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APRIL–JUNE 1939

COMPILED BY

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GEOPHYSICAL ABSTRACTS 97, APRIL–JUNE 1939

Compiled by W. AYVAZOGLOU

1. GRAVITATIONAL METHODS

4887. Daly, R. A., Regional departures from ideal isostasy: Geol. Soc. America Bull., vol. 50, No. 3, pp. 387–420, Washington, 1939.

It is now generally agreed that each continental segment of the lithosphere is in almost perfect balance with each segment that is covered by any of the oceans. There is also general agreement that (1) the isostatic compensation is regional, not local, difference in and strength of the lithosphere—a fact necessarily implying permanent stress, (2) the average thickness of the lithosphere is not much more than 100 km., and (3) the lithosphere is underlain by an asthenosphere. Less unanimous are the views of geophysicists and geologists regarding (1) the strength of the asthenosphere and corresponding maximum for stress-difference within it, (2) the thickness of the asthenosphere, (3) the true geoidal figure of the earth, and (4) the degree of parallelism between the geoid and the levels—equipotential surfaces—below the surface of the globe.

The observed facts recounted in this paper suggest that (1) the asthenospheric material must flow under a shearing stress less than 3 kg. per square centimeter, (2) the major belts of one-sign gravity anomaly on land and at sea are apparently not to be satisfactorily correlated with such asthenospheric weakness if the international formula for the figure of the earth be assumed when computing the anomalies, (3) the 1938 triaxial figure of Heiskanen is helpful in providing a basis for the reconciliation, (4) if this be true, the stresses associated with the departure of the geoidal equator and parallels of latitude from circularity must be largely borne by a thick, centrospheric layer beneath the astenosphere, (5) there is no evident reason why the geoidal figure should not approximate a triaxial ellipsoid, (6) the algebraic increase of the isostatic anomalies with increase of depth for the ocean offshore from continents and large islands seems referable to a systematic form of regional compensation, owing to the failure of the strong lithosphere to attain fully the isostatic equilibrium which had been disturbed by prolonged denudation of the lands, (7) the ocean deeps, like some of the smaller glaciated tracts, give an idea of the minimum strength of the lithosphere, and (8) the areas of positive anomaly represented in the mediterranean seas appear to indicate at least as high a degree of strength for the curved, domed, lithospheric shell of the earth. The foregoing suggestions are of course tentative. Their statement does not mean that the writer believes them throughout to represent the truth. His main object is to emphasize once more a fundamental and ineluctable problem of earth science and to ask those more competent in geophysics to attack the problem in the light of the new facts discovered by Hirvonen, Heiskanen, Erola, Hunter, Glennie, Vening Meinesz, Cassinis, Matuyama, and the

experts participating in the measurement of gravity in the West Indian region. Of those problems not the least baffling is the contrast of behaviour of the Basement complex in India and in Fennoscandia as this Sialic layer feels pressures of comparable intensity.—*Author's summary.*

4888. Graf, Anton, Über die Bestimmung der Gravimeterkonstante bei einem frei hängenden Federsystem [On the determination of the gravimeter constant in a freely suspended spring-system]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 49–55, Braunschweig, 1939.

This investigation is concerned with the manner and accuracy of physical determination of the scale-value of a nonastatic pendulum provided with a freely suspended spring. The readings of the instrument and the scale-value were checked by exact measurements made at gravitational stations by two different pendulum-crews of the Potsdam Geodetic Institution. The distance between the two check points was 7.5 miles; the difference in altitude about 1,500 feet. The maximum error of 12 series of pendulum observations was 2 milligals; the maximum error of the gravimeter readings was 0.18 milligal. The gravitational difference as determined by pendulum observations was 85.6±0.2 milligals; the difference obtained by the gravimeter was 85.8±0.06 milligals.—*Author's abstract.*

4889. Heiland, C. A., Gravimeters; their relation to seismometers, astatization, and calibration: Am. Inst. Min. Met. Eng., Tech. Pub. No. 1049, 26 pp., New York, 1939.

A comprehensive paper on gravimeters. The working principles of a number of instruments are illustrated and treated in relation to the action of corresponding seismometer and astatization methods. Also included is a description of calibration methods.—*Abstract in Mining and Metallurgy, vol. 20, No. 388, p. 230, 1939.*

4890. Jung, Heinrich, Dichtebestimmung im anstehenden Gestein durch Messung der Schwerebeschleunigung in verschiedenen Tiefen unter Tage [Determination of density in adjacent rock by measuring the gravity acceleration at various depths underground]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 56–65, Braunschweig, 1939.

Tests were made inside the Wilhelm-shaft, near Clausthal, to determine by means of gravity measurements with the Thyssen gravimeter the density of the different adjoining rocks. The results of these tests are discussed. Densities obtained from gravity measurements agreed well with the results of comparative measurements of rock samples taken from the drifts underground.—*Author's abstract translated by W. A.*

4891. Lagrula, Jean, Nouvelles mesures de l'intensité de la pesanteur dans les Départements d'Alger et de Constantine [New measurements of the intensity of gravity in the departments of Algiers and Constantine]: Acad. sci. Paris Comptes rendus, vol. 208, No. 10, pp. 734–736, 1939.

The results of measurements made at 37 stations with the Holweck-Lejay pendulum 42 are shown in a table.—*W. A.*

4892. Larmor, Joseph, Distortion of mountain strata, isostasy, and glacial periods: Nature, vol. 141, No. 3577, pp. 906–907, London, 1938.

The correlation of distorted mountain strata with isostatic adjustment has been examined previously (see Geophys. Abstracts 93, No.

4282). In this article a brief discussion is given of ideas concerning the formation of mountain roots by the isostatic sinking of folded mountain bodies.—*W. A.*

4893. Lejay, Pierre, L'isostasie et les anomalies positives de la gravité en certains massifs montagneux et en particulier dans la chaîne de Zambalès [Isostasy and positive gravity anomalies in certain mountainous massifs, in particular in the Zambales range]: Acad. sci. Paris Comptes rendus, vol. 28, No. 7, pp. 480–483, 1939.

In a previous paper (see Geophys. Abstracts 96, No. 4756) the author established that, contrary to the general rule, strong positive anomalies were found in mountainous regions of the Philippine Islands.

In this article these positive anomalies are attributed to local underground excess of mass caused by heavy minerals, which have been observed to crop out, especially in the region of the Zambales Range. On this assumption, isostatic equilibrium is still possible.—*W. A.*

4894. Lindblad, Axel, and Malmquist, David, A new static gravity meter and its use for ore prospecting: Ing. Vetenskaps Akad. Proc., No. 146, 52 pp., Stockholm, 1938.

Static gravity meters of several types have been in practical use for structure mapping in oil prospecting, notably for determining anticlines, synclines, and salt domes, but as far as the authors are aware none of them have been used till now for ore prospecting. It is shown that gravity anomalies over an ore body, even of relatively large dimensions, can scarcely be expected to exceed 2 to 4 milligals. Thus a very high sensitivity in the instrument is required in searching for ores with the aid of a gravity meter.

In this paper the authors report on the results of their studies and experiments with a view to constructing an instrument of the required sensitivity. In the first chapter they discuss the theoretical bases of ore prospecting with the aid of gravimetric measurements, and they draw special attention to the possibilities of their method of procedure. The second chapter contains a description of the instrument; the third, a report on the results obtained in testing the instrument over known ore bodies. A surveyer profile across a barren area where electrical indications had previously been observed is given.—*W. A.*

4895. Meisser, O., Zur absoluten Schweremessung [On the absolute measurement of gravity]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 41–46, Braunschweig, 1939.

To increase the accuracy of the absolute g-measurement, the author proposes a pendulum in which the knife edge is replaced by a new roller joint. Some properties of this roller joint are discussed mathematically.—*W. A.*

4896. Nörgaard, G., Ein statischer Quarzschweremesser und Schweremessungen [A statical quartz gravity meter and measurements of gravity]: Geodaetisk Inst., meddelelse No. 10, 24 pp., Copenhagen, 1939.

The construction of a statical quartz gravity meter is described. This instrument has two almost vertical springs, thickened at their upper ends. Bending of the upper points of the springs toward each other, with increase of gravity, for example, causes a decrease in the distance between these two points and thus serves as a measure of gravity. A

special device for reading the distances between the points of the two springs is attached. The practical application of the instrument is described, and the results obtained from measurements made along several profiles near Agerskov, Denmark, are given in a table. A map of the gravity anomaly of the region is added.—*W. A.*

4897. Schwinner, Robert, Auswahl der Stationsorte für Schweremessung im Gebirge [Selection of sites for stations in making gravity measurements in mountainous regions]: Berg- u. hüttenm. Monatsh., vol. 87, No. 1, pp. 10–11, Vienna, 1939.

In his article "Application of gravity measurements to geology and mining in Austria" (see Geophys. Abstracts 94, No. 4435), Mader mentions that gravity measurements should be made in the future also on the summits of high mountains. Schwinner explains why such measurements cannot be of great value and gives a few figures of possible errors resulting from them:

1. Unfavorable conditions under which a station can be established on the summit of a mountain, in comparison with the conveniences offered to stations in valleys, will result in an error of measurement estimated at several milligals.

2. An error of 1 m. in determining the altitude of the summit produces an error in measurement of gravity of 0.3 milligal.

3. Topographic correction is more difficult.

4. Insufficient geological information at high altitudes will result in another error of measurement.

It is estimated that an error of 5 percent made at a station in a valley will produce an error in measurement of 1 to 3 milligals and at a station on the summit of a mountain an error of 10 to 20 milligals. Thus the data obtained at such stations may often be of no value.—*W. A.*

4898. Sezawa, Katsutada, and Kanai, Kiyoshi, The effect of viscosity on the gravitational stability of the earth at its liquid cooling stage: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 16, No. 4, pp. 690–701, 1939.

In a previous paper (see Geophys. Abstracts 96, No. 4760) the gravitational stability of the earth at its liquid stage was discussed without taking into account the viscosity of the liquid.

In this article the authors discuss the problem of the stability of a plane boundary between two liquids extending upward and downward to infinity, as well as the problem in which a superficial layer of one liquid on another extends downward to infinity. The investigation shows that viscosity affects gravitational stability only to a small degree. Mathematical solutions for the two problems are given.—*W. A.*

4899. Wright, F. E., and England, J. L., An improved torsion gravity meter: Am. Jour. Sci., 5th ser., vol. 35–A, pp. 373–383, New Haven, Conn., 1938.

In the improved instrument, recently built at the Carnegie Geophysical Laboratory, Washington, D. C., the torsion element is the same as that used heretofore, but its other parts have been rearranged to provide simpler control for operation in the field. The present apparatus is lighter than its predecessor and gives promise of even better field performance. The last instrument, during one period of 8 months' service in 1937 in occupying and reoccupying old and new gravity stations, yielded results that, for any given station, agreed

within 1 milligal. The new instrument is mounted inside a covered, insulated motortruck. Under ordinary conditions 20 stations or more per day can be occupied. The torsion element in this balance is under load only during the time required to make a gravity measurement (either 4 or 6 minutes); otherwise it is at rest, and the small residual strains are dissipated. This procedure maintains the characteristics of the spring remarkably constant.—*Authors' abstract.*

2. MAGNETIC METHODS

4900. Bock, R., Über die magnetische Reichsvermessung II Ordnung und ihre ersten vorläufigen Ergebnisse [On the second-order magnetic survey of the Reich and its preliminary results]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 66–73, Braunschweig, 1939.

A new second-order magnetic survey of Germany was started in 1937. Measurements of magnetic declination and of vertical intensity were included. Preliminary results of the survey carried out during 1937 and 1938 are given in a map that shows the differences of declination concerning the station at Niemegk and in a map that shows vertical isodynamic lines near Erkelenz.—*W. A.*

4901. Duthoux, P. V., Etude géomagnétique du massif de Hourt [Geomagnetic study of the Hourt-massif]: Soc. géol. Belgique Mem., vol. 62, No. 2, pp. M107–M150, Liège, 1938–1939.

The application of geophysical methods of prospecting to the solution of a geologic problem that could not be solved by geology alone is described. An attempt is made to give a detailed explanation of the structure of the Lower Cambrian Hourt-massif and to define its relation to the Middle Cambrian. First, the author briefly describes the theory and technique of the method of observation and of interpretation; then he gives a detailed account, from which a deduction can be made as to the independence of the Lower and Middle Cambrian in the eastern part of the Hourt-massif. Reasons in favor of this concept are given. The main subjects of the article are (1) geomagnetic methods of prospecting, (2) details of magnetic observations, (3) structural interpretations, and (4) general conclusions.—*W. A.*

4902. Ėblé, Louis, and Gibault, Gaston, Valeurs des éléments magnétiques a l'Observatoire de Chambon-la-Forêt (Loiret) au 1er Janvier 1939 [Values of magnetic elements at Chambon-la-Forêt (Loiret) Observatory on Jan. 1, 1939]: Acad. sci. Paris, vol. 208, No. 11, pp. 823–824, 1939.

Values of magnetic elements on January 1, 1939, were calculated from all the hourly values recorded during December 1938 and January 1939. Secular variations are the differences between these values and those published for January 1, 1938 (see Geophys. Abstracts 94, No. 4448). The added table contains (1) absolute values for the epoch 1939.0 and (2) the secular variations for the elements of declination; of inclination; of horizontal, vertical, north, and west components; and of the total force.—*W. A.*

4903. Elsasser, W. M., On the origin of the earth's magnetic field: Phys. Rev., vol. 55, No. 5, pp. 489–498, Lancaster, Pa., 1939.

The terrestrial field is traced here to the existence of thermoelectric currents in the metallic interior of the earth. The currents owe their existence to inhomogeneities continually created by turbulent convective

motions. In order to obtain a nonvanishing resultant angular momentum of the currents around the earth's axis, the current system must exhibit a particular asymmetry. The latter is shown to originate through the preponderant influence of the Coriolis force upon the convective motions. In part one the well-known proof, based on potential theory, of the fact that the currents must flow inside and not outside the earth is briefly reproduced. In part 2 an analysis of the formal expression for the current density is given. By means of a development in spherical harmonics the conditions for a nonvanishing-current momentum can be formulated. It appears that temperature fluctuations in an otherwise homogeneous medium always yields a zero momentum; therefore the existence of inhomogeneities in the material is also required. In part 3 it is pointed out that geophysicists have previously obtained evidence of the existence of a metallic core of the earth in which the viscosity is extremely low as compared to the viscosity of the rocks. Radioactive impurities which are very small compared to the total radioactivity of the earth are sufficient to maintain thermally driven convective motions in the metallic core. An estimate of the various terms in the hydrodynamic equations shows that the Coriolis force is much larger than all other dynamical effects. In part 4 we discuss the effect of the Coriolis force in producing that particular asymmetry which leads to a resultant angular momentum of the currents. It is shown that the inhomogeneities in material required according to the analysis of part 2 can be accounted for by phase transformations of the material induced by the pressure changes which are connected with the vertical component of the motions. In part 5 an attempt is made to estimate numerically the current density, basing the estimate on some general results of the theory of conductivity. For temperature variations of the order of 10° the calculated value of the current is in satisfactory agreement with the observed magnitude of the earth's magnetic moment. At the end, the bearing of these ideas upon the magnetism of sunspots is briefly discussed.—*Author's abstract.*

4904. Elsasser, W. M., Origin of the earth's magnetic field: Nature, vol. 143, No. 3618, pp. 374–375, London, 1939.

Assuming the existence of inhomogeneities and thermal currents in the earth's core, Dr. W. M. Elsasser calculates that temperature differences as low as 10° would give rise to currents whose irregular distribution might result in a small one-sided excess that would account for the earth's magnetic field.—*Editorial abstract.*

4905. Fanselau, G., Geophysikalische Arbeiten Prof. Filchner's in inner Asien [Prof. Filchner's geophysical work in central Asia]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 1–7, Braunschweig, 1939.

A brief description is given of Filchner's two expeditions in central Asia—one from 1926 to 1928 and the other from 1934 to 1938—for the purpose of making measurements of the earth's magnetic field. Stations on an average of 20 km. apart are shown on a map. Instruments used during the first expedition consisted of a traveler's theodolite and an earth inductor; a Schmidt field balance was included in the second expedition. Many local stations are investigated magnetically, in addition to about 300 main stations. Magnetic investigations made from time to time in unknown regions contribute greatly to the general knowledge of secular variations.—*W. A.*

4906. Forberger, Karl, and Metz, Karl, Magnetische Bodenforschungen im Gebiete zwischen Leibnitz und Randkersburg [Magnetic investigation of the ground in the region between Leibnitz and Randkersburg]: Berg- u. hüttenm. Monatsh., vol. 87, No. 3, pp. 61–66, Vienna, 1939.

Measurements of vertical intensity by means of the Schmidt vertical balance were made in 1936 with the object of determining the underground structure in the Leibnitz-Randkersburg area. At the same time, the region was investigated as a possible source of oil. The method and interpretation of magnetic measurements are described, and a map showing the isogams of the vertical intensity of the region is given. The results of measurements made at 182 stations are summarized in a table.—*W. A.*

4907. Ivanov, N. A., Application of a micromagnetic survey in prospecting for bauxite deposits [in Russian]: Geology and Geophysics, Trans. Ural Sci. Research Inst. of Geology, Prosp., and Econ. Mineralogy, No. 1, pp. 121–127, Sverdlovsk, 1938.

Results are described of magnetic surveys over several groups of bauxite deposits in the Urals. From these results the following conclusions are drawn: (1) Distinct magnetic anomalies are caused by large accumulations of pisolitic bauxites, (2) magnetic methods may be considered the most suitable of all methods used in prospecting for bauxites, (3) a micromagnetic survey is best for determining the borders of bauxite deposits, (4) the theoretically calculated magnetic intensities over bauxite deposits agreed with the observed anomalies within limits ranging from 15 to 20 percent, and (5) magnetic methods cannot be applied successfully in prospecting for Paleozoic and clayey bauxite deposits.—*W. A.*

4908. Johnson, E. A., A primary standard for measuring the earth's magnetic vector: Terres. Magn. and Atmos. Electr., vol. 44, No. 1, pp. 29–42, Baltimore, Md., 1939.

The theory of a new primary standard for measuring any component of the earth's magnetic field is developed. The magnetometer consists of a Helmholtz-Gaugain coil, which provides a standard field opposed to that component of the earth's magnetic field which is to be measured, and a rotating coil used as a null detector. The voltage generated in the rotating coil is detected by an alternating-current amplifier. The constant of the Helmholtz-Gaugain coil is computed from the formulas developed by C. Snow from the mutual inductance between two concentric cylinders. Corrections are computed for the fact that the Helmholtz-Gaugain coils are helices, for the axial components of current, for the effect of the lead-in wires, and for nonuniformities in winding. The finite size of the detector is not a limitation on the accuracy since it is taken into account in the computation. Consequently, the accuracy of the coil-constant of the new standard depends only upon constructional accuracy. Inhomogeneity in the field of the Helmholtz-Gaugain coil necessitates the use of small correction-terms to the voltage of fundamental frequency generated in the detector and produces odd harmonics of the fundamental frequency in the detector. The errors in orientating the Helmholtz-Gaugain coil are also examined. The limiting sensitivity of the detector is calculated from the thermal agitation of electricity in the coil of the detector.—*Author's abstract.*

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4909. Krakau, E. B., Secular changes in the geomagnetic field in the Crimea between 1900 and 1936 [in Russian]: Trudy Glavnoy Geofizicheskoy Observatorii, No. 29, pp. 62–77, Leningrad, 1939.

From the investigation of secular changes in the geomagnetic field in the Crimea, the fact is established that the irregularity of these changes as observed from measurements made between 1900 and 1936 depends partly on local influences, which are possibly attributable to geotectonic changes produced in the Crimea by many earthquakes. Two tables are given showing the changes in local differences of the magnetic elements caused by secular changes from 1900 to 1936 and from 1914 to 1936. Maps of isanomalies of Z_a for the epochs 1900 and 1936 and maps of summarized changes in local differences of δZ, δH, and δT for the years 1909–1936 and 1914–1936 are added.—*W. A.*

4910. Lasserre, A., Mesure de magnétisme terrestre en Algerie et dans les territoires du sud [Measurements of terrestrial magnetism in Algeria and in the southern territories]: Jour. physique et radium, vol. (7) 9, No. 3, pp. 425–435, Paris, 1938.

A map of isogonic lines, exhibited in the "Institut de physique du globe" in Paris, is drawn for Algiers and the French southern territories. The text is mainly an explanation of the method of reduction by which the very different local and secular determinations of declination are adapted to one another to obtain the probable values with reference to 1931, O.—*W. A.*

4911. Mikov, D. C., Application of magnetometry in drawing geologic maps [in Russian]: Geology and Geophysics, Trans. Ural Sci. Research Inst. of Geology, Prosp., and Econ. Mineralogy, No. 1, pp. 138–140, Sverdlovsk, 1938.

A brief account is given of the magnetic surveys of an area of about 5,000 km.^{2} in connection with geologic mapping over deposits containing magnetite. Two graphs are added to illustrate this work. The following conclusions are drawn: (1) The distribution of rocks according to their content of magnetite could be determined, (2) the precision of the results of the surveys was always dependent on the magnetic properties of the rocks and on the sharpness of the boundaries of the geologic structure of the region under investigation, (3) ultrabasic rocks (pyroxenites, peridotites, dunites, porphyrites, tuffs, diabases, serpentinites, and other rocks containing a sufficient amount of magnetite) could be differentiated by magnetic surveys, and (4) the boundaries of such deposits could be well defined even where the overburden was very thick.

Magnetic surveys by which characteristic geologic features of deposits at depth may be obtained are therefore of great aid in geologic mapping.—*W. A.*

4912. Mikov, D. C., Prospecting for iron-ore deposits by geophysical methods [in Russian]: Geology and Geophysics, Trans. Ural Sci. Research Inst. of Geology, Prosp., and Econ. Mineralogy, No. 1. pp. 116–121, Sverdlovsk, 1938.

Magnetometric work carried out with a Schmidt balance and a Tiberg-Thalen magnetometer over iron-ore deposits in the Urals is discussed. The general conclusion is that titanomagnetite ore bodies can be disclosed distinctly by magnetic methods of prospecting, provided a net of comparatively closely spaced stations is used.—*W. A.*

4913. Orkisz, Henryk, Levé de la composante verticale à l'aide de la balance de Schmidt dans l'avant-pays des Carpathes Orientales [Surveying the vertical component with the Schmidt balance in the foreland of the eastern Carpathians] [in Polish]: Inst. Géophys. et Météorol. de l'Université de Lwow, Comm., vol. 9, No. 111, pp. 33–108, 1937.

This survey, carried out with a Schmidt balance from 1929 to 1935, is presented in 39 maps. More than 12,000 observations were made at 4,980 stations. Homogeneity in the distribution of isanomalies is shown in a general map of the region. Geological reasons for the magnetic anomalies in several areas are discussed.—*W. A.*

4914. Pudovkin, I. M., Geologic mapping by the method of magnetic surveys [in Russian]: Trudy Glavnoy Geofiz. Observatorii, No. 29, pp. 50–61, Leningrad, 1939.

A magnetic survey of a well-known molybdenite deposit in northern Karelia is described. The purpose of the survey was to study the possibility of determining magnetically the exact borders of adjoining granite and greenstone rocks. After a brief outline of the geologic features of the area, the procedures of the magnetic work and the geological interpretation of the data obtained by the survey are given. Graphs showing the intensity of magnetic fields over granites, amphibolites, greenstone, slates, and greenstone rocks of diabase types illustrate the results.

It is concluded that a magnetic map based on the magnetic survey could be drawn, by which the geologic features already known could be defined still more accurately.—*W. A.*

4915. Rayner, J. M., The Henbury meteorite craters and geophysical prospecting: Australian Jour. Sci., vol. 1, No. 3, pp. 93–94, Sydney, 1938.

Geophysical methods of prospecting have recently been applied to determine whether or not large masses of meteoric material lie beneath the craters at Henbury, in Central Australia. Thirteen craters, the largest of which is about 660 feet in diameter and some 45 feet in depth, have been discovered within an area of about a quarter of a square mile. The work was done in 1937 by using vertical and horizontal magnetic-force variometers manufactured by Watts. Only small magnetic anomalies (less than 40 gammas) were found. The detailed results of the survey are still being worked out. It appears, however, that there are no large meteorites lying beneath the Henbury craters. This result is of considerable interest as it supports the belief that large meteorite craters do not represent the pitting by a meteorite penetrating the surface, but rather are the site of an explosive impact that shattered the meteorite.—*W. A.*

3. SEISMIC METHODS

4916. Bullen, K. E., Ellipticity correction and deep-focus earthquakes: Royal Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 4, No. 6, pp. 469–471, London, 1939.

The effect of abnormal depth of focus on earthquake ellipticity corrections is examined, and for *P* waves it is shown that in most cases the effect is less than 0.1 second and only very rarely can exceed 0.2 second. For all present practical purposes the depth of focus may be completely ignored in estimating ellipticity corrections.—*Author's abstract.*

4917. Collins, M. P., Local earthquakes in New England: Seismol. Soc. America Bull., vol. 27, No. 1, pp. 41–48, Berkeley, California, 1937.

During 1934 and 1935, records of approximately 150 definitely local disturbances were obtained on the Benioff seismographs at the Harvard Seismograph Station. Because of a curious concentration in the daytime hours and the few earthquakes reported felt during this interval, an attempt was made to establish criteria by which records of blasts and of local earthquakes might be distinguished from each other. Three [factors]—the ratio of the maximum *P* to the maximum *S*, the character of the surface waves, and the angle of emergence—are discussed. The records of 32 of these disturbances, well recorded on all three Benioff components, are described. It is concluded that although some of New England's seismic activity is artificial, there is nevertheless a greater amount of natural activity than is ordinarily attributed to this region.—*Author's abstract.*

4918. Dix, C. H., Interpretation of well-shot data: Geophysics, vol. 4, No. 1, pp. 24–32, Houston, Tex., 1939.

A method of interpreting well-shot data is presented having the advantage that the velocity distribution calculated can be made to fit the data with any desired closeness. In practice the method is not difficult to apply. With discrete data a unique interpretation evidently cannot be given, but in the case of ideal data, including also surface refraction data, the velocity distribution is uniquely determined.—*Author's abstract.*

4919. English, W. A., Tracy, W. H., Nomann, Arthur, Ittner, Frank, and Kelly, P. C., Seismograph prospecting for oil: Am. Inst. Min. Met Eng., Tech. Pub. No. 1059, 29 pp., New York, 1939.

An introduction and four papers dealing with the various phases of seismograph work, by members of the staff of the Superior Oil Co. of California: Introduction, by W. A. English; Theory of seismic reflection prospecting, by W. H. Tracy; Instruments for reflection seismograph prospecting, by A. Nomann; Seismograph field operations, by F. Ittner; and Determining geologic structure from seismograph records, by P. C. Kelly.

The material is presented in a nontechnical manner, principles rather than details of apparatus being stressed.—*Abstract in Mining and Metallurgy, vol. 20, No. 388, 1939.*

4920. Ewing, Maurice, Woollard, G. P., and Vine, A. C., Geophysical investigations in the emerged and submerged Atlantic Coastal Plain, Part 3, Barnegat Bay, New Jersey, section: Geol. Soc. America Bull., vol. 50, No. 2, pp. 257–296, Washington, 1939.

Seismic-refraction measurements, from Princeton to Barnegat Bay, N. J., have been made as a continuation of similar measurements of the depth of the crystalline basement made at Cape Henry, Va., and Woods Hole, Mass., in 1935. The standard technique for seismic-refraction measurements was followed. The observed depths are in agreement with the well logs of two deep wells extending to the basement. A geologic section constructed from these measurements is in agreement with known geologic and gravitational data. The numerous geologic indications of the investigation are summarized.—*Authors' abstract.*

4921. Herrmann, A., Grundsätzliche Betrachtungen über piezoelektrische Beschleunigungsmesser [Fundamental considerations on piezoelectric accelerometers]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 31–37, Braunschweig, 1939.

The author investigates single bars and pieces of crystal from quartz and Rochelle (seignette) salt that are cut in different directions, and also quartz hollow cylinders, with regard to the possibility of their application in constructing piezoelectric accelerometers for use in seismic methods of prospecting and working without amplifiers. He finds that the required high sensitivity of acceleration is obtained by using (1) quartz bars with the stress parallel to the neutral axis, (2) seignette salt bars with the stress perpendicular to the C-axis, and (3) seignette salt benders composed of bars that are perpendicular to the C-axis.—*Author's abstract translated by W. A.*

4922. Jeffreys, Harold, Japanese deep-focus earthquakes: Royal Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 4, No. 6, pp. 424–460, London, 1939.

Ten deep-focus earthquakes in or near Japan are discussed. They provide evidence that the hypothesis of a sudden increase of velocity corresponding to the 20° discontinuity is nearer the truth than that of a smooth time curve; but the *P* observations suggest that continuous refraction, strong enough to produce a loop in the time curve, is closer still. The observations of *S* at short distances yield a satisfactory solution for *Sd*, since the uncertainty of identification is much less than that found in normal earthquakes. Corrections to the times of *Sr* and *SKS* are found. Comparison of the *pP–P* and *sS–S* intervals with those calculated from the focal depths found from *P* alone suggests corrections to the thickness of the upper and intermediate layers; these thicknesses are now found to be 15±3 km. and 18±4 km.—*Author's abstract.*

4923. Johnson, C. H., Steady-state polar sensitivity curves: Geophysics, vol. 4, No. 1, pp. 33–52, Houston, Tex., 1939.

The resultant amplitude, "*A*", of the combined outputs of a group of geophones is derived as a function of the difference in time of arrival, ΔT, at extreme geophones in the group, the number of geophones and the period of the waves being parameters.

"*A*" plotted as a function of ΔT is shown to have principal and secondary maxima whose amplitudes, separation, and sharpness are discussed. The relative response of the geophone group to waves from every direction is considered and illustrated by polar sensitivity curves. The changes in the polar sensitivity curves effected by changes in the number of geophones, the geophone spread, or the wave length, are considered. The effect of introducing articificially controlled time differences between geophone outputs, so as to vary the direction of maximum response (so-called variable compounding) as is done in the Rieber sonograph, is considered. By this means the resultant response of the group of geophones can be focused, so as to emphasize waves arriving from any specific direction. While the results are strictly applicable only to the case of steady-state, sinusoidal waves, they may apply qualitatively to all the waves encountered in seismic exploration. The versatility of variable compounding is pointed out.—*Author's abstract.*

4924. Kelly, Dunford, A reaction-type shaking table: Geophysics, vol. 4, No. 1, pp. 69–75, Houston, Tex., 1939.

A steady-state shaking table utilizing the principle of reaction has been constructed for the measurement of the response of seismometers and the over-all response of seismograph apparatus. A mass of 500 pounds is driven at amplitudes of the order of 10^{-4} inches by a small eccentric mass which is rotated at the center of percussion of a bar, the upper end of which is pivoted to the bottom of the heavy mass. The amplitude of motion of the table top is independent of frequency between 10 cycles per second and an undetermined upper limit higher than 150 cycles per second.—*Author's abstract.*

4925. Krumbach, Gerhard, Über ein Stationsseismometer für optische Registrierung [Station seismometer for optical recording]: Zeitschr, Geophysik, vol. 15, No. 1/2, pp. 17–24, Braunschweig, 1939.

Construction of a seismometer by which the movements of an oscillating mass can be recorded directly without the insertion of an intermediate apparatus is now possible, thanks to systematic developments made in the optical device of the oscillating system and in the recording apparatus. The fineness of the line made by the recording pen allows us to reduce considerably the consumption of recording paper. Small dimensions of the seismometer and recording apparatus make the outfit suitable for seismic field tests, especially for its quick operation in the region of the center of an earthquake. Photographs of the seismometer and recording apparatus are given.—*Author's abstract translated by W. A.*

4826. Martin, Henno, Ein neuer Erschütterungsmesser und die Aufzeichnung nichtsinusförmiger Bewegungen [A new oscillograph and the recording of nonsinusoidal movements]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 24–31, Braunschweig, 1939.

The author describes a new oscillograph by which the movement of a mass can be simultaneously recorded (1) directly by means of a system of mirrors and (2) inductively by means of a coil moving within a magnetic field. New possibilities of recording the movements of the ground result from this arrangement. Examples of simultaneous recording of nonsinusoidal movement by using different apparatus are given. Finally, the possibility of explaining some theoretical questions connected with the Galitzin pendulum by using the new, simple apparatus is indicated.—*Author's abstract translated by W. A.*

4927. Mott-Smith, L. M., On seismic paths and velocity-time relations: Geophysics, vol. 4, No. 1, pp. 8–23, Tulsa, Okla., 1939.

It is shown that only a few very simple velocity-depth laws lead to path equations that can be integrated, and that none of them are suitable for application, either because there are no empirical velocities to which they conform sufficiently closely, or because the difficulties of fitting them to an empirical velocity are too great. It is shown that there are velocity-time relations that do conform closely to the usual form of an empirical velocity, relations which can be easily fitted to the latter, which are not difficult to handle, and which have other advantages. Two ways of applying the seismic paths are discussed.—*Author's abstract.*

4928. Nagata, Takesi, Geophysical studies of Mihara Volcano, Ooshima Island. A minor activity of volcano Mihara, Aug. 11, 1938: Tokyo Imp. Univ., Earthquake Research Inst. Bull., vol. 16, No. 4, pp. 714–720, 1938.

From the distribution of fragments ejected during the recent activity of Mihara Volcano, the initial velocity of moving fragments and the gas pressure of the eruption are estimated. The relation between the distribution and the initial velocity of fragments is calculated mathematically by taking into account the effects of air viscosity and the shape of the pit.—*W. A.*

4929. Riabinkin, L. A., Seismic methods of prospecting [in Russian]: Razvedka Nedr, vol. 9, No. 1, pp. 24–27, Moscow, 1939.

A general description is given of the application of the two seismic methods of prospecting—refraction and reflection—in parts of the U. S. S. R. The good results obtained from combining both these methods for prospecting salt domes—the refraction method for determining the dome itself and the reflection method for determining its side walls—are especially emphasized.—*W. A.*

4930. Schmerwitz, Gerhard, Ausgleichung der besten Stationsbeobachtungen mitteleuropäischer Erdbeben [Adjustment of the best observations made at stations to the earthquakes of central Europe]: Zeitschr. Geophysik, vol. 14, No. 7/8, pp. 351–390, Braunschweig, 1938.

This article consists of the following four parts:

Part 1, Calculation of coordinates.

It is proved that the widely accepted procedure in geophysical literature of considering the parallel circle as one of the axes of a rectangular system of coordinates, causes errors up to 20 km. in the determination of the position of a station for distances of about 500 km. from the epicenter. The distribution of the stations within a rectangular spherical system of coordinates is considered, and the necessary corrections in connection with this distribution are made.

Part 2, Adjustment.

From the different times of the beginning of the propagation of earthquake waves five unknown quantities must be found for the evaluation of observations made at earthquake stations. The adjustment, which can be made according to the method of least squares must, therefore, be applied to the following five elements simultaneously: The coordinates X and Y, the focal time t , the focal depth z, and the velocity of propagation V. The method was applied to 12 observations of earthquakes made at from 7 to 22 stations.

Parts 3 and 4, Conclusions derived from the results of adjustments, and the main result.

By computing errors, the author shows that the usually accepted values for the accuracy of determining focal depth and velocity are too high. He further shows that velocity decreases with depth of focus. Thus the P-layer and the other hypothetical layers with high values of velocities inside the earth's crust are deprived of an observational foundation. By the use of the times of propagation of P-waves observed at 89 stations and of S-waves at 49 stations, the detailed investigation of the remaining errors observed at stations makes it possible to answer several questions with greater reliability than could have been answered previously. This investigation concerns especially the in-

fluence of the subterranean geologic factor, changes produced by aftershocks as compared with the main shock, the form of the focus (whether a point or an extended focus), accuracy of observations at stations, and systematic errors at stations.—*Author's abstract translated by W. A.*

4931. Sezawa, Katsutada, and Kanai, Kiyoshi, Anomalous dispersion of elastic-surface waves, Part 2: Tokyo Imp. Univ., Earthquake Research Inst. Bull., vol. 16, No. 4, pp. 683–689, 1938.

In a previous paper (see Geophys. Abstracts 95, No. 4649) it was shown that the transmission of Rayleigh-type waves of certain ranges of wave length was possible even when the velocity of bodily waves in the surface layer was higher than that in the subjacent layer, the propagational velocity of the waves diminishing with the increase in wave length.

In this article the authors (1) discuss the velocity equation of dispersive Rayleigh waves and (2) give numerical examples and interpretation. The anomalous dispersion of Rayleigh waves under certain conditions of elasticity and density was found from the results of mathematical calculations.—*W. A.*

4932. Sieberg, August, Arbeitsgebiete der Reichsanstalt für Erdbebenforschung in ihren Beziehungen zur Geologie und Bergbau [Sphere of action of the Government Institute for Earthquake Research and its relation to geology and mining]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 7–17, Braunschweig, 1939.

The importance of the Government Institute for Earthquake Research is evident because uniform plans and methods of investigating earthquakes can be applied. Problems assigned to this institute call for the solution of questions involving effects of earthquakes on buildings, dependence of these effects on the ground, mechanical processes during the destruction of buildings, oscillations caused by traffic, rock bursts (Gebirgschläge), and many others.—*W. A.*

4933. Silverman, Daniel, The frequency response of electromagnetically damped dynamic and reluctance type seismometers: Geophysics, vol. 4, No. 1, pp. 53–68, Houston, Tex., 1939.

The steady-state shaking table has been used to determine the response, as a function of frequency and terminating resistance, of a dynamic and a reluctance seismometer. The observed response of the dynamic seismometer is shown to be identical with that predicted by theory. The response curves for the reluctance seismometer qualitatively substantiate analytical predictions as to the value of terminating resistance for maximum damping and of the shift, with decreasing resistance, of the peak of response to the higher frequencies. A short discussion of the electrical-equivalent seismometer is given, and a comparison is shown between the experimentally determined response of a reluctance-type seismometer and that of its equivalent network.—*Author's abstract.*

4934. Sparks, N. R., and Hawley, P. F., Maximum electromagnetic damping of a reluctance seismometer: Geophysics, vol. 4, No. 1, pp. 1–7, Houston, Tex., 1939.

An explicit solution of the third-order differential equation of motion of an electromagnetically damped reluctance seismometer is obtained for the case of greatest interest, that is, when the terminating resistor

is adjusted to give greatest damping. This solution shows that definite interrelationships among the instrument constants are necessary for appreciable damping. The theoretical limitations of the maximum damping which can be obtained are discussed.—*Authors' abstract.*

4935. Stoneley, R., Two double earthquakes: Royal Astron. Soc. Monthly Notices, Geophys. Suppl., vol. 4, No. 6, pp. 461–468, London, 1939.

Two earthquakes from the same epicenter both show an abnormal frequency of P residuals of about $+20^s$. Analysis of residuals and examination of the Kew seismograms show that both earthquakes are double—a feeble first shock succeeded by a strong one—in each case between 19 and 20 seconds later. For the shock in which the two onsets are the more clearly separated it is shown that the two are referable to the same focus. A comparison is made with a normal earthquake from an epicenter very close to the others.—*Author's abstract.*

4936. Takabeya, F., Model experiments on the minimization of structural vibrations caused by seismic disturbances: Nature, vol. 142, No. 3583, pp. 38–39, London, 1938.

Experiments have been made on the horizontal movement of a model foundation table. After several experiments with different conditions of loading, it was found that vertical loads placed on a group of shot (spheres of equal diameter) are very effective as a practical method of flattening the resonance curve. The load on the shot acts as a very good damper of the vibration and is more effective the nearer it is placed to the roof.—*W. A.*

4937. Tams, Ernst, Zur Frage der regionalen Verkoppelung von Erdbeben [On the question of the regional coupling of earthquakes]: Zeitschr. Geophysik, vol. 14, No. 7/8, pp. 241–260, Braunschweig, 1938.

After a close study of favorable occurrences in Iceland, Austria, and the Philippines, the author shows that in similar regions earthquakes that seem to be independent may be basically connected with one another by means of an extensive endogenous process, if considerable intervals in space and time are taken into consideration. If treated statistically according to theoretical probability, they cannot be considered as independent incidents. Perceptible relations have not been observed recently among the several earthquake regions in Norway. Seismic activity, however, has diminished noticeably during the past 25 years. It is probable that the intensity of ground uplift also has diminished recently.—*Author's abstract translated by W. A.*

4938. Trappe, Fr., and Ruprecht, Leo, Die Anwendung der seismischen Reflexionsmethode zur Untersuchung von Salzstöcken im Harzvorland [Application of the seismic-reflection method to the investigation of salt domes in the Harz foreland]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 37–40, Braunschweig, 1939.

The main difficulties in applying the seismic-reflection method of prospecting to salt domes in the Harz region are due to such geologic conditions as (1) frequent great change in densities of the horizontal layers and (2) changes in thickness of the Quaternary cover. The influence of the irregularity of the cover on the reflection seismogram is shown in a figure. Better conditions were found at the west flank

of the Flachstöckheim salt dome. The seismic-reflection profile and the position of this salt dome are given. Results of the investigation were proved by boring; the salt dome, predicted at a depth of 905 m., was found at 889 m.—*W. A.*

4939. Waagen, Lukas, Geophysikalische Tiefenforschung mit dem "Geoskop" [Geophysical sounding with the "geoscope"]: Bohrtech. Zeitung, vol. 57, No. 1, pp. 5–7, Vienna, 1939.

A brief description is given of the practical application of the "geoscope," designed by Machts. Results of the measurements made with this geoscope over coal deposits in the eastern Ruhr area, over matasomatic ore deposits, and in an oil-bearing region, are shown in a few examples.—*W. A.*

4. ELECTRICAL METHODS

4940. Evjen, H. M., Electrical methods of geophysical exploration: Geol. en Mijnb., new ser., vol. 1, No. 1, pp. 2–8, Leyden, Netherlands, 1939.

A discussion is given in defense of the electrical method of prospecting, which has been neglected since the early days of electrical methods, when ignorance, wishful thinking, and extravagant claims were so manifest.

Several electrical methods are classified and their advantages and disadvantages analysed. The difference between seismic and electrical exploration, especially regarding the question why one should have become a big success and the other a comparative failure, is explained as follows: Both are based in the final analysis on wave equations—one on the wave equation of elasticity; the other on that of electromagnetism. Theoretical possibilities of the two methods are much the same, and there is a close parallelism between the two, except in one respect—electric equations permit conduction currents. The seismic analogue to this would be an inelastic transport of mass particles through the medium. The comparative absence of this phenomenon accounts for the comparative absence of absorption in sesmic waves. Thus it permits the use of much shorter wave lengths, with consequent improvement in resolving power; but, most important, it permits the theory of interpretation to be reduced to that of geometrical optics. That is, it reduces the theory to the high-school stage and makes it available for the practical man. A reduction to simple terms is not possible in electric methods because of the phenomenon of absorption. Here the problem is one of physical rather than geometrical optics. The practical man therefore has difficulty in understanding the theory and cannot apply himself intelligently to the improvement of the technique. The theoretical man, on the other hand, who thoroughly understands the principles involved as a rule does not have much practical ability or inclination to apply his knowledge. This is probably the fundamental reason for the comparative failure of the electrical method.—*W. A.*

4941. Fritsch, Volker, Einiges über die Eigenschaften geologischer Leiter und deren Bestimmungen [On the properties of geological conductors and their determination]: Hochfrequentech. u. Elektroakustic, vol. 51, No. 4, pp. 138–146, Brünn, 1938.

A definition is given of a "geological conductor" and its electrical characteristics. Factors by which the electrical properties of the geo-

logical conductor may be changed are examined, and methods of measuring the electrical properties in radio prospecting and their applicability within practical limits are discussed. Many results of measurements and directions for radio prospecting are given.—*W. A.*

4942. Fritsch, Volker, Einiges über die Widerstandsverfahren der Funkmutung [On the resistance methods in radio prospecting]: Zeitschr. Geophysik, vol. 14, No. 7/8, pp. 260–270, Braunschweig, 1938.

It is shown how geoelectric high-frequency resistance methods can be applied and what new methods become possible by using radio prospecting in geology. Results of the investigations are summed up as follows:

1. Some information may be determined from the frequency in all high-frequency resistance methods. This is especially true in the possible determination of depth.

2. Selective prospecting is possible by changing the frequency.

3. Errors caused by electrodes are eliminated because earth antennas are used in the methods discussed instead of the polarizing electrodes.

4. It is possible to disclose the existence of nonconductors interstratified with other nonconductors if their apparent dielectric constants are different.

5. High-frequency methods may be applied in the same way as direct-current and low-frequency methods already developed. The change in the resistance and in the dielectric constant caused by frequency must be considered, however, and special attention must be paid to possible displacement currents.—*Author's abstract translated by W. A.*

4943. Komarov, S., Lateral electrical logging [in Russian]: Azerbaidjanskoe Neftianoe Khoziaistvo, vol. 18, No. 9, pp. 32–37, Baku, 1938.

Data obtained from the usual methods of electrical logging of boreholes give, as a rule, only the apparent resistances of rocks traversed by boring because the resistances measured inside the hole are affected by the kind of solution used in drilling. To obtain values of the true resistances, the author proposes lateral electrical logging. He describes several methods that depend on the permeability of the rocks penetrated by drilling as well as on the kind of solution used. A typical interpretation of the data obtained by lateral logging is shown in a table.—*W. A.*

4944. Leonardon, E. G., and McCann, D. C., Exploring drill holes by sample-taking bullets to supplant electrical logging: Oil and Gas Jour., vol. 37, No. 41, p. 49, Tulsa, Okla., 1939.

The abstract of a paper presented at the annual meeting of the American Institute of Mining and Metallurgical Engineers follows: "The sample-taking tool can be applied at any point in the hole desired, thus eliminating some of the expense involved in mechanical coring of uninteresting sections. Points from which samples are desired are marked on electrical logs. The bullet, which is fired into the formation by means of a powder charge, is a hollow cylinder attached to a gun barrel and housing by two lengths of wire and the housing in turn by the supporting cable. The cylinder bullet must be open on both ends so that drilling and side-wall mud can pass through and permit the cylinder to penetrate the native formation. The cores are three-fourths of an inch

in diameter and from 1½ to 2½ inches long. A housing for 6 or 18 bullets can be used in obtaining any number of cores up to the maximum from as many different levels in the hole by discharging a predetermined number at each level. The samples of formation obtained are sufficient for the usual laboratory core analysis. The sample tool has proved valuable in establishing the oil-water contact, and the paper describes the physical procedure involved."

4945. Pigrov, V. M., Combined apparatus for electrical logging and measuring crookedness of boreholes [in Russian]: Azerbaidjanskoe Neftianoe Khoziaistvo, vol. 18, No. 10, pp. 26–27, Baku, 1938.

To reduce the time necessary for carrying out two operations (electrical logging and measuring crookedness of holes) a combined apparatus designed by a group of engineers is offered. The following figures are given of the time necessary for separate measurements of a borehole 2,000 m. deep: (1) For electrical logging, 6 hours 50 minutes, and (2) for the inclinometer, 5 hours. This is a total of 11 hours 50 minutes. Using the combined apparatus reduces the time to 9 hours 10 minutes.

A schematic design of the apparatus and a diagram showing the method of operation are given.—*W. A.*

4946. Roman, Irwin, Electrical resistivity of snow and ice: Transactions of the Meeting of the International Commissions of Snow and of Glaciers, Edinburgh, September 1936. Internat. Assoc. Hydrology, Bull. 23, pp. 483–491, Riga, 1938.

It is shown that the method of electrical resistivity better meets the requirements for studying the depth of snow and ice cover than, for example, the seismic, magnetic, and gravimetrical methods. Fundamental principles of resistivity measurements and of the ice-cap problem are discussed. The method was tested on a small scale at two locations in Soda Springs, Calif., and the results of the field observations are summarized in a table. The curves and the data from which the conclusions are drawn indicate that the readings are reliable. No attempt is made to improve the quality of the readings or to correlate the values with the physical properties of snow at different depths, as the main purpose of this project was to determine and overcome instrumental difficulties. The experiments have indicated that porous pots are not needed for work in snow or ice. As ordinary dry cells freeze and crack under conditions likely to be encountered in polar regions, some other source of current and potential must be found. Several substitutes are suggested.—*W. A.*

4947 Rössiger, M., Die experimentellen Grundlagen des Dipol-Induktionsverfahrens [The experimental foundations of the dipole-induction method]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 83–87, Braunschweig, 1939.

A method, called by the author "the dipole-induction method," is described. Briefly, it consists of the following arrangement: A sinusoidal pulsating magnetic field (primary field) is produced by a current loop (ring), through which alternating current is flowing; the magnetic field of the induced current (secondary field) is measured by means of a coil. Theoretically, as well as from the technique of measurement, the method may be best applied when measurements are made at comparatively great distances from the sending coil, as

in this way the effect of the magnetic field of the coil may be compared with that of a dipole. Diagrams show the arrangement of the apparatus.—*W. A.*

4948. Schlomka, Teodor, Zur Electrodynamik des rotierenden Erdmagneten [On the electrodynamics of the rotating earth magnet]: Zeitschr. Geophysik, vol. 14, No. 7/8, pp. 285–297, Braunschweig, 1938.

After an introductory discussion of "unipolar-induction," the author indicates that during the rotation of the earth magnet there appear electrical field intensities that produce distribution of charges inside the earth, on the surface of the earth, and in the atmosphere rotating with the earth, as well as at its external border. Methods of calculating these distributions of the charge are given in detail. The influence of the produced spatial charges and surface charges upon the atmospheric-electrical field is discussed. In conclusion, a calculation of the electromagnetic radiation of energy by the rotating earth magnet is given.—*Author's abstract translated by W. A.*

4949. Todd, J. D., and Roper, F. C., Eola discovery shows multiple-sand possibilities of Sparta-Wilcox trend: Oil Weekly, vol. 92, No. 8, pp. 15–20, Houston, Tex., 1939.

The importance of the Sparta-Wilcox trend was increased greatly by the discovery of 105 feet of saturated oil sand. A brief review and discussion are given of the formations in this trend. As an illustration of sand conditions, typical electriclogs of the Wilcox and Sparta sands are shown. The authors conclude that anyone considering sand conditions in this trend must constantly keep in mind the three sand horizons—Yegua, Sparta, and Wilcox. The Yegua and Sparta seem to be rather variable but in many places constitute excellent reservoirs. It is believed that the Wilcox sands extend uniformly over the entire trend and can produce wherever structurally trapped. At Eola the Wilcox appears to be an excellent reservoir.—*W. A.*

4950. Todd, J. D., and Roper, F. C., New discoveries add to knowledge of Sparta-Wilcox trend: Oil Weekly, vol. 92, No. 9, pp. 18–22, Houston, Tex., 1939.

Among recent developments in the Sparta-Wilcox trend is the discovery of production from the Wilcox formation at Eola, Avoyelles Parish, La. This not only extends proof of prolific Wilcox sands eastward for 100 miles but demonstrates how structures weakly indicated by geophysical methods can prove to be first-class oil fields in this trend. It is definitely ascertained that an excellent producing section has been found at Eola. An electrical log of the Wilcox section at Eola and a subsurface map of the Eola area, presumably on top of the Cane River formation, are given.—*W. A.*

5. RADIOACTIVE METHODS

4951. Barth, T. F. W., Radium and the petrology of certain granites of Finland: Am. Jour. Sci., 5th ser., vol. 35-A, pp. 227–229, New Haven, Conn., 1938.

The radium content of various types of granites of Finland is compared with certain petrologic characteristics of the several rocks. No relation is found between radium and potash or ferrous oxide, but for granites belonging to the same type the radium content can be correlated with the amount of biotite.—*Author's abstract.*

4952. Keevil, N. B., The calculation of geological age: Am. Jour. Sci., vol. 237, No. 3, pp. 195–214, New Haven, Conn., 1939.

New equations are developed by conventional methods for computing the age of rocks and minerals from radioactivity data, and errors in some of the past work are pointed out. By a suitable choice of equations, any desired degree of accuracy in calculation of the age can be obtained for all methods involving the accumulation of lead and helium from the thorium, uranium, and actino-uranium series. At low ages, the simple equations with constants dictated by recently improved values of the disintegration constants is satisfactory, and at higher ages a new equation, which corrects the age by means of a constant involving the thorium-uranium ratio, can be generally applied. It is pointed out that if an average value of three is assumed for this ratio, the errors introduced into the calculated ages for ordinary rocks are less than those involved in experimental measurements and in changes in the rock since consolidation.—*Author's abstract.*

4953. Piggot, C. S., Radium in rocks: The radium content of the four groups of pre-Cambrian granites of Finland: Am. Jour. Sci., 5th ser., vol. 35–A, pp. 227–229, New Haven, Conn., 1938.

The radium content of the pre-Cambrian granites of Finland is reported, grouped according to the four classifications of Sederholm.—*Author's abstract.*

6. GEOTHERMAL METHODS

4954. Koenigsberger, J. G., Temperature gradients and rock conductivity: Mining and metallurgy, vol. 20, No. 388, p. 208, New York, 1939.

Reference is made to two articles on temperature gradients published in Mining and Metallurgy, vol. 19, No. 381, 1938, pp. 405 and 410 (see also Geophys. Abstracts 95, No. 4686). In the first of these articles the heat conductivity of the rock, K, in a well in Texas was given as 7.4×10^{-3}. This, Koenigsberger considers to be too high, as so high a value for K is found only in quartzites, marbles, and polymineral rocks of a density of 2.7 to 3.0, whereas sediments at an average depth of 5,000 feet in Texas are likely to have a density of 2.5 to 2.65. So K is probably 3.5 to 4.5×10^{-3}.

As for the *KCl* well at Wasco, Calif., discussed in the second article, the author wishes the given value of K to be checked also.—*W. A.*

4955. Kraskovsky, S., Review of the results of geothermal measurements made in the U. S. S. R. [in Russian]: Izv. Gosudarstvennago Geograficheskago Obshchestva, No. 4/5, pp. 612–628, Moscow, 1938.

The history of geothermal work in the U. S. S. R. is outlined. Tables show the results of geothermal measurements made in (1) ore-bearing regions, (2) coal-bearing regions, (3) artesian-water regions, and (4) oil-bearing regions.—*W. A.*

4956. Paul, M., Erfahrungen mit einem neuen geothermischen Aufschlussverfahren [Experience with a new geothermal method of prospecting]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 88–93, Braunschweig, 1939.

Measurements of the temperature of the ground above sulphide-ore deposits show that the heat continuously produced in them increases

the temperature of the ground above such deposits, so that in one deposit it was possible to determine the position and course of a pyrite from measurements of the ground temperature made at a depth of 2 m. Curves show the course of the temperature.—*W. A.*

4957. Weiss, Oscar, Temperature measurements with an electrical resistance thermometer in a deep borehole on the East Rand: Chem., Met. and Min. Soc. South Africa, Jour., vol. 39, No. 6, pp. 149–166, Johannesburg, 1938.

The increase of rock temperatures with depth is one of the chief problems of deep mining on the Witwatersrand. Mercury-filled maximum thermometers have been used heretofore in the survey of borehole temperatures. The work described in this paper has the following features: (1) Use of a platinum resistance thermometer in a deep borehole in South Africa, (2) determination of the temperature gradient in Ventersdorp lava, (3) temperature gradient of upper Witwatersrand quartzites as obtained in a deep hole (not in a mine), and (4) greater details of temperature data through measurements about every 100 feet.

The method and results of the measurements in relation to previously published data in South Africa and elsewhere are discussed by the writer under the following headings: (1) Locality of the measurements and description of equipment, (2) results (shown in diagrams and tables), (3) merits and costs of different methods of measurement, (4) influence of several factors on the determination of thermal gradients from borehole measurements, (5) relation between temperature gradients, conductivity, heat flow, and thermal history of rocks, and (6) values of reciprocal temperature gradients in South Africa and their relation to data observed in other parts of the world.—*W. A.*

7. UNCLASSIFIED METHODS

4958. Croll, J. C. H., Geophysics as applied to structural geology; Min. and Geol. Jour., Dept. of Mines, Victoria, vol. 1, No. 4, pp. 51–58, Melbourne, 1939.

After a brief discussion of the general principles of the magnetic, electrical, electromagnetic, gravimetrical, and seismic methods of geophysical prospecting, a description is given of the work done by these methods in Australia. Locations in which methods were applied are enumerated. From the results of a comprehensive series of tests, the committee in charge of geophysical prospecting gives the following statement:

"The experience of the survey has shown that the outstanding applications for geophysical work in Australia are: (1) Electrical surveys for base metal ores (principally sulphides) in Tasmania and in other parts of the Commonwealth where the salinity of the surface and underground waters does not preclude the use of electrical methods, (2) electrical surveys in saline water-bearing districts with a view to determining the distribution and character of the underground water supplies, (3) gravimetric surveys in the brown coal fields of Victoria and South Australia, (4) magnetic surveys over the subbasaltic tin and gold deep leads [old river bed, Australia] in New South Wales, Victoria, and Tasmania, (5) seismic and gravimetric surveys in suballuvial gold and tin deep-lead areas."

The most outstanding application of geophysical methods is the one in progress in connection with the Aerial, Geological, and Geophysical Survey of Northern Australia, an organization established in 1934–1935 by arrangement between the Governments of the Commonwealth, Queensland, and Western Australia.—*W. A.*

4959. Geologie, Geophysik der deutschen Gesellschaft für Mineralölforschung [Geology and geophysics discussed in the German society for oil prospecting] [editorial note]: Bohrtech. Zeitung, vol. 57, No. 1, pp. 1–3, Vienna, 1939.

A review is given of the following articles reported at the meeting of the society on December 8, 1938:

1. Geophysical surveys in German oil-bearing regions made by the German Government, by H. Reich.

Regions investigated up to October 1938 are mentioned. It is pointed out that to avoid false conclusions the interpretation of the data obtained from geophysical methods of prospecting should take into consideration the known geological data.

2. Geology and gravity disturbances between the Aller and the Steinhuder lake line, by R. von Zwerger.

Based on the results obtained from measurements of the intensity of gravity over salt domes of the Steinhuder lake line and the Neustadt-Engelbosteler saddle, some conclusions are drawn concerning the tectonics of the region; and the possibilities of oil accumulation are discussed from the geologist's viewpoint.

3. Seismic work in the region between the mouth of the Aller and the Weser highland, by P. Rössle.

Two zones were established by seismic methods of prospecting: (1) The zone to the north and along the Aller River with salt domes having steep flanks. Rocks containing salt were proved to exist here at various depths. (2) The zone to the south of the line connecting Wildeshausen and Hoya and extending to the west of the Weser has been found to be fundamentally different with no traces of salt domes.

4. Influence of the accuracy of the scale value on the usefulness of gravity measurements, by Schleusener.

It is pointed out that a small error in the calibration of the scale in the practice of applied geophysics is not of such great importance in gravity measurements as is often stated. It is proved that an error of about 2 percent in the accuracy of the scale value may be neglected.

5. A new device for a quick determination of the traveltimes of elastic waves in cores, by Stephan von Thyssen-Bornemisza. The principle of the apparatus is briefly as follows: A sample of rock or of the ground is caused to oscillate by means of an electrical apparatus, and the natural frequency of oscillation of the sample is measured. The traveltime of the elastic waves thus produced is calculated from the length of the sample and from the measured natural frequency according to formula $V_1=2f_o:1$. The accuracy of measurement is about 1 percent.—*W. A.*

4960. Geophysics aids the examination of alluvial deposits [editorial note]: Chem. Eng. and Min. Rev., vol. 31, No. 364, pp. 170–172, Melbourne, 1939.

A summary is given of the report of the Department of Scientific and Industrial Research in New Zealand on the work carried out during recent years on alluvial deposits in the following regions:

Cornish Point, Cromwell, investigation of alluvial channel by magnetic and seismic methods. A geophysical survey showed correctly the existence of an old channel not otherwise evident and disclosed accurately its general depth; the survey did not show correctly the exact location of the center line as a result of the fact that the cross sections were at wide intervals.

Cromwell Flat, Central Otago, investigation by magnetic, electrical; and seismic methods. Two deep leads of buried channels were located, and the geophysical results were confirmed by a series of boreholes.

Wetherstones Flat, Lawrence, investigation by the seismic method. Operations had been started before a geophysical survey was commenced. When the hope of finding pay conglomerate was not realized a geological-geophysical investigation was made that supplied strong evidence against the existence of the lead in the area selected.

Growler's Flat, Upper Whakaea Valley, Southland, investigation by seismic and magnetic methods. A relatively small portion of the area was found to be suitable for dredging purposes.

Winding Creek and Otama Valley, Waikaia, Southland, investigation by the seismic method. The principal object of the application of geophysics in the Waikaia area was to trace the deep ground worked by the King Solomon mine. The results of the geophysical study surrounding the King Solomon mine showed the existence and the boundary of the depression in which the mine is operating, indicated the possible continuation of the deep ground in a southerly direction, and eliminated a large area as unsuitable for future prospecting.

Nelson Creek, Westland, investigation by the seismic method. It has been shown that it is possible to differentiate between a lead [old river bed, Australia] formed of less consolidated gravel and the more consolidated gravel in which it is embedded. It is intended also to study such problems electrically.

Mahakipawa Valley, Marlborough, investigation by the seismic method. The main object of the geophysical survey was to trace the course of an ancient channel and to eliminate those parts of the area where the schist was above the channel. The results obtained by the seismic method agreed remarkably well with those found by actual drilling.—*W. A.*

4961. Hoffman, M. G., An advance in exploration by soil-analysis methods: Oil and Gas Jour., vol. 37, No. 44, pp. 23, 24, 115, Tulsa, Okla., 1939.

A recent advance in exploration technology is the introduction of the soil survey. A chemical analysis showing the hydrocarbon content of soils is made, and the hydrocarbon values are studied in an attempt to locate, by their relative amounts, the presence or absence of underlying oil reservoirs. The theoretical principles on which the method is based are outlined. Russian and American methods are compared. The Russian method consists of analyzing gas from the soil; the American, of collecting samples of soil and then of distilling off the hydrocarbons. Types of curves developed over producing areas and

the interpretation of anomalies are discussed. To obtain better results, the following factors involved must be studied as well as the analysis of samples and the interpretation of the data obtained: (1) Relative amount of organic matter in the soil, (2) character of the soil, (3) topography, (4) soil covering, (5) surface geology, particularly of those beds immediately underlying the surface, (6) climate of the region, (7) methods of collecting samples and of making an analysis, and (8) contamination of the soil.—*W. A.*

4962. Ivanov, N. A., Brief review of the development and work of geophysical organizations in the Urals [in Russian]: Geology and Geophysics, Trans. Ural Sci. Research Inst. of Geology, Prosp., and Econ. Mineralogy, No. 1, pp. 115–117, Sverdlovsk, 1938.

Organization of the work of the Ural Scientific Research Institute of Geophysical Methods of Prospecting, established since 1931, is briefly described. Among the most successful surveys mentioned are (1) micromagnetic experimental work in prospecting for bauxites, (2) gravimetrical experimental prospecting for chromite, (3) gravimetrical survey of Cheliabinsk brown-coal deposits, (4) micromagnetic experimental surveys of areas supposed to contain platinum deposits, (5) complex (gravimetrical, seismic, and magnetic) surveys of the northern part of the Egorshin coal deposits, and (6) geophysical surveys in the Ishimbaev and Chusovaia oil-bearing regions.—*W. A.*

4963. Ivanov, N. A., Geophysical methods of prospecting for mica deposits [in Russian]: Geology and Geophysics, Trans. Ural Sci. Research Inst. of Geology, Prosp., and Econ. Mineralogy, No. 1, pp. 131–133, Sverdlovsk, 1938.

Prospecting for mica deposits was carried out by geophysical methods in 1934 and 1935 in two regions of the Urals—Kondakov and Mama.

In the Kondakov region magnetic methods were applied at 4,014 stations, electrical-resistance methods at 3,800 stations, and emanation methods at 390 stations. The possibility of using geophysical methods in prospecting for pegmatite veins under the geologic conditions existing in the Kondakov region was established. The most successful results were those of electroprofiling and of determining the gradients of the electrical potential. The emanation method served as a good auxiliary. No result could be obtained from the magnetic method.

In the Mama region the morphology of pegmatite bodies, the differentiation of biotite gneiss from pegmatites, and the relative amount of mica in pegmatites could be determined by electrical methods of prospecting. No result was obtained from magnetic observations with the Schmidt balance, and no result was obtained from the radioactive method of prospecting, owing probably to geologic conditions that were unfavorable to its application.—*W. A.*

4964. Jung, Heinrich, Anwendung geophysikalischer Verfahren bei der Erdölsuche [Application of geophysical methods in prospecting for oil]: Bohrtech. Zeitung, vol. 57, No. 2, pp. 25–27, Vienna, 1939.

This is a general discussion of geophysical methods of prospecting, which includes the gas survey.—*W. A.*

4965. Kelly, S. F., and Galloway, D., Stimulating mineral development by geophysical prospecting: Miner, vol. 11, No. 7, pp. 39–44, Vancouver, July 1938.

Advances made in recent years in the science and art of geophysics and a better understanding in the mining world of the scope of application of geophysical methods of prospecting are facts that will assist in accelerating the development of mineral resources of Canada. Electrical and magnetic techniques are best adapted to mining work. The authors discuss (1) prospecting for sulphide deposits by the spontaneous-polarization method, (2) geologic features of British Columbia, (3) application of geophysical methods of prospecting in British Columbia, and (4) placer mining.

After briefly outlining the production of minerals in British Columbia to the end of 1937, the authors conclude that to maintain or increase the present annual volume of metal output it is essential that new ore bodies be discovered and old ones extended.—*W. A.*

4966. Malamphy, M. C., Petroleum problem of Brazil hinges on law and technique: Oil Weekly, vol. 92, No. 11, pp. 114–124, Houston, Tex., 1939.

An attempt is made to explain the actual status of the petroleum problem of Brazil. The data presented have been obtained from official and semiofficial publications and from the author's personal experience. Part 1 deals with the physical problems of the search for oil, and describes (1) the general geology, (2) the prospecting history, and (3) the Permo-Triassic belt of southern Brazil. A sketch map shows geologic possibilities of the existence of petroleum in Brazil, and another map shows geophysical results (magnetic isoanomalies and gravity gradients) in the Sao Pedro-Xargueda area, State of Sao Paulo.

Geophysical surveys were carried out in the States of Santa Catharina, Parana, Sao Paulo, Alagoas, and Bahia by the geophysical section of the Servico Geologico e Mineralogico do Brasil, organized under the direction of the author in 1932.—*W. A.*

4967. Reich, Hermann, Die Arbeiten der geophysikalischen Reichsaufnahme in deutschen Erdölgebieten [Geophysical survey of the Reich in German oil-bearing regions]: Oel and Kohle, vol. 15, No. 2, pp. 23–26, Berlin, 1939.

The conditions that prevailed at the time of the survey in the autumn of 1938 are described. Maps show the areas surveyed by the gravimeter and torsion balance, as well as by seismic and magnetic methods. In discussing the relation between the general exploration work and geology and geophysics, the author states that although both these branches are indispensable in the field of scientific research, the fact that the objects of investigation belong to geology makes this branch the leading one.—*W. A.*

4968. Reich, Hermann, Stand der geophysikalischen Reichsaufnahme [State of the geophysical survey of the Reich]: Zeitschr. Geophysik, vol. 15, No. 1/2, pp. 73–83, Braunschweig, 1939.

The organization, purpose, and extent of the geophysical survey of Germany, thus far carried out, are examined. Discussion of the prog-

ress in the geological interpretation of the areas investigated is based on a series of examples of gravimetrical, seismic, and magnetic surveys. It is emphasized that a schematic interpretation of data obtained from measurements may still cause errors, and that a correct interpretation may be obtained only if all the geologic factors are considered.—*Author's abstract translated by W. A.*

4969. Rosaire, E. E., Stratigraphic vs. structural prospecting: Oil and Gas Jour., vol. 37, No. 32, pp. 43–56, Tulsa, Okla., 1938.

The general characteristics of all methods of exploration are pointed out. Discoveries of salt domes and oil fields year by year (1930–1938) are shown in diagrams. Methods of exploration are broadly divided into two general classes—first, those that rely upon vertical changes in sediments (structural-prospecting methods), and second, those that rely upon lateral changes in sediments (stratigraphic-prospecting methods). Structural-prospecting methods (drilling, prospecting by means of the reflection seismograph, refraction profiling, and electrical profiling) and limitations of these methods when used in reconnaissance are discussed. In contrast with refraction profiling (a structural-prospecting method is one in which depths are determined), refraction-fan exploration is a stratigraphic method of prospecting, as only lateral changes in sedimentation are observed and as depths are not determined. Thus, after a salt dome is discovered by a refraction fan, the depth to the top of the salt can be found only by a structural-prospecting method, generally a refraction profile, in advance of the drill. Stratigraphic-prospecting methods yield high survey densities at low costs per acre but no depth determinations; whereas structural-prospecting methods yield depth determinations but high survey densities only at high costs per acre.

The article is concluded with a brief discussion on (1) preferred prospecting tactics, and (2) future prospecting.—*W. A.*

4970. Umantzev, D. F., Geophysical methods of prospecting for oil deposits [in Russian]: Geology and Geophysics, Trans. Ural Sci. Research Inst. of Geology, Prosp., and Econ. Mineralogy, No. 1, pp. 133–136, Sverdlovsk, 1938.

The author describes the results of extensive magnetic, gravitational, and electrical surveys for oil in (1) the northern part of the Ural-Emba oil-bearing region (Orenburg), (2) Bashkiria (Ufa-Busuluk, Ishimbaevo), and (3) the Kama River region (Krasnokamsk-Osa, Chusovskie Gorodki).—*W. A.*

4971. von Thyssen-Bornemisza, Stephan, Die Bedeutung der Geophysik beim Auffinden von Erdöl-Lagerstätten in den Vereinigten Staaten von Nordamerika [Importance of geophysics in the discovery of oil-bearing deposits in the United States]: Oel und Kohle, vol 15, No. 6, pp. 113–117, Berlin, 1939.

The development of geophysical exploration for oil since 1923, when the first salt dome (Nash, Tex.) was discovered by the gravitational method, is outlined. The following approximate figures of the expenditures for exploration from 1924 to 1938, based on American writings, are given: $69,000,000 for seismic work, $21,000,000 for torsion-balance work, $4,500,000 for magnetic work, $3,500,000 for gravimetrical and pendulum work, and $3,000,000 for electrical work (with the exception of electrical logging).

The data are summarized in a list showing (1) year of discovery, (2) location of the oil field, (3) output to July 1, 1938, and (4) method or methods by which the oil field was discovered. According to the list, 31 oil fields were discovered by torsion balance, 36 by the refraction-seismic method, 34 by the reflection-seismic method, and 53 by combined application of the torsion balance, seismic, and gravimetrical methods.—*W. A.*

4972. Yunkov, A. A., Geophysical methods of prospecting for chromite deposits [in Russian]: Geology and Geophysics, Trans. Ural Sci. Research Inst. of Geology, Prosp., and Econ. Mineralogy, No. 1, pp. 127–131, Sverdlovsk, 1938.

The suitability of applying electrical, gravimetrical, and magnetic methods for prospecting chromite deposits, as shown by tests carried out since 1932 in the Urals, is described. From the results of these tests it was found that (1) electrical methods are to be rejected because of the very different electrical conductivities of rocks with which chromite is associated, (2) gravimetrical methods can be applied successfully only to deposits conforming to special conditions of geology, orography, and morphology favorable to gravimetrical methods of prospecting in general, and (3) magnetic methods can be applied with the greatest success as it is possible by these methods to determine the location and dip of the contacts of basic massifs, as well as the boundaries of such lithologic units as gabbro, peridotite, and dunite.—*W. A.*

8. GEOLOGY

4973. DeWolf, F. W., and West, W. W., Stratigraphic studies of Baker-Glendive anticline, eastern Montana: Am. Assoc. Petroleum Geologists Bull., vol. 23, No. 4, pp. 461–475, Tulsa, Okla., 1939.

The Northern Pacific Railroad Co. well No. 1, drilled with rotary tools in 1935–1936 by the Montana-Dakota Utilities Co. to the depth of 8,186 feet on the Baker-Glendive anticline of eastern Montana, following geophysical exploration of the subsurface, revealed that strata above the Pennsylvanian are similar to those of the Black Hills section except that 350 feet of salt was found in the Spearfish formation (or possibly the Permian). However, between the top of the Minnelusa formation at 5,631 feet and the top of the Madison at 7,440 feet there are present 1,325 feet of beds representing the Big Snowy group of central Montana as described in 1935 by H. W. Scott. The Madison appears to extend to a depth of about 8,055 feet, and the strata below that depth represent the Devonian. Considerable help with correlations was obtained from a restudy of samples from the Sinclair Prairie Oil Co.'s Westphal well, drilled in 1931 on the Porcupine dome, 135 miles northwest of the Northern Pacific well. It appears that the Big Snowy geosyncline of Mississippian age extends east at least to the Northern Pacific well No. 1 and has a length of at least 375 miles.

Oil was produced from the Northern Pacific well between 6,747 and 6,796 feet from the Big Snowy formation, and also between 8,130 and 8,186 feet from beds that may be Devonian in age.—*Authors' abstract.*

4974. Mather, K. F., Earth structure and earth origin: Science, vol. 89, No. 2300, pp. 65–70, Lancaster, Pa., 1939.

The planetesimal and tidal theories of the earth's origin are discussed. The conclusion is drawn that the concept of earth structure based on

recent geophysical and seismological research is not nearly so unfavorable to acceptance of the planetesimal theory of the earth's origin as many geologists have supposed it to be. On the contrary, modern investigations pertaining to the fundamental structures of the earth have brought renewed confidence in the basic principles of that theory, in at least one particular—that which deals with the origin of folded mountains.—*W. A.*

4975. Meyer, W. G., Stratigraphy and historical geology of Gulf Coastal Plain in vicinity of Harris County, Texas: Am. Assoc. Petroleum Geologists Bull., vol. 23, No. 2, pp. 145–211, Tulsa, Okla., 1939.

A description of all post-Weches formations of the Gulf Coastal Plain in the vicinity of Harris County, Tex., and the geologic history of the Gulf Coastal Plain of southeastern Texas are presented. The many deep wells in this region make it a favored area for such an investigation as the one here attempted. A comparison of surface sections with subsurface sections reveals important changes of facies in nearly every formation.

A geosyncline of major dimensions is located near the outer margin of the Gulf Coastal Plain in eastern Texas and Louisiana. The formation of this geosynclinal depression and the accumulation of sediment in it are the dominant features of the Cenozoic history of this region. Tertiary and Quaternary deposits in the vicinity of Galveston, Tex., are estimated to be 35,000 feet thick. The origin of this geosynclinal depression is discussed.—*Author's abstract.*

4976. Sanders, C. W., Emba salt-dome region, U. S. S. R., and some comparisons with other salt-dome regions: Am. Assoc. Petroleum Geologists Bull., vol. 23, No. 4, pp. 492–516, Tulsa, Okla., 1939.

Although oil has been produced since 1908 from salt domes in the Emba area, which lies between the south end of the Ural Mountains and the north shore of the Caspian Sea, the geological situation in that region has escaped the attention of many American geologists. Salt-dome geologists of the Gulf Coast region have frequently had their attention directed to the salt structures of Germany and of Rumania, whereas greater resemblance to the Gulf Coast is to be found in the Emba district, where more than 100 salt domes are known in an area about the size of the Gulf Coast exclusive of south Texas. Future discoveries may bring the total to 300 or more salt domes, including deep ones. Only 6 domes are being exploited, but many others have shown evidence of accumulations of oil and gas. Production has been found in "Permo-Triassic," Jurassic, and Cretaceous strata, but chiefly in Jurassic sands. The oil reserves appear to be commercially important but do not rank with those of the Gulf Coast.

The Emba mother salt series is of Permian age—probably Upper Permian. The overburden is much thinner than that of the Gulf Coast, consisting chiefly of Mesozoic strata with local patches of Tertiary sediments and a blanket of Quaternary (Caspian) beds in the coastal area.

Many of the shallow salt structures are larger than any Gulf Coast shallow domes. Future exploration will probably reveal an increasingly larger percentage of deep domes.

More is known about pre-salt strata in the Emba region than in the Gulf Coast because of the outcrops in the southern Urals. The upper Carboniferous and Permian sections have been rather closely correlated by several investigators with the Pennsylvanian and Permian sections of the Mid-Continent region, largely on the basis of the ammonites contained.

Development has been slow in the Emba district due largely to the remoteness of the area, the long severe winters, and the thinness of the sands as compared with the prolific Tertiary sands of the Caucasus belt.

The tectonic setting of the Emba domes is discussed and compared with that of the salt domes of the Gulf Coast, of the North German Basin, of Persia (Iran), and of the Carpathian foothills belt in Rumania.—*Author's abstract.*

9. NEW BOOKS

4977. Earthquake notes, R. R. Bodle, editor, vol. 10, No. 3, 15 pp., Seismol. Soc. America Bull., Eastern section, Washington, 1938.

This issue contains a paper by Ross R. Heinrich and Albert Frank entitled "The Illinois Basin earthquake of November 17, 1937," pp. 1–6, and the following short editorial notes: (1) Comments on shock of November 10, 1938, (2) Amateurs and shock of November 10, 1938, (3) Earthquake at Beaverton, Pa., (4) Earthquake discussion (from Nautical Magazine, London, July 1938), (5) Fault noises, (6) Improved equipment at Honolulu, (7) Hurricane microseisms, (8) Deep-focus shock studied, (9) Toronto, Canada, Seismograph Station, (10) Seismology in Martinique, (11) Bermuda Seismograph Station, (12) New vault at Pennsylvania State College, (13) Riverview College Observatory, (14) Seismology and mathematics, (15) Papers scheduled for holiday meetings, (16) Joint geological-seismological meeting, (17) Seismograph improvements at Salt Lake City, (18) Frederick J. Pack, (19) New seismograph station, (20) Earthquakes and engineers, (21) Amateur accelerograph, (22) Appointments to live-loads committee, (23) Strong-motion records, 1938, (24) Time signals on seismograms, (25) International seismological summary, (26) Washington visitors, (27) Submarine earthquakes—North Atlantic Ocean, (28) United States earthquakes, 1936 (ser. No. 610, U. S. Coast and Geodetic Survey), (29) Earthquake history of the United States (ser. No. 609, U. S. Coast and Geodetic Survey), (30) Epicenters, and (31) Seventh assembly of International Union of Geodesy and Geophysics, September 4–15, 1939, Washington.

4978. Eve, A. S., and Keys, D. A., Applied geophysics in the search for minerals, 316 pp., 112 figs., MacMillan Co., New York, 1938. Price, $4.25.

This book presents a review of the theory and application of the five branches of geophysics used in geologic exploration, namely, magnetic, electrical, electromagnetic, gravitational, and seismic methods.

The third edition of this book contains added material dealing with advances made in the past 6 years. Among these advances are (1) Schlumberger's "electrical coring" for exploring uncased borings for oil, (2) ratiometer methods of electrical prospecting, and (3) improvements in the magnetic, resistivity, and seismic methods of exploration.

4979. Fritsch, Volker, Grundzüge der Funkgeologie [Elements of radio geology], 121 pp., 90 figs., Friedrich Vieweg und Sohn, Braunschweig, Germany. Price, RM. 9.

This is volume 116 of the Sammlung Vieweg, Tagesfragen aus den Gebieten der Naturwissenschaften und der Technik (Vieweg Collection, Recent questions concerning natural sciences and techniques).

4980. Heck, N. H., Earthquake history of the United States, Part 1, Continental United States (exclusive of California and western Nevada) and Alaska: U. S. Coast and Geodetic Survey, ser. No. 609, 83 pp., Washington, 1938. Price, 20 cents.

The purpose of this publication is to describe the most severe earthquakes of the United States, excusive of those in California and western Nevada, from the earliest times to the close of 1937. Although no essential facts have been omitted, nevertheless because the descriptions are concise the reader must consult the references for minor details.—*W. A.*

4981. Heck, N. H., Instructions for the compensation of the magnetic compass: U. S. Coast and Geodetic Survey, Special Pub. No. 96, 49 pp., Washington, 1939. Price, 15 cents.

This publication is a reprint of an earlier edition. The principal changes concern the correcting of some of the equations for probable errors and the bringing of tables of magnetic elements up to date.—*W. A.*

4982. Howe, H. H., Results of observations made at the United States Coast and Geodetic Survey Magnetic Observatory near Tucson, Ariz., in 1929 and 1930; U. S. Coast and Geodetic Survey, Mo–7, 117 pp., Washington, 1939.

Contents: (1) Introduction; (2) Instruments—(*a*) variation instruments, (*b*) temperature, (*c*) absolute instruments, (*d*) seismograph, (*e*) atmospheric-electric instruments; (3) Constants of the magnetograph—(*a*) declination, (*b*) horizontal intensity, (*c*) vertical intensity; (4) Absolute observations and base-line values—(*a*) declination, (*b*) horizontal intensity, (*c*) vertical intensity; (5) Description of diurnal variation tables—(*a*) ten selected quiet days, (*b*) five international quiet days, (*c*) five international disturbed days; (6) Magnetic storms. Illustrations and tables.

4983. Krumbein, W. C., and Pettijohn, F. J., Manual of sedimentary petrography, 549 pp., 265 figs., 53 tables, D. Appleton-Century Co, New York, 1938. Price, $6.50.

The book is divided into two parts: Part 1, Sampling, preparation for analysis, mechanical analysis, and statistical analysis, by Krumbein; Part 2, Shape analysis, mineralogical analysis, chemical analysis, and mass properties, by Pettijohn.

A detailed review of the book is given by Parker D. Trask in the Bulletin of the American Association of Petroleum Geologists, vol. 23, No. 2, 1939, pp. 256–258.

4984. Wilmarth, M. G., Lexicon of geologic names of the United States (including Alaska) : U. S. Geological Survey Bull. 896, 2,396 pp. (in two parts), 1938. Price, $2.50 for the set, available through the Superintendent of Documents, Washington.

This lexicon gives formal definitions of formations, and it states briefly their lithologic character, thickness, geologic age, stratigraphic relations to underlying and overlying formations, and type locality.

10. PATENTS

4985. Method of geophysical exploration; Frank Rieber, Los Angeles, Calif., assignor of one-half to Continental Oil Co.: U. S. patent 2,144,812, issued January 24, 1939.

This invention relates to the method of geophysical exploration which comprises the steps of initiating an earth impulse, phonographically recording earth movements ensuing upon said impulse, translating the record thus formed as a plurality of components each representative of said record and differing from the other components in time phase as related to the initial impulse, and recording the resultant of said components. The method of analysis of a complex vibration set up by a single source, which comprises phonographically recording a plurality of records of said vibration each arriving over different paths, combining retranslations of said records into a single channel, filtering from said single channel all components except those having predetermined specific characteristics, and utilizing the resultant to create a secondary record. Claims allowed, 13.

4986. System for geological explorations; Oscar E. Dudley, Hyattsville, Md., assignor to Submarine Signal Co., Boston, Mass., a corporation of Maine: U. S. patent 2,147,643, issued February 21, 1939.

In a system for determining geologic structures by conductive methods, means for effecting the reversal of current supply between two spaced electrodes and means for making periodic observations of the potential between two points in the field of said electrodes including means for adjusting the time interval of observations during the making of observations to periods when steady-state conditions have occurred regardless of the spacing of the electrodes or the ground structure over which the observation is made. Claims allowed, 5.

4987. Method of determining the dips of geological strata with substantially vertical reflections; Ludwig W. Blau, Houston, Tex., assignor to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,148,422, issued February 28, 1939.

This invention refers to the method of determining the dip of a geological substratum which comprises generating seismic waves at a selected point, receiving reflections of said waves from the substratum under investigation at a plurality of points spaced from each other and arranged in alinement with each other, said receiving points being arranged in pairs with respect to said selected point, with the receiving points of each pair being equidistantly spaced from the selected point and all of said receiving points being spaced from said selected point a distance less than the depth of the substratum under investigation, and recording simultaneously on a single record the reflected waves arriving at the receiving points. Claims allowed, 6.

4988. Subsurface exploration; Lawrence Y. Faust, Tulsa, Okla., assignor to Geophysical Research Corporation, New York, a corporation of New Jersey: U. S. patent 2,149,427, issued March 7, 1939.

This invention relates to a device for receiving artificial seismic waves transmitted through earth having a surface layer of soft material overlying the hard material, which comprises a rod of sufficient length to pass through the soft surface layer into the hard material there below, a casing of sufficient length to pass through said surface layer, said casing enclosing and being spaced from said rod throughout its entire length and a wave detector mounted on the upper end of said rod. Claims allowed, 3.

4989. Core-orientation apparatus; John M. Pearson, Swarthmore, Pa., assignor to Sperry Sun Well Surveying Co., Philadelphia, Pa., a corporation of Delaware: U. S. patent 2,149,715, issued March 7, 1939.

This invention relates to apparatus for the determination of the dip and strike of a bedding plane indicated in a magnetically anisotropic core taken from a borehole, said apparatus comprising means defining a horizontal plane at the position where the core was taken, means defining the azimuth and dip at said position of the earth's magnetic vector relative to said plane, means universally pivoted relative to said plane defining means for defining relatively to the horizontal plane and magnetic vector the axis of the portion of the borehole from which the core was taken, means defining relative to said universally pivoted means the axial plane containing the axis of magnetic anisotropy of the core, and means defining the bedding plane of the core relative to the axis of the borehole and the last-named plane, said various means being relatively adjustable for the representation of the data belonging to different cores and to represent the earth's magnetic vector in said axial plane containing the axis of magnetic anisotropy of each core, whereby the relationship of said means defining the bedding plane and said means defining a horizontal plane and the earth's magnetic vector may be made to represent a relationship of the bedding plane to the earth. Claims allowed, 3.

4990. Orientation apparatus: Clay H. Beattie, Jr., Covina, Calif., assignor to Sperry Sun Well Surveying Co., Philadelphia, Pa., a corporation of Delaware: U. S. patent 2,149,716, issued March 7, 1939.

This invention relates to apparatus for the determination of the dip and strike of a bedding plane indicated in a magnetically anisotropic core taken from a borehole, said apparatus comprising means providing an axis vectorially representing a horizontal plane at the position where the core was taken, a member mounted to rotate about said axis, and a plurality of gimbals mounted on said member, one of the gimbals being mounted on an axis perpendicular to, and intersecting, the first-named axis, and another gimbal being mounted on the first gimbal on an axis, which intersects the point of intersection of the first two axes, said first- and second-mentioned gimbals defining, respectively, the axis of a borehole and the bedding plane indicated in a core therefrom. Claims allowed, 6.

4991. Method and apparatus for calibrating magnetometers; John M. Pearson, Swarthmore, Pa., assignor to Sperry Sun Well Surveying Co., Philadelphia, Pa., a corporation of Delaware: U. S. patent 2,149,717, issued March 7, 1939.

This invention relates to the method of testing a magnetometer having a suspended magnetic system adjacent to which a rock core is adapted to be rotated comprising locating in definite position relative to said system a coil passing through said coil, a measured current to produce thereby a determinate field affecting said suspended system, determining the effect on the system on such field, and then rotating adjacent said system, in the position to be occupied by a rock core, a dummy core of fixed magnetic characteristics to thereby ascertain the normal results on the magnetic system to be expected by such manipulation of said dummy core.

A dummy core for use in testing a magnetometer having a suspended magnetic system adjacent to which a rock core is adapted to be rotated comprising a magnetic body and a cylindrical carrier therefor arranged to be rotated in the location of rotation of a rock core, said magnetic body having its magnetic axis transverse to the axis of said cylinder. Claims allowed, 4.

4992. Automatic leveler for gravity-measuring instruments; August K. Birnbaum, Houston, Tex., assignor of one-half to Horton C. Cockburn, Houston, Tex.: U. S. patent 2,149,953, issued March 7, 1939.

This invention relates to apparatus for making geophysical measurements upon shallow water-covered areas of the earth's surface, which comprises a torsion balance and a container therefor, means in said container for supporting said balance for tilting movement so that the instrument will seek a gravitational level, means to seal said container whereby the container may be immersed and deposited upon the earth's surface in a submerged area and recordings of gravity measurements obtained, and additional means attached to said container to lower and retrieve the container. Claims allowed, 2.

4993. Method and apparatus for continuous exploration of boreholes; John Jay Jakosky, Los Angeles, Calif.: U. S. patent 2,150,169, issued March 14, 1939.

This invention relates to a method for determining variations in an electrical property of the strata at different depths traversed by a borehole during the process of drilling said borehole, which comprises: Taking a measurement of an electrical variable in an electrical circuit comprising a drilling apparatus extending within a borehole and serving as an electrode, another electrode connected to the earth at a position removed from said borehole, and the portion of the earth included electrically between said electrodes; and representing such measurement as said drilling apparatus is extended to different depths, while maintaining said other electrode substantially at a fixed position, said drilling apparatus being exposed to electrical contact with the wall of said borehole thoroughout substantially its entire length, and said other electrode being sufficiently distant from the borehole so that the measurements obtained are influenced to an important degree by variations in an electrical property of the formation adjacent the lower end of the drilling apparatus. Claims allowed, 17.

4994. Gravity meter; Serge Alexander Scherbatskoy, Tulsa, Okla., assignor to Engineering Laboratories, Inc., Tulsa, Okla., a corporation of Oklahoma: U. S. patent 2,150,405, issued March 14, 1939.

In an apparatus for effecting measurements of gravity variations, a movable mass, a spring supporting the mass, the said spring possessing elastic imperfections which accompany the displacement of the mass from its mean position, stops for limiting the maximum displacement of the mass, means for producing an electrical signal when the said maximum displacement is attained, an adjustable spring for returning the mass to its mean position when the said electrical signal has been produced, and a means for indicating the conditions of the said adjustable spring as a measure of the said gravity variations. Claims allowed, 5.

4995. Electrical exploration method; David Saville Muzzey, Jr., Houston, Tex., assignor to Shell Development Co., San Francisco, Calif., a corporation of Delaware: U. S. patent 2,150,517, issued March 14, 1939.

In a method for the electrical exploration of ground strata having different electrolytic properties, the steps of passing through the ground an alternating current, allowing said alternating current to be partially rectified at surfaces of discontinuity between said strata, and observing the direct-current potential difference generated in the ground by said rectification. Claims allowed, 4.

4996. Method of measuring gravity; Bolidens Gruvaktiebolag, a joint stock company registered and existing under the laws of Sweden, of 17 Västra Trädgardsgatan, Stockholm, Sweden: British patent 493,404, issued October 7, 1938.

This invention relates to an improved method for measuring gravity or variations in gravity with the aid of a movable body whose weight has been balanced by means of a spring device or in some other way, characterized by the feature that the movable body is completely enclosed in a thermostat provided with a heating device, which during the measurement is maintained at a temperature higher than that of the surrounding air. Claims allowed, 1.

4997. Improvements in or relating to the determination of relative plummet deviations for prospecting for minerals and other subterrestrial deposits; Bolidens Gruvaktiebolag, of 17 Västra Trädgardsgatan, Stockholm, Sweden: British patent 493,738, issued October 13, 1938.

This invention relates to a method of discovering the extent of ores, metalliferous deposits, or other subterrestrial localities by means of ascertaining and determining changes in the horizontal component of the force of gravitation by measuring relative plummet deviations characterized in that the image of a fixed object is reflected into a fixed telescope by means of a mirror attached to the suspension cord of a plummet, which is moved to different places, the said telescope always being in the same horizontal plane as the mirror. Claims allowed, 9.

4998. Improvements in or relating to apparatus for determining electrically the direction and, if desired, the value of the dip of the formations cut by a borehole; Société de Prospection Électrique (Procédés Schlumberger), of 30, Rue Robert, Paris VII–e, France: British patent 495,867, issued November 14, 1938.

This invention relates to an apparatus for determining electrically the direction and, if desired, the value of the dip of the strata traversed

by a borehole, comprising a supporting structure adapted to be moved in the interior of the borehole, one movable electrode or a plurality of fixed or movable electrodes in relation to this structure and means for enabling electrically the recording of a plurality of separate potential differences spontaneously existing in the borehole at different points distributed in any given transverse plane in the said borehole, means also being provided for measuring the orientation of the electrode or electrodes in the borehole. Claims allowed, 11.

4999. Gravity-determining apparatus; Bolidens Gruvaktiebolag, assignee of Axel Rudolf Lindblad, both of Stockholm, Sweden: Canadian patent 377,931, issued November 29, 1938.

This invention relates to a gravimeter consisting of a movable body, the weight of which is balanced by a spring device or like means, the movable body together with the suspension device being encased in a heat-conducting measurement vessel having substantial heat capacity, the measurement vessel being itself encased in a vacuum container. Claims allowed, 3.

5000. Gravity balance; Standard Oil Development Co., Linden, N. J., assignee of Ludwig W. Blau, Houston, Tex., both in the United States of America: Canadian patent 378,978, issued January 17, 1939.

In a gravity balance, a suspended beam, a weight supported directly by one end of the beam, a second weight, and an endless carrier associated with the opposite end of the beam for suspending the second weight at varying vertical distances from the beam. Claims allowed, 25.

5001. Vorrichtung zum Messen von Schwerkraftsunterschieden [Apparatus for measuring gravity differences]; Askania Werke A. G. vormals Centralwerkstatt Dessau und Carl Bamberg-Friedenau of Berlin-Friedenau: German patent 650,566, issued February 28, 1938.

This invention relates to a gravity meter based on a barometric principle. The apparatus works with the aid of a quicksilver column not exposed to atmospheric pressure and maintained in equilibrium by the difference in pressure of two special gas chambers. The apparatus is characterized by the feature that the quicksilver column, situated between the two gas chambers, is divided into two or more parts, and the reading device is arranged between these partial columns. Claims allowed, 7.

5002. Vorrichtung zur Messung von Schwerkraftunterschieden [Apparatus for measuring gravity differences]; Askania Werke A. G. vormals Centralwerkstatt Dessau und Carl Bamberg-Friedenau of Berlin-Friedenau: German patent 661,406, issued June 17, 1938.

Addition to patent 650,566 (see abstract 5001).

This invention relates to an arrangement for measuring gravity differences. The difference in pressure in the two gas chambers is shown by the position of the liquid in a graduated tube inserted between the two quicksilver columns. The arrangement is characterized by the feature that a throttle (valve) is built into the graduated tube, and such a length of the column of the liquid serving for indication is used that during the movement of the liquid in the column along the whole range of measurement the throttle acts as a device retarding the flow of the indicating liquid, thus facilitating the reading of the values of measurements. Claims allowed, 6.

5003. Elastisches Pendel, insbesondere zur Messung der Schwerkraft [Elastic pendulum, in particular for measuring gravity]; Askania Werke A. G. vormals Centralwerkstatt Dessau und Carl Bamberg-Friedenau of Berlin-Friedenau: German patent 661,497, issued June 20, 1938.

This invention relates to an elastic pendulum for measuring gravity, in which the center of gravity lies above the fictitious point of rotation. The pendulum mass is secured to the lower end of a leaf spring subjected to tension stress. The arrangement of the leaf spring is characterized by the feature that this arrangement consists of one single leaf spring. Claims allowed, 1.

5004. Drehwaage nach Eötvös [Torsion balance according to Eötvös]; Naamlooze Vennootschap de Bataafsche Maatschappij in Haag, Netherlands: German patent 669,289, issued December 21, 1938.

This invention relates to improvements in a torsion balance according to Eötvös. The balance is provided with a rod equiaxially connected to the torsion wire. The rod is secured within a cylinder, the latter being movable within a cylindrical case. The rod is provided with a plate within a section of the cylindrical case, arranged suitably. The damping is accomplished by liquid into which the rod and the torsion wire are immersed. Claims allowed, 4.

5005. Procédé et appareil pour prospection sismique [Method and apparatus for seismic prospecting]; Engineering Laboratories, Inc., of the United States of America: French patent 834,841, issued December 2, 1938.

This invention relates to the method of seismic prospecting by which the determination of the points of reflection of the waves is facilitated. The method comprises creating a disturbance below the earth's surface, receiving the several waves thus formed, translating these waves into electrical vibrations, applying the electrical vibrations to an element responsive to their magnitude and their derivative, and recording the output of the said element. Claims allowed. 38.

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