers—the Wood-Anderson torsion seismometer, the Wilip-Galitzin seismometer, the Wenner seismometer, and the McComb-Romberg seismometer—are described briefly. The authors describe the shaking table, its method of operation, the method of recording the motion of the table, and the methods of recording the responses of the instruments relative to the table. In order that a comparison might be made between actual performance and that which might be predicted from theory, data were obtained from which the instrumental constants may be computed. Curves showing the response of seismometers to various movements of the shaking table are given for checking the accuracy of the determinations of ground displacements from the records made by different types of instruments. The data from which the constants of the seismometers may be determined are available.—*W. A.*

3587. Mitera, Z. A., Reflection seismology in exploring for potential fields in Poland: Oil Weekly, vol. 84, no. 11, pp. 164–176, Houston, 1937.

Reflection seismology was introduced in Poland in 1934 through the Pionier Co. Most of the Polish oil fields are within the Carpathian Range, in a belt 30 miles wide and 250 miles long, extending from Jaslo to Stanislawow. Steep dips, such as are usually found in Carpathian geologic structures, present a difficulty for field technique. As a rule shooting in two directions at right angles was applied to establish the correct strike and dip of reflecting horizons. Systematic variations of shot distances, shot depths, and charge are sometimes necessary to obtain fairly clear reflections. Better geologic conditions exist between the Carpathian Range and Podolian Plateau (Carpathian foreland). Typical records obtained in the foreland are shown in figures. Large areas of the foreland were surveyed by the reflection method, from which contour maps were obtained furnishing interesting information as to the geologic subsurface conditions. Experiments in winter had shown that on frozen and snow-covered surface the dynamite charges could be reduced considerably and that under such conditions the seismic energy penetrated much more easily into the deeper strata than in summer.

More detailed information as to the practical results of the extensive seismic exploration work is expected after the completion of the drilling of the holes recently begun, but there are well-founded possibilities of obtaining positive results.—*W. A.*

3588. New portability in seismic instruments throws open important Gulf coast areas heretofore largely unexplored [editorial]: Oil Weekly, vol. 83, no. 13, pp. 30–34, Houston, Tex., 1936.

Because of its light weight, a new reflection seismograph (less than 100 pounds) is enabling operators to penetrate the timbered swamps, dense thickets, and marshy lakes that cover much of the area. This light weight has been obtained without the least sacrifice in any feature

possessed by the old-style large outfits. The equipment can be easily transported on foot by four men. A small battery of motorcycle size is used for the amplifiers, which are 3 by 6 by 12 inches in size. The six geophones weigh 1½ pounds each. The various parts are assembled as two units. One unit is composed of the oscillograph and the six amplifiers, weighs about 70 pounds, and measures about 24 by 24 by 12 inches. The other unit consists of the geophones and their cables, batteries, developing box, and other small equipment and with litter weighs about 50 pounds. The increase in the reflection seismograph crews through the last few years is given as follows: Those operating in 1932, 10; 1933, 31; 1934, 42; 1935, 54; and there are at present 66 parties on the Gulf coast proper.—*W. A.*

3589. New shaking table reproduces earthquakes [editorial note]: Civil Engineering, vol. 6, no. 3, p. 222, New York, 1936.

A brief description of the new type of shaking machine developed at the Massachusetts Institute of Technology by Arthur C. Ruge. The machine may be used principally for model testing in engineering seismologic research. (See also abstract 3452.)—*W. A.*

3590. Nishimura, Genrokuro, and Takayama, Takeo, On stresses in the interior and in the vicinity of a spherical inclusion in a gravitating semi-infinite elastic solid: Earthquake Research Inst. Bull., vol. 11, no. 2, pp. 196–228, Tokyo, 1933.

The writers studied the stress distribution, assuming that the state of the solid is one of plane strain.—*Authors' abstract.*

3591. Nishimura, Genrokuro, and Takayama, Takeo, On stresses in the interior and in the vicinity of a horizontal cylindrical inclusion of circular section in a gravitating semi-infinite elastic solid: Earthquake Research Inst. Bull., vol. 11, nos. 2 and 3, pp. 229–253 and 454–487, Tokyo, 1933.

The writers studied the stress distribution under a state of plane strain.—*Authors' abstract.*

3592. Pentz, H. H., Formula of calculation of slope of reflecting horizon in seismic reflection prospecting: Am. Inst. Min. and Met. Eng. Tech. Pub. 766, 6 pp., New York, 1937.

The derived formula is an approximation that can be used where the slope of the reflecting horizon is less than 250 feet per 1,000 and the depth to the reflecting horizon is greater than 2,500 feet. The slope of sediments in petroleum-producing areas is generally considerably less than 250 feet per 1,000. This is particularly true of the Gulf coast, with the exception of the salt domes, which usually have the sediments at a greater slope than 250 feet per 1,000.—*Author's abstract.*

3593. Ramspeck, A., Die Verwendung sinusförmiger elastischer Wellen bei der Untersuchung des Baugrundes [Application of sinusoidal elastic waves in investigating ground assigned for construction of buildings]: Zeitschr. Geophysik, vol. 12, no. 7–8, pp. 354–355, Braunschweig, 1936.

The application of geophysics in the construction of buildings is discussed. The problem is suggested to be solved empirically by measuring the velocity of propagation in a series of well-known grounds and determining the relation between the velocities measured and the pressures of the buildings already erected on similar grounds. In the practice of construction the load per unit of surface is usually called the "admissible ground pressure." The relation between the velocity of propagation and the "admissible ground pressure" for various grounds is

shown in a table. The possibility of improving the ground by artificial condensation is mentioned, and a practical example by which the velocity of propagation was increased from 150 m/sec. to 320 m/sec., thus increasing the admissible ground pressure from 2 to 4.5 kg/cm², is given.—*W. A.*

3594. Rieber, Frank, Geological causes of poor reflection records [abstract]: Am. Assoc. Petroleum Geologists Bull., vol. 20, no. 11, p. 1520, 1936.

[This paper was presented at the 13th annual meeting of the Pacific section of the Association.]

Clear-cut reflection records are obtained only with sharply defined, conformable bedding, of considerable lateral extent, uncomplicated by steep folding or faulting. Deviations from these conditions will give rise to waves returning from the earth from a number of directions at approximately the same time. Such multidirectional arrivals produce unsatisfactory reflection records on the usual visual seismograph record. A method is presented for overcoming these difficulties by analyzing the received vibrations and separating them into their component wave trains.—*Author's abstract.*

3595. Rosaire, E. E., Exploration by the reflection seismograph in the Gulf coast of Texas and Louisiana: Inst. Petroleum Technologists Jour., vol. 23, no. 159, pp. 40–56, London, 1937.

After an outline of the history, present situation, development resulting from the use of the method, developments in the method, and its future, the conclusion is drawn that, unless a method of higher finding power appears, the present activity in reflection exploration should decline in the future. Therefore, foresighted operators in the Gulf coast area will probably do two things—(1) make intelligent investments in possible new methods of oil finding with potential finding powers still higher than are available in the methods now in use; (2) complete their blanket explorations of this area by the reflection seismograph in the shortest possible time and at the lowest possible cost.—*W. A.*

3596. Rutherford, H., Geological interpretations of seismic reflection data on the Gulf coast [abstract]: Geol. Soc. America Preliminary list of titles and abstracts of papers to be offered at the 49th Ann. Meeting, Cincinnati, Dec. 29–31, 1936.

Investigation of geologic substructure in the Gulf coast requires a technique that differs in many respects from that used elsewhere. The absence of definite seismic markers necessitates the correlation of events reflected on the seismogram by either computations or "continuous" shooting. The various arrangements of the instruments are shown, together with the records obtained. It is also shown how average velocities and dips can be obtained from the data on the records alone. Sample cross sections obtained by the seismic reflection method are shown.—*Author's abstract.*

3597. Schulze, G. A., Das elastische Verhalten des Bodens bei sinusförmiger Anregung [The elastic behavior of the ground produced by a sinusoidal impulse]: Zeitschr. Geophysik, vol. 12, no. 7–8, pp. 350–353, Braunschweig, 1936.

A special oscillator serves as a sender of ground oscillations and electrical signals produced at certain positions of the mass of the oscillator. The receiver is an electrically adjusted seismograph with 10,000-time magnification. Oscillations of the ground and electrical signals are

registered at various distances from the sender along a profile, the phase difference between the electrical signal and a certain phase of ground oscillation being drawn in seconds as a function of the distance. In this way travel-time curves are obtained directly. The results of observations are shown in two figures.—*W. A.*

3598. Sezawa, K., and Kanai, K., Seismic vibrations in actual buildings: Tokyo Univ., Earthquake Research Inst., Bull., vol. 14, no. 3, pp. 377–386, 1936.

The improved theory of the authors is applied to the energy dissipation in the seismic vibrations of actual buildings. Every maximum bending moment induced in columns lies within a certain specified range of resonance curves. The theory explains the fact that the columns most damaged in great earthquakes were those on floors a few stories above ground level.—*Authors' abstract.*

3599. Sezawa, K., and Kanai, K., Damping of seismic vibrations of a surface layer due to obliquely incident disturbance: Tokyo Univ., Earthquake Research Inst., Bull., vol. 14, no. 3, pp. 354–359, 1936.

A consideration of distortional waves with horizontal disturbance.—*W. A.*

3600. Slichter, L. B., Exhibition and description of three-component portable seismograph [abstract]: Geol. Soc. America Preliminary list of titles and abstracts of papers to be offered at the 49th Ann. Meeting, Cincinnati, Dec. 29–31, 1936.

A completed sample, of which eleven more are under construction, of a new three-component seismograph and camera will be exhibited and described. The instruments are designed for the purpose of securing accurate ground motions, with special reference to the study of quarry explosions. The design is arranged for changing the mechanical magnification in the range 25 to 25,000; thus the instruments may be adapted to either strong motion or teleseismic use. Results of laboratory tests will be shown.—*Author's abstract.*

3601. Takahasi, Ryutaro, Tilt of the earth's crust observed at the Asama volcano: Tokyo Univ., Earthquake Research Inst., Bull., vol. 11, pp. 25–37, 1933.

This paper deals with the tilt of the earth's crust observed at Komoro, a village at the southern slope of the volcano Asama, during an active period in the year 1932. The instrument used is the Ishimoto tiltmeter, a horizontal pendulum of silica. It was found that eruptions occur in groups, the largest one standing generally at the head of the group; that the earth's crust begins to tilt toward the northwest several days before the commencement of each group of eruptions and continues to tilt until the first eruption of the group occurs, and then the tilt usually reverses its sense, returning gradually to the original position as the eruptions progress. This phenomenon is attributed to the pressure generated in the magma as the result of differentiation, which makes the earth's crust swell before the first explosion and disappears with the successive eruptions. Considerations with regard to other volcanic phenomena are also given.—*Author's abstract.*

3602. Trappe, Fr., Die Anwendung der seismischen Reflexionsmethode in Deutschland [Application of the seismic reflection method in Germany]: Oel und Kohle, vol. 12, no. 42, pp. 901–904, Berlin, 1936.

The development of the reflection method and its wide application with good results in the oil-bearing regions of many parts in the world, espe-

cially in the Gulf coast of the United States, is briefly outlined. Typical examples of the application of this method in Germany (northern part of Hannover, Alpine Tertiary basin of Bavaria, Ruhr and Aachen coal regions) are given by which depths down to almost 3,000 m could be investigated. Great accuracy in determining salt domes was proved by borings down to about 1,400 m.

The advantages of the reflection method—namely, the possibility of attaining great depths and the fact that underground structure immediately below the station of measurement may be determined—increase the importance of the application of this method in Germany.—*W. A.*

3603. Wenner, Frank, and McComb, H. E., The Galitzin seismometer: Seismol. Soc. America Bull., vol. 26, no. 4, pp. 317–323, 1936.

The discrepancies between the Galitzin theory and the performance of a Wilip-Galitzin seismometer are discussed, as it was observed in the shaking-table tests (see abstract 3586) that the performance of this seismometer departed considerably from what was expected on the basis of the generally accepted theory. The principal reasons for these departures are shown to be (1) failure of the Wilip-Galitzin design to comply with the assumption made in the Galitzin theory that the reaction of the motion of the galvanometer coil upon the motion of the steady mass of the seismometer is negligible, and (2) defective construction in the particular seismometer used in the shaking-table tests.—*W. A.*

3604. zur-Mühlen, Walter von, Seismische Oberflächenwellen und Fragen der Grosstektonik Nord- und Mittel Deutschlands [Seismic surface waves and questions of gross tectonics of north and central Germany]: Deutsche geol. Gesell. Zeitschr., vol. 88, no. 5, pp. 341–354, Berlin, 1936.

In earthquakes with focuses at great distances, 1,000 kilometers and more, measurements of the thicknesses of the layers are not of practical geologic interest. These measurements are of importance for solving problems of gross tectonics, and they may, of course, serve to complete the picture of the structure of the upper earth's crust. For example: Himalaya complexes, which attained depths of 70 kilometers (depth of sial), were determined from these measurements. The smallest depth at which layers of discontinuity were discovered by these waves was 15 kilometers, as established by Carder (1934) for North America and by the author of the present work for the north German lowland. Layers of discontinuity (Unstätigkeitsflächen) could not be determined by far-distance earthquake surface waves at depths less than 8 to 10 kilometers. Depths and magnitudes of geologic bodies of considerably smaller order of size could be established by investigations of close-distance earthquakes. In contrast to the gravimetrical and magnetic methods, the seismic method cannot be applied to every region to be investigated, as its application is limited by the existence and distribution of earthquake stations and the location of earthquake focuses. The north German lowland, in which the author is most interested, and its crystalline zones of elevation could be investigated through the stations in Helgoland, Hamburg, Potsdam, Göttingen, Jena, Leipzig, and Koenigsberg. The location of focuses was generally limited in the south by the zone of the Mediterranean Sea and in the northwest by Iceland and Greenland. Geologic interpretation of the results of investigations is made with regard to (*a*) the structure of the Thuringia Basin; (*b*) comparison of the results obtained from seismic observations

with those obtained from gravimetric and magnetic surveys; (*c*) Flechtinger mountain chain; and (*d*) tectonics of the north German lowland, Bohemian mass, and Thuringia Basin. A schematic representation of the stratification of the north German lowland, Bohemian mass, and Thuringia Basin is given, as well as the results of the calculation of their thickness based on the dispersion of the seismic surface waves.—*W. A.*

4. ELECTRICAL METHODS

3605. Fritsch, Volker, Einiges über die Funkmutung nach der sogenannten Kapazitätsmethode [Contribution to radio (spark) prospecting according to the capacity method]: Montan. Rundschau, vol. 28, no. 7, pp. 2–5, Berlin, 1936.

In addition to previous experiments with radio prospecting according to the capacity method (see abstract 2593), results of the latest experiments in Kotterbach, Ostrov, and Macochy are presented. The process of radio prospecting according to the capacity method is described, taking into consideration the geologic conductor and its conductance, as well as the position of the antenna. In addition to the theoretical discussion practical radio prospecting is examined under the assumption that the geologic and electrical conductors remain the same but the distance between them is changed. Theoretically the method is sufficiently developed to be tried out in practice.—*W. A.*

3606. Gish, O. H., The natural electric currents in the earth: Sci. Monthly, vol. 43, pp. 47–57, 1936.

A brief historical outline of electrical messages and of earth-current storms is given. A pronounced similarity in the character of the magnetic and the electric records is noticed. When one is disturbed, the other is also disturbed. The correspondence between the occurrence of auroras and disturbances in earth currents and possibly solar activity is also suggested. Observations indicate that an electric storm is likely to follow another storm at intervals of 27 days. The author recalls in this connection that 27 days is the period of rotation for the sun. A relation is also found between the variations in earth currents, the activity of the earth's magnetism, and the occurrence of spots on the face of the sun. They all run through a cycle which has a period of roughly 11 years. The difficulties to establish just what relation exists between earth currents and terrestrial magnetism are discussed. Questions concerning "currents in high atmosphere" and "the great electric eddies" are examined by the author in the last part of the article.—*W. A.*

3607. Jakosky, J. J., and Armstrong, H. K., Geoelectric exploration in the Tejon ranch area, California: Am. Assoc. Petroleum Geologists Bull., vol. 20, no. 11, p. 1519, 1936.

[This paper was presented at the 13th annual meeting of the Pacific section of the Association.]

The Tejon ranch area lies within the southern part of the San Joaquin Valley. Marine beds crop out around the border of the area, but the central portion is buried beneath thick continental deposits. Core holes and a few exploratory wells have been drilled, while the remainder of the area has been explored by geoelectric work. The theory and operating technique of the electrical-conductivity method employed in the geophysical work are given in detail. Comparison of results of drill holes with the geophysical predictions is given.—*Authors' abstract.*

3608. Johnson, E. A., Design of tuned resistance-capacity coupled amplifiers: Physics, vol. 7, no. 3, pp. 130–132, Lancaster, Pa., 1936.

The behavior of resistance-capacity coupled amplifiers is studied with regard to their behavior as resonant networks. Expressions are obtained for the optimum value of circuit constants and the design procedure developed. Tuning at one cycle per second has been successfully applied to low-noise amplifiers.—*Author's abstract.*

3609. Maillet, R., Les méthodes de prospection électrique Schlumberger [Schlumberger's methods of electrical prospecting]: Soc. ing. civils France Mém. 4, pp. 618–641, Paris, July–August, 1936.

Electrical methods of prospecting have been used in Yugoslavia, Canada, and Belgian Congo (methods of spontaneous polarization). Principles of Schlumberger's resistivity methods and his potentiometer are briefly described. Work in Normandie, Grozny (U. S. S. R.), Africa, and France is mentioned.—*W. A.*

3610. Runge, Hans, Einige nord- und süddeutsche Erfahrungen mit elektrischen Bohrlochuntersuchungen als stratigraphischem Hilfsmittel [Some experience obtained in north and south Germany with electrical borehole investigations as additional means for stratigraphic determinations]: Oel und Kohle, vol. 12, no. 42, pp. 890–897, Berlin, 1936.

Experience obtained during the 3 years of work in the Hannover oil-bearing region and in Baden with Schlumberger's electrical coring is discussed, and a series of diagrams recorded in these regions are given. It is established that the results of electrical coring depend not only on the rocks penetrated by boring, but also to a considerable degree on other factors, such as the diameter of the hole and the density, viscosity, and electric conductivity of the mud, factors not sufficiently considered so far. The constants of these factors must be determined in order to make them similar for work in bore holes of a certain region. By eliminating the changeable conditions the interpretation of the measurements will become easier and more reliable. A comparison is made of two diagrams recorded from two adjacent bore holes, similar geologically, by using mud of different electrical conductivity.—*W. A.*

3611. Safronov, A. P., and Sergeev, E. A., New geophysical methods of prospecting for deposits based on the study of "aureoles of dissemination" [in Russian]: Razvedka Nedr, no. 18, pp. 24–25, Moscow, 1936.

In the oxidation, dissolution, and mechanical destruction of the outcrop of a deposit the products of decomposition are moved into the surrounding zone in solid, liquid, or gaseous form and may be detected in the so-called aureoles of dissemination. The character of the underlying unoxidized material was inferred from a study of the "aureoles" over polymetallic deposits, borate deposits, and veins containing tin. The apparatus consisted mainly of a pair of electrodes and a potentiometer. The methods and apparatus are now developed, and a more detailed description of their application will be given in a series of articles to be published.—*W. A.*

3612. Spieker, E. M., Radio transmission and geology: Am. Assoc. Petroleum Geologists Bull., vol. 20, no. 8, pp. 1123–1124, 1936.

The author summarizes a report by R. C. Higgy and E. D. Shipley on "Radio transmission survey of Ohio." The phenomenon with definite geologic implications occurred once before, and in 1934 E. Cloos published the results of observations in which he found that broadcast

reception by automobile radio fell off notably as his car crossed faults and steeply dipping contacts between different kinds of rocks. The report here reviewed was made after measurements of conductivity, with apparatus designed for the purpose and used under controlled conditions, had shown that surface geology has effects on radio transmission more extensive than that shown by Cloos and had confirmed his prediction that radio transmission would embrace a useful geophysical principle. The radio-transmission map accompanying the report separates the State into four zones graded as to effectiveness of transmission. It thus becomes a lithologic map of the State. The northwestern part of Ohio is one zone, outlining roughly an area underlain by Ordovician, Silurian, and Devonian limestones. This zone furnished the best transmission. A belt consisting dominantly of Devonian and Mississippian shale was the next best zone. The Pennsylvanian-Permian coal measures, lithologically very varied and containing much sandstone, was the next zone; and the last and poorest zone probably corresponds to a large channel or group of channels buried under Pleistocene materials. From these facts it appears that radio transmission is affected by the texture of the surface and immediate subsurface rocks. Tight, solid rock affords the best conditions, and loose, open-textured the worst.—*Author's abstract.*

3613. Stefanescu, S. S., Sur les fondements théoriques de la prospection électromagnétique par courant alternatif à très basse fréquence [On the theoretical foundations of electro-magnetic prospecting by alternating current at very low frequency]: Beitr. angew. Geophysik, vol. 6, no. 2, pp. 168–201, Leipzig, 1936.

Starting with magnetic and electric fields as a sine curve a. c. régime, two new vectorial fields, M and N, are defined as the limiting values of the derivatives of the former with respect to the frequency, when this tends to zero. For the inductive methods, the field M in the air is derived from a Newtonian potential of a vertical cylinder having as a base the inductor, the density of which at a depth $2h$ equals the conductivity of the ground at a depth h. Thus for calculations of M only a Newtonian potential outside the attractive mass is required. For components of M various apparent conductivities at the surface are connected by linear integral equations with values below the ground. With a measuring device expanding homothetically with respect to a fixed point, all cases of stratification can be derived from a single chart consisting of a simple line. The vertical component M_z in the case of a bipole and a rectilinear transmitter with earth contact is also studied. The field N of an inductor is not influenced by horizontal stratification. Finally, assuming the existence of vectors M and N, the equations with partial derivatives are given which satisfy the fields for a certain isotropic heterogeneous medium.—*Author's abstract.*

3614. Storm, L. W., and Wade, R. T., Electrical logging technique as applied to petroleum production and engineering problems: Petroleum Engineer, vol. 8, no. 2, pp. 66–80, Dallas, 1936.

The authors outline the application of electrical logging for the solution of practical field problems encountered particularly in connection with the following operations: (1) The completion of wells; (2) reconditioning wells to shut off water; (3) reconditioning wells to exclude gas; (4) evaluating the sands, calculating reserves, estimating potentials, and other similar problems; (5) various operations, such as checking casing depth,

locating junk in a well, ascertaining distribution of cement behind casing, etc. In addition to the regular equipment for resistivity and porosity surveys, the authors describe the temperature surveys used in conjunction with them. The temperature survey also provides a continuous record, which may be compared directly with the resistivity and porosity diagrams. The temperature record is obtained by lowering into the well a very sensitive electrical thermometer, which records the temperature to scale on the surface. In giving a series of examples the authors illustrate the results obtained and explain the methods applied. Though a cased well may be tested for temperature, resistivity and porosity surveys can be made only in an uncased hole.—*W. A.*

3615. Tagg, G. F., A new earth tester: Min. and Ind. Mag. Southern Africa, vol. 22, no. 6, p. 317, Johannesburg, 1936.

This is a detailed abstract of the paper published by Tagg under the same title in Mining Magazine, London, vol. 54, no. 3, March 1936. (See abstract 3203.) The method of operation and the instrument are described and a plan of earth tester, showing generator, resistor, and deflecting coil, is added.—*W. A.*

3616. Tagg, G. F., Interpretation of earth-resistivity curves: Am. Inst. Min. Met. Eng. Tech. Pub. 755, 11 pp., New York, 1937.

In an earlier paper the author described a method of interpreting the results obtained from an earth-resistivity survey in the case of two layers. This method was based on mathematical investigation and could be extended to the case of three layers. It involved, however, an accurate determination of the resistivity of the surface layer and, in the three-layer case, an accurate determination of the equivalent resistivity of the two upper layers. Although used successfully in many places, the determination of the surface resistivity often presents considerable difficulty, and a modification of the method has now evolved in which this value is no longer required. Resistivity values are taken at two chosen electrode separations and the ratio of these resistivities calculated. This is done for several pairs of values. By referring these ratios to sets of master curves, deductions can be made as to the depths to the various layers. Tables of figures are given from which the master curves can be drawn.—*Author's abstract.*

5. RADIOACTIVE METHODS

3617. Asayama, Tetuzi, Radioaktive Untersuchung des Hiei-granitgebiets [Radioactive investigation of the Hiei granite region]: Japanese Jour. Astr. and Geophysics, vol. 14, no. 1, pp. 19–26, Tokyo, 1936.

A brief outline of the geology of the Hiei granite region is given. The solution method was used for measuring the radium content of the rocks. The radium content of 13 samples of granite, 2 samples of quartz porphyry, and 2 samples of dike rocks of the Hiei granite stock were determined by this method. The mean content of radium was 1.28×10^{-12} g per g of rock. Both the quartz porphyry samples contained values very close to that of the mean radium content of granite. The radium content of the Hiei granite stock is comparatively small. A schematic diagram of the arrangement of the apparatus, three tables showing the results of measurements, and a map of the region of investigation are added.—*W. A.*

3618. Garrigue, Hubert, La radioactivité de l'air en montagne [Radioactivity of the air in mountains]: Annales de physique, vol. 6, pp. 751–826, Paris, December 1936.

In making electrometrical measurements at the Observatory of Pic-du-Midi (2,800 m) a new phenomenon is observed: Radioactive emanations, especially radon, accumulate under the snow on the slopes of the mountains, the layer of the snow forming the "semi-impermeable" screen. This accumulation, it seems, depends on the local wind only: its maximum is on the surface of the mountain covered with snow; at the more abrupt surfaces, which consequently have less snow, as it is blown away by the wind, the emanations escape abundantly through the fissures of the rocks not covered with snow, or under the layer of the snow in the direction opposite to that from which the wind blows. Measurements in the laboratory and in the field with a new very portable apparatus showed that the air close under the layer of snow at the summit (the layer may be several meters thick) may contain up to 10^{-9} curie of radon per liter at normal pressure. Also the emanation into free air may attain, for Pic-du-Midi, the value of radon produced by the whole terminal mass of the mountains (100 g of radium). The author expects to continue his measurements on various mountains and plains covered with snow in order to draw conclusions on the content of emanation in large masses of the air.—*Author's abstract, translated by W. A.*

3619. Grammakov, A. G., The influence of some factors on the spreading of radioactive emanations in natural conditions [in Russian]: Jour. Geophysics, vol. 6, no. 2/3, pp. 123–146, Moscow, 1936.

From theoretical considerations as well as experimental studies discussed in this article and represented in tables and graphs, the following conclusions are drawn:

1. The value of the coefficient of diffusion of radioactive emanations in a porous medium depends to a great extent on the moisture content of the medium. The diffusion is considerably smaller in a medium with a higher degree of moisture. This is explained by the fact that with the increase of moisture the porosity of the medium decreases, as well as by the absorption of the emanation by water.

2. The products of the dissociation of radioactive emanations (radioactive inductions) cannot move far away from the place of their formation; thus the distribution of radioactive induction along the area of their concentration in the soil air must represent the distribution of the concentration of the emanations themselves.

3. Owing to the fact that a noticeable influence of radioactive induction on the value of the coefficient of diffusion of radioactive emanations was not observed, the author concludes that the method of determining the values of the coefficient of diffusion by measuring the flow of radioactive emanations through layers of various thicknesses may be considered to be suitable for practical purposes.—*W. A.*

3620. Hatuda, Zin'itiro, Radium contents of rocks in Nippon, I: Kyoto Imp. Univ., Coll. Sci., Mém., ser. B, vol. 12, no. 1, pp. 1–18, 1936.

Radium contents of granites were measured by using the fusion method, in which radon was expelled from the melt of rock substance by heating in an electric furnace. The average radium content of twenty granites was determined to be 1.46×10^{-12} grams per gram. The principle, apparatus, and technique of the measurement are described, and the method is critically discussed. Radioactivity has a

general tendency to increase with silica percentage, and accordingly the radium content seems to vary inversely with the alkali-lime content of the rock.—*Author's abstract.*

3621. Scheuer, W. O. E., Eine neue Emanationswaage [A new emanation balance]: Petroleum, vol. 33, no. 5, pp. 9–10, Berlin, 1937.

The experience obtained by the author from about 6,000 measurements made with the torsion balance according to Eötvös' principle incited the construction of an improved instrument with a highly sensitive balanced system, so that it was possible to record the gamma rays, to determine and record the specific deflections produced according to the nature of the emanating substances, and to evaluate the results to disclose structural formations. The new balance, a detailed description of which is given, is adapted in the first place to prospecting for oil.—*W. A.*

3622. Urry, W. D., Radioactivity in rocks [abstract of paper presented before New England section of Am. Phys. Soc., February 1, 1936, in Cambridge, Mass.]: Physical Rev., vol. 49, no. 6, p. 481, 1936.

The presence of minute traces of radioactivity in nearly all common rocks affords a means to the physicist of converting the qualitative geological study of the history of the earth into a time function based on an actual physical unit—for example, the year. The theoretical assumptions of a constant disintegration rate and stability of the end-products of the radioactive series under all possible terrestrial conditions are well proved. On the basis of present available data the time function is a self-consistent record and the correctness of the absolute magnitude supported by semi-independent evidence.—*Author's abstract.*

6. GEOTHERMAL METHODS

3623. Schlumberger, U., Doll, H. G., and Perebinossoff, A. A., Temperature measurements in oil wells: Inst. Petroleum Technologists Jour., vol. 23, no. 159, pp. 1–25, London, 1937.

Continuous temperature measurements in oil wells can now be made with an extremely sensitive recording thermometer. They can be applied to a great number of oil-field problems, both in wells in thermal equilibrium and in wells in thermal evolution, and also both in open and in cased holes. The data on geothermal gradients and their variations interest both the regional and local geologist. Knowledge of subsurface temperatures can aid the technologist in problems related to mud and cementing. Temperature measurements can yield valuable corroborative data on the sequence of formations in a well, the main data always preferably being given by electrical logging. They can be applied to location of water, oil, and gas sands, both in drilling and in producing or abandoned wells. They are invaluable for checking the results of cementing operations. The paper presents the principles of the major thermometric techniques and illustrates them with some practical examples. In conclusion, attention is drawn to the time and care that may sometimes be required for optimum results, but practice has already proved that the best local operating conditions are very soon determined in most regions, thanks to the spirit of cooperation between the surveyor and the local technologists.—*Authors' abstract.*

3624. Spicer, H. C., Tables of temperature, geothermal gradient, and age of a nonradioactive earth: Geol. Soc. America Bull., vol. 48, no. 1, pp. 75–92, 1937.

Among the methods that have been presented as a means to determine the age, temperature gradient, and temperature of the earth are two solutions based on the linear flow of heat, one by Kelvin and the other by Ingersoll and Zobel, both solutions pertaining to a nonradioactive earth. As it is somewhat difficult to visualize and interpret the equations of heat flow, an evaluation of the two solutions is given in this article in tables and figures. The range of constants chosen for the solution of the equations is ample to cover those mentioned in the literature, and the equations have been transformed and solved for the different unknowns.—*Author's abstract.*

7. UNCLASSIFIED METHODS

3625. Adams, L. H., The earth's interior, its nature and composition: Sci. Monthly. March 1937, pp. 199–209.

The present notions concerning the earth's interior and the steps by which the information has been obtained are summarized. The following definite accomplishments during the last several years are pointed out: (1) Precise measurement of the elastic constants of rocks and the determination of the speeds with which elastic waves will travel through them; (2) identification of the upper half of the crust as a granitic layer; (3) a demonstration that the core of the earth contains a heavy material such as iron; (4) an explanation of the two major discontinuities within the earth in terms of the elastic constants of typical rocks; (5) the supplying of strong evidence that large masses of iron may exist in the interior without influencing the earth's magnetic field; and (6) the establishment of an improved depth-temperature curve for the crust and the region immediately below it.—*W. A.*

3626. Barsch, O., Die geophysikalische Reichsaufnahme als Grundlage für die Erschliessung neuer Lagerstätten [Geophysical survey of the Reich as a foundation for discovering new deposits]: Oel und Kohle, vol. 12, no. 45, pp. 1035–1039, Berlin, 1936.

An outline of the progress of the geophysical survey of the Reich, started 2 years ago in order to obtain general foundations for further exploration of new deposits, especially of oil. The results of the regional survey of the Hannover district, in which 35 new oil-bearing structural features were established, are shown in a map, and the future work is briefly outlined according to these new disclosures. Another example of the value of the geophysical work is given by the underground picture of a part of the Schleswig-Holstein region. Data obtained from the gravitational work served for drawing the maps of these two regions. The application of magnetic methods for establishing the presence of iron-ore deposits and of radioactive methods for determining the mineral-water resources are included in the problem of the general survey of the Reich. In conclusion the necessity of close cooperation of geophysicists with the geologists is emphasized.—*W. A.*

3627. Brace, O. L., Interrelationship of geology and geophysics: Am. Assoc Petroleum Geologists Bull., vol. 21, no. 2, pp. 197–211, 1937.

Geophysics has advanced to such an important place in the field of structural prospecting that there is a tendency, in some quarters, to relegate the geologist to a position of secondary importance in this field.

Geophysics is here regarded as purely a new and complex means of reading strike and dip and, as such, is to be classed as an additional geologic tool. Geology serves as an indispensable guide to every step of geophysical activity, and without such guidance the geophysicist cannot hope to reach his objective. Lack of coordination between the two technical branches has led, in the past, to much misinterpretation of geophysics, and continued future success will depend upon a greater degree of cooperation in preparing the background for geophysical prospecting and in interpreting the results obtained by such methods.—*Author's abstract.*

3628. Johnson, F. M. S., Foundation engineering by geophysics: Military Engineer, vol. 9, no. 064, pp. 121–125, Washington, 1937.

The determination of depth to bedrock and the determination of geologic structure at relatively shallow depths are of primary interest in the construction of all engineering projects involving consideration of underground conditions (dams, bridges, roads, etc.). The two principal geophysical methods used in foundation exploration are the seismic-refraction method and the electrical-resistivity method. The magnetometer and the potential-drop ratio method are also applied with advantage. History, principles, instruments, practice, and interpretation of the two chief methods are described. A few examples of the application of these methods are given in figures.—*W. A.*

3629. Junner, N. R., Report of the Geological Survey Department for the financial year 1935–36, Gold Coast Colony, 38 pp., 1936.

Geophysical work in the Gold Coast is mentioned in the following articles of this report:

Art. 87. Magnetic observations. Traverses with a Watts vertical magnetic-force variometer were made by H. Service, from the Banko Stream on the Kumasi-Abonu road and thence around the lake to Isasi via Bodekwano, Juasi, and Bansu. Another traverse was made from Konkoma up the Beposo path to the rim of the crater. The results showed only weak anomalies.

Arts. 129–133. Observations to determine the diurnal variation in the vertical component of the earth's magnetic field and to ascertain what changes in vertical intensity were caused by different types of local rocks.

Art. 136. Electrical tests near Lake Bosumtwi consisted of spontaneous polarization traverses over various places. The anomalies observed could not be connected with any particular geologic phenomena.

Arts. 150–152. Northern territories water-supply investigations. A complete report submitted by Dr. Cooper gives the results of his resistivity measurements for determining (*a*) depth of water table; (*b*) depth of bottom of water; (*c*) depth of overburden on solid rock; and (*d*) nature of underlying rocks, and if a laterite or surface ironstone capping is present.—*W. A.*

3630. Karcher, J. C., Geophysical prospecting for oil: Mining and Metallurgy, vol. 18, no. 361, pp. 28–29, New York, 1937.

Geophysical methods were applied to prospecting for oil during 1936 more extensively than at any previous time. In the United States not less than 10 magnetometer parties, 9 gravimeter parties, 5 electrical surveying crews, 50 torsion-balance parties, 200 seismic-reflection parties, and several refraction parties were operating throughout the year. The tendency to abandon the use of the pendulum for prospecting in the oil fields and to increase the use of the gravimeter is noted. The use of

the Schlumberger well-surveying method increased considerably, as the electrical logs are found to be of great aid to geologists in making accurate correlations. There is every reason to believe that exploration during 1937 will continue at a rapid pace.—*W. A.*

3631. Kelly, S. F., Geophysics discloses hidden mineral wealth: Mineral Survey, vol. 4, no. 11, pp. 22, 25–26, 1936.

Principles of geophysical methods of prospecting and their application to various problems in geology and engineering are briefly discussed, and the important part played by geophysicists in expanding the use of natural resources is mentioned.—*W. A.*

3632. Kelly, S. F., Geophysical prospecting: Mining and Metallurgy, vol. 18, no. 361, pp. 26–27, New York, 1937.

A brief review of the geophysical work during the last year in many parts of the world.—*W. A.*

3633. Petroleum geophysicists hold Houston meeting [editorial]: Oil and Gas Jour., vol. 35, no. 28, p. 26, Tulsa, 1936.

The following papers and discussions featured the second midyear meeting of the Society of Petroleum Geophysicists held in Tulsa, Okla., November 20 and 21, 1936. The society voted to change its name to Society of Exploration Geophysicists.

1. Exploration of the reflection seismograph in the Gulf coast, by E. E. Rosaire.

2. D. C. Barton took issue on the difficulty of finding new fields, expressing opinion that the increased efficiency of geophysicists and improved instruments really had made the work easier.

3. Gravitational survey with the gravity meter, by L. M. Mott-Smith.

4. The effect of moisture on the d. c. resistivity of oil sands, by J. J. Jakosky and R. H. Hoppe.

5. Abnormal velocities in sedimentary beds in western Utah, by A. L. Smith.

6. James B. Macelwane stressed the need of establishing a geophysical library of data from the findings of geophysical workers.

7. Some Gulf coast velocity curves, by C. M. Boos.

8. Geologic discussion of the Gulf coast, by F. W. Rolshausen.

9. Psychology and geophysical exploration in the Gulf coast, by E. E. Rosaire and K. Ransone.

10. Complex reflection patterns and their geologic sources, by Frank Rieber.

11. Keeping cost record on insurance, by A. C. Burnett.

12. Recent developments in explosives for seismograph exploration, by W. Farren, Guy Roland, and Harold White.

13. Developments of essential characteristics of electric blasting caps for seismograph prospecting, by W. Farren, Guy Roland, and Harold White.

14. M. C. Bowsky in a talk on electro-chemical exploration and correlation of cased bore holes explained the operation of the stratagraph, a newly developed instrument for surveying, by electrical impulses, formations in cased holes.

15. Field technique of the magnetometer and its uses in locating serpentine plugs, by Paul D. Crawford.

16. Notes on dip shooting, by Sylvan Pirson.—*W. A.*

3634. The geophysical search for minerals [editorial note]: South African Min. and Eng. Jour., vol. 47, no. 2292, pp. 657–658, Johannesburg, 1937.

The note mentions H. Shaw's book "Applied geophysics", published on behalf of the Science Museum at South Kensington by His Majesty's Stationery Office at Adastral House, Kingsway, W. C. 2, London, price 2s. The book comprises a brief survey of the development of apparatus and methods employed in the investigation of subterranean structural conditions and the location of mineral deposits. It deals with the magnetic, gravitational, seismic, and electrical methods generally. There is included, also, a descriptive catalog of exhibits relating to these several methods that are to be seen in the Museum, together with a number of illustrations of the various types of apparatus.—*W. A.*

3635. Williams, Neil, Geophysical exploration of East Indies conducted under great difficulties: Oil and Gas Jour., vol. 35, no. 40, pp. 53–54, 1937.

Geophysical work by J. L. Davidson with the torsion balance in the Dutch East Indies from 1934 to 1936 is described. Most of the work was done in the Bandjarmasin Basin, a large expanse of low jungle swamp in the southern part of Borneo. Owing to the great difficulties of moving in this basin only a comparatively small amount of work has been done. Geophysical work in Sumatra has been attended by less difficulty. Very little work was done in Java. Most generally the torsion balance was used; it has worked very satisfactorily. The magnetometer was used in Borneo to some extent. It was not applicable in Sumatra, through which the magnetic Equator passes. The seismograph was tried but was not satisfactory. Cutting trails and bridging them was necessary. By employing from 200 to 400 native workers the trail cutters could cut and bridge about 1,500 meters a day, for which they were paid about $8 for each 1,000 meters. Stations were located about 300 meters apart, and by working night and day 8 torsion-balance stations could be made daily. The average cost per station was about $30. Complete overhauling of instruments was to be done at the end of each 6 months.—*W. A.*

8. GEOLOGY

3636. Boon, J. D., and Albritton, C. C., Jr., Meteorite craters and their possible relationship to "cryptovolcanic structures": Field and Laboratory, vol. 5, no. 1, 9 pp., November 1936.

The increasing number of recognized meteorite craters indicates that these features are not so rare as formerly believed. It is probable, moreover, that meteorite craters of the geologic past were larger and more abundant than the relatively recent examples. Evidence for the fall of ancient meteorites must be sought, however, in geologic structures produced by impacts. The history of a large falling meteorite of the order of 100 feet or more in diameter may be divided into three intervals—(1) interval of passage through air; (2) interval during which meteorite is brought to rest; (3) interval of explosion. During the first interval the meteorite possesses kinetic energy several hundred times that of an equal weight of nitroglycerin. Upon impact, this energy is immediately transformed into heat and pressure potential energy. Beds immediately beneath the site of impact would be momentarily subjected to pressures of several million atmospheres. The next instant the highly compressed rocks, by virtue of their high elasticity of volume, would expand with explosive violence, backfiring the meteorite and forming a crater. A

more lasting result of impact and explosion would be the formation of elastic waves of large amplitude. These would be strongly damped and fixed to form a central dome surrounded by ring folds of diminishing amplitude outward. Long after the surficial evidence for impact had been destroyed, the subjacent structures might be preserved.

The type of structure to be expected beneath large meteorite craters is strikingly similar to certain "cryptovolcanic structures", currently believed to have been formed by explosive release of subterranean gases. It is suggested, therefore, that some of these structures may record the fall of meteorites in the geologic past.—*Authors' abstract.*

3637. Ritz, C. H., Geomorphology of Gulf coast salt structures and its economic application: Am. Assoc. Petroleum Geologists Bull., vol. 20, no. 11, pp. 1413–1438, 1936.

The importance of rim synclines around Gulf coast salt domes as structural features affecting the migration and accumulation of oil and gas has not been generally recognized. The synclines may divert the migrating oil, in those formations old enough to be affected by subsidence into the syncline, around the dome and on up dip. They may also overlap with synclines of other domes to form effective traps for the accumulation of oil and gas in the interdomal area. The synclines may be circular with the dome in the center, circular with the dome in an eccentric position, or irregular in shape, depending largely on the geologic conditions affecting the migration of salt into the dome during the entire history of the growth of the dome.

Differential upward growth of the salt is believed to be caused largely by the differential rate of flow of salt into the dome. Under the resultant forces it is believed that the vertical axis of the dome may migrate a distance as great as the radius of the dome. Such migration of the vertical axis is of interest to the geologist primarily because of the effect it may have on the structure of the oil-bearing formations.—*Author's abstract.*

9. NEW BOOKS

3638. Bodle, R. R. (editor), Earthquake Notes, vol. 8, no. 3, 12 pp., Washington, Eastern section, Seismol. Soc. America, U. S. Coast and Geodetic Survey, 1936.

This issue contains the following articles: (1) First seismograph in the United States; (2) List of papers presented at the 1936 meeting of the International Union of Geodesy and Geophysics, held at Edinburgh, Scotland; (3) Commission on continental and oceanic structure; (4) Catalog of earthquake epicenters; (5) Seismology in New Zealand; (6) Dynamic distortions in structures subjected to sudden earth shock; (7) Japanese earthquakes; (8) Amateur seismological league; (9) Data needed for design purposes; (10) Faults of Panama region; (11) Seismology in Washington State; (12) New strong-motion stations; (13) Teleseismic stations; (14) Seismic forces and the San Francisco-Oakland Bay bridge; (15) Cisterns for fire fighting after earthquakes; (16) Earthquake-proof earth dams; (17) Designing bridge towers 708 feet high; (18) Accelerograph at Texas exposition; (19) Borger, Tex., shock of June 19, 1936; (20) Epicenters; (21) Building vibration work; (22) Publications by members of the Eastern section; (23) Lectures by section members; (24) Gravity expedition.

3639. Davidson, Charles, Great earthquakes, 286 pp., 12 plates, 122 ills., London, Thomas Murby, 1936. Price 17s. 6d. net.

This volume describes 18 of the greatest earthquakes of the last 2 centuries, the selection being made chiefly toward the understanding of the nature and origin of earthquakes, Careful studies have been made on the phenomena that accompanied and followed them.

3640. Krejci-Graf, K., Erdöl [Petroleum], 163 pp., illus., diagrams, tables, Berlin, Julius Springer, 1936. Price RM. 4.80.

Presents views concerning the origin of petroleum and summarizes recent researches.

3641. Milne, E. A., Relativity, gravitation, and world structure, 365 pp., 4 pls., 21 figs., Oxford, Clarendon Press, London, Humphrey Milford, 1935. Price 25s. net.

A detailed review of Milne's book is given by G. Temple in Science Progress, vol. 31, no. 121, July 1936, pp. 150–155, under the heading "The new cosmology." Temple says:

"The problem envisaged is nothing less than the large-scale distribution of matter and motion in the universe regarded as a whole. The importance of Milne's researches is that he has completely emancipated himself from the restrictions of view imposed by Einstein's general theory of relativity and has propounded a new, simple, and powerful method of obtaining a theoretical solution of this problem."

10. PATENTS

3642. Electrical apparatus for locating bodies having anomalous electrical admittances; Barret, William M., and Mayer, Randolph H., Shreveport, La., assignors to Engineering Research Corporation, Shreveport, La., a corporation of Louisiana: U. S. patent 2066135, issued Dec. 29, 1936.

This invention relates to an electric apparatus for locating bodies having anomalous electrical admittances, comprising an oscillator unit, a detector unit, each of said units having a housing, a pair of supporting bars, clamping screws for adjustably clamping said housings to said bars at the respective ends, said clamping means acting to hold said housings at a desired angle with respect to said bars, and a pair of uprights connected with said bars having handholds whereby a person may grasp the handles and move the device over the surface of the ground during the operation of the device. Claims allowed, 5.

3643. Metalloscope; Fischer, Gerhard, Palo Alto, Calif.: U. S. patent 2066561, issued Jan. 5, 1937.

This invention relates to a metal finding apparatus comprising the combination of means for radiating modulated high-frequency waves, means for receiving and demodulating said waves, separate containers for said radiating means and for said demodulating means, and handles spaced apart a sufficient distance to permit an operator to stand between said containers for mechanically connecting said containers to provide a portable unit, said radiating means and said receiving means each comprising a loop, the axes of said loops being substantially at right angles, the connecting means between said handles and said containers comprising means for varying the angular relation of said loops. Claims allowed, 3.

3644. Seismograph; Green, William G., Tulsa, Okla.: U. S. patent 2062784, issued December 1, 1936.

This invention relates to a device having a support, a pair of magnets having poles for establishing a magnetic field, means of mounting the magnets on the support with their poles in spaced alining relation to form an air gap therebetween, an armature, means for pivotally supporting the armature centrally within said air gap, means for adjusting the magnets on said mounting to vary the width of the air gap, a current-conducting coil, means for supporting said coil in encircling relation with the armature and in the field of the magnets, and means on the support engaging the armature for effecting pivotal movement of the armature in response to vibratory movement of said support and inertia of said magnets to generate a current in said coil. Claims allowed, 9.

3645. Vibration detector; Heiland, Carl A., assignor to Heiland Research Corporation, Denver, Colo., a corporation of Colorado: U. S. patent 2067636, issued Jan. 12, 1937.

This invention relates to a vibration detector containing the combination with a plurality of completely separate permanent turbulant magnets, each magnet having a pole at each of its ends and located one within the other and with their poles reversed, thereby providing magnetic fields between said poles, of current-generating coils surrounding the ends of the inner magnet and located in the magnetic fields, and vibratory means for supporting the coils to permit their movement longitudinally of the magnets. Claims allowed, 5.

3646. Method of recording seismic waves; McHenry, Karmon Lorane, Dallas, Tex., assignor by direct and mesne assignments of one-third to C & G Oil Co., Inc., and one-third to Wanete Oil Co., both of Dallas, Tex.: U. S. patent 2063820, issued Dec. 8, 1936.

This invention relates to means for exploring geological formations in an area having a substratum of different density than the overlying strata, said means comprising an apparatus for recording seismic waves from an artificially created center of disturbance near the surface of the earth and from which seismic waves are propagated in all directions, the apparatus comprising a plurality of seismometers or electrical detectors placed at points remote from the center of disturbance and spaced apart so that substantially horizontal waves are out of phase on arrival at the seismometers or detectors, the seismometors or detectors, severally and individually, electrically connected to a like number of individual elements of a multiple-string galvanometer and the several strings mechanically linked so that they will move freely in unison but their action is restricted when not acting in unison, whereby to record simultaneously the impulses received by the several seismometers or detectors and whereby, also, horizontal and/or other substantially "out-of-phase" components of the seismic wave trains received at the several seismometers or detectors are damped or diminished in amplitude in proportion to the inertial resistance of, or reversal of phase in, the several strings and the effects of the substantially "in-phase" waves reflected from the substratum are recorded in substantially their full, true, and characteristic forms. Claims allowed, 3.

3647. Apparatus for determining subsurface geological formations; Salvatori, Henri, Hollywood, Calif., assignor to Western Geophysical Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2064385, issued Dec. 15, 1936.

This invention relates to an apparatus for recording reflected seismic waves comprising a plurality of progressively spaced seismometers, a plurality of separate transformer primary circuits for said seismometers, said seismometers constituting a plurality of groups of adjacent seismometers, each of said groups containing at least one but less than all the seismometers of an adjacent group, the seismometers in each of said groups actuating a plurality of said separate transformer primary circuits, a separate recording device corresponding to each of said groups of seismometers and means for actuating each recording device jointly by the seismometers of the group corresponding to said recording device, said means comprising a transformer secondary circuit operatively associated with the corresponding transformer primary circuits actuated by the group of seismometers corresponding to said recording device. Claims allowed, 3.

3648. Seismic surveying; Voorhees, Vanderveer, Hammond, Ind., assignor to Standard Oil Co., Chicago, Ill., a corporation of Indiana: U. S. patent 2064451, issued Dec. 15, 1936.

This invention relates to a method of generating a sustained seismic wave for use in seismic surveying which comprises arranging a plurality of explosive charges in a substantially linear relationship to each other in the direction which the desired seismic wave is to take, the spacing between each adjacent pair of said charges being substantially integrally related to the spacing between other adjacent pairs of said charges, and simultaneously detonating said charges. Claims allowed, 11.

3649. Ground impedance measurement; Wascheck, George, Chappaqua, N. Y., assignor to American Telephone & Telegraph Co., a corporation of New York: U. S. patent 2046436, issued July 7, 1936.

This invention relates to the measurement of the mutual impedance of earth return circuits and more particularly to methods of an apparatus for measuring earth resistivity. It also has application to the determination of the contour of substrata of the earth and particularly to the location of oil and mineral deposits by what is commonly known as the earth-resistivity method. As an improvement on the prior art, an object of this invention is to provide an earth-resistivity measuring system in which stray earth and polarization potentials are completely and automatically neutralized at all times. Another object is to obviate the introduction of the commutator factors into the mathematical computations. A subsidiary object is to reduce commutator sparking and the effect on the measurements of this and other transient disturbances. Another object is to provide an alternating-current system for measuring earth resistivity and means for determining the phase angle between primary-circuit current and secondary-circuit voltage. A feature of the invention is a device introducing in the secondary circuit a voltage that is periodically and automatically adjusted to effect complete neutralization of stray earth potentials and other voltage disturbances. In one specific embodiment the adjustment of the neutralizing voltage is effected by applying the disturbing voltage to a control device at periodic intervals between pulses of the primary-circuit currents. Claims allowed, 10.

3650. Method of making subsurface determinations; Weatherby, Benjamin B., Tulsa, Okla., assignor to Geophysical Research Corporation, New York, N. Y., a corporation of New Jersey: U. S. patent 2062151, issued November 24, 1936.

This invention relates to the method of making subsurface determinations which comprises arranging wave detectors on the earth's surface at unequal distances from the mouth of a well bore, operating a drilling tool at the bottom of said bore, with consequent production of seismic waves and recording their arrival at said detectors. Claims allowed, 9.

3651. Method and apparatus for electrical prospecting; Zuschlag, Theodor, West Englewood, N. J., assignor to Hans T. F. Lundberg, New York, N. Y.: U. S. patent 2062630, issued December 1, 1936.

This invention relates to a method of electrical prospecting in which the steps of establishing an electric ground field in a tract to be investigated, producing in a measuring network having a plurality of branches current flow due to the character of said ground field, balancing the current in said network by procedure including the adjustment of a potentiometer to compensate for phase displacement between different branches of said network, and reestablishing the balance of said network. Claims allowed, 15.

3652. Improvements in or relating to methods of and means for locating earth faults on overhead electric-power transmission lines; Warren, Thomas Reginald, of Lynton, Granville Drive, Forest Hall, County of Northumberland, England: British patent 451288, issued June 26, 1935.

This invention relates to the method of locating earth faults on overhead electric-power transmission lines comprising a conductor supported through insulating means by a tower in which a portion of the fault current is diverted through a subsidiary earth circuit directly connected in parallel with the main earth circuit and including grounding means separate from those of the main earth circuit and an indicating device responsive to the current passing therethrough. Claims allowed, 10.

3653. Improvements in magnetometers; Watts, E. R., & Son, Ltd., 123 Camberwell Road, London, S. E. 5, and Towns, Victor William Henry, of the company's address: British patent 448647, issued November 16, 1935.

This invention relates to a magnetometer of the kind as employed in measuring the intensity of the earth's magnetic field, in which the magnet blades and the central body by which the fulcrum of the balance system is carried are cast in one piece from cobalt steel. The central body is formed in part by the magnet blades and in part by two webs extending transversely of the blades. The balance system is combined with temperature-compensating means. Claims allowed, 4.

3654. Méthode de prospection géophysique en particulier pour l'exploration et la localisation d'huile minérale, par voie électrique [Method of geophysical prospecting, especially of exploration and localization of petroleum, by electrical means]; Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij, of Netherlands: French patent 801397, issued Aug. 3, 1936.

This invention relates to the electrical method of geophysical prospecting, especially applicable to prospecting for oil. The method consists in determining the relationship existing between the time and one of the magnetic or electrical elements (such as tension, intensity, resistance, power, etc.) during the interval of the change between two

or more than two stationary or semistationary conditions. Claims allowed, 2.

3655. Procédé pour l'étude des couches perméables traversées par un sondage [Method for studying permeable layers penetrated by boring]; Schlumberger, Conrad, France (Seine): French patent 797811, issued May 5, 1936.

The present invention relates to a method of determining the permeable layers penetrated by a bore hole. It consists mainly in obtaining along the nontubed part of the bore hole, two series of measurements of a physical parameter of the ground adjoining the hole (such as electrical resistivity, specific induction power, density, thermal conductibility, etc.). This is accomplished by changing the liquids by which the pores of the permeable layers may be filled. In comparing the two series of measurements the points at which the change of the liquid modified the value of the parameter may be determined. No modification would occur in case of impermeable layers. Claims allowed, 4.

3656. Verfahren und Vorrichtung zur Untersuchung der verschiedenen von einem Bohrloch durchsunkenen Schichten [Method and apparatus for investigating various layers penetrated by bore holes]; Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij in Haag, Holland: German patent 634816, issued September 1, 1936.

This invention relates to a method and apparatus for determining the nature, thickness, and succession of various geological layers penetrated by boring. The method consists of filling the hole with a liquid, the uniform temperature of which differs from that of the single layers. Changes in the temperature of the liquid are measured and interpreted. The electrothermometer used has an arrangement in which one soldered joint of the thermo-element is connected to an insulated body having considerable heat capacity and secured inside of the thermometer; the other soldered joint is secured to the external surface of the thermometer. Several thermo-elements connected in series are used. Claims allowed, 4.

INDEX

The figure in parentheses refers to the serial numbers in the table of contents