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

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

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JANUARY–DECEMBER 1940

COMPILED BY

W. AYVAZOGLOU

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GEOPHYSICAL ABSTRACTS 100, JANUARY-MARCH 1940

Compiled by W. AYVAZOGLOU

1. GRAVITATIONAL METHODS

5299. Breyer, Friedrich, Die topographische Reduktion der Lotabweichungen am Nanga Parbat mit Hilfe eines Diagramms [Topographic reduction of plumb-line deviations at Nanga Parbat with the aid of a diagram]: Zeitschr. Geophysik, vol. 15, No. 5/6, pp. 229–247, Braunschweig, 1939.

Plumb-line deviations measured at the Nanga Parbat massif are reduced for topography with the aid of a diagram. An attempt is made to interpret the residual plumb-line deviations by comparing them with calculated curves of some simple bodies under assumed large-space conditions. Assumed differences in density are not extremely great; however, a complete explanation is not yet possible. Finally, an outline is given of accurate measurements made in Europe.—*Author's abstract, translated by W. A.*

5300. Evans, J. F., Correlating gravity maximum with oil structure in Ramsey field: Oil and Gas Jour., vol. 38, No. 26, p. 37, Tulsa, Okla., 1939.

A definite correlation exists between gravity maximum and a producing oil structure in the Ramsey field of Oklahoma. Gravity-meter observations were taken at 70 stations to determine the location and magnitude of the gravitational anomaly at the Ramsey field. Gravity values are plotted and shown by contours on a map of the field.—*W. A.*

5301. Gamburtsev, G. A., Determination of the center of gravity of a perturbing body from gravity observations [in Russian]: Acad. sci. U. R. S. S. Bull., sér. Géog. Géophys., No. 4, pp. 307–315, Moscow, 1938.

Coordinates of the center of gravity of a perturbing body are calculated, and formulas are applied for the interpretation of the results of a gravimetrical survey in a region of local anomalies of gravity.—*W. A.*

5302. Hayakawa, Masami, The most suitable formula for gravity values in Tyosen, Japan: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 423–428, 1939.

The most suitable formula for gravity values in Japan, excluding Tyosen (Korea), was determined and later revised by Tsuboi. (See Geophys. Abstracts 59 and 87, Nos. 1793 and 3264.) According to Tsuboi's formula, the value of the "flatness," deduced as $\epsilon=\frac{1}{322}$, was smaller than the value $\left(\frac{1}{298}\right)$ given by Helmert, Hayford, and others. It is believed that the difference is due to local anomalies in the distribution of gravity values in Japan. Therefore, the writer studied

the form of the geoid in other localities near Japan and investigated gravity values in Tyosen. Results of the study are summarized in a table and are shown graphically.—*W. A.*

5303. Johnston, W. D., Jr., Gravity section across the Sierra Nevada [abstract]: Geol. Soc. America Bull., vol. 50, No. 12, part 2, pp. 1953–1954, Washington, Dec. 1, 1939.

In 1939 the Coast and Geodetic Survey occupied 11 pendulum gravity stations, approximately 12 miles apart, extending from Sacramento to Reno across the northern part of the Sierra Nevada. Eight stations located upon predominantly granodiorite bedrock showed negative isostatic anomalies ranging from −5 to −44 milligals, and their average is of the same order as the average of the anomalies of the 46 pendulum stations in the California-Nevada block. Three stations, located upon the belt of Carboniferous and Jurassic strata, have positive isostatic anomalies ranging from +5 to +15 milligals. The positive anomalies are near areas of gabbro and are believed to reflect the excess mass of gabbro intrusive rocks extending downward from the surface to a depth of the order of 10,000 feet.

5304. Kazansky, A. P., Determining the elements of a mineral bed according to gravimetric data [in Russian]: Acad. sci. U. R. S. S. Bull., sér. Géog. Géophys., No. 2/3, pp. 241–249, Moscow, 1938.

The writer studies mathematical expressions for the center of gravity and for differences in curvature for bodies of infinite extent and of any form of cross section. He derives simple formulas to determine the following data from observed profiles of the gradients of gravity, and from differences in curvature: (1) The area of the cross section of the body, (2) the depth of the center of gravity of the cross section of the deposit, and (3) the abscissa of the center of gravity of the cross section. He studies an example that is based on data obtained from actual prospecting.—*W. A.*

5305. Kazansky, A. P., Determining the main elements of a deposit having great extension in depth according to gravimetric and magnetometric data [in Russian]: Acad. sci. U. R. S. S. Bull., sér. Géog. Géophys., No. 2/3, pp. 251–260, Moscow, 1938.

The writer studies mathematical expressions of the components of magnetic force and of the gradients of gravity of a magnetic and gravitational body of any form. He derives formulas to establish the following data from observed profiles of magnetic forces and of gradients of gravity: (1) Location of the borders of the deposit, (2) mean value of the depth of the deposit, (3) equation of a straight line closest to the line of the upper border of the deposit, and (4) mean quadratic deviation of ordinates of the straight line from ordinates of the line of the upper border of the deposit.—*W. A.*

5306. Nörgaard, G., Einige Schwereverhältnisse in Dänemark [Some gravity relations in Denmark]: Geod. Inst., Medd. No. 12, 35 pp., Copenhagen, 1939.

The results of measurements at about 150 new gravity stations in Jutland (July 1938) are given. These results, together with the results obtained previously in neighboring waters, are shown in a map. A new great maximum at Silkeborg, several minima, as well as special gravity gradients (for example the hard gradient in north Öresund), are indi-

cated on the map. More detailed measurements of the northern front of the Silkeborg maximum are shown in another map. Some of the most interesting minima in the northwest of Silkeborg, especially the minimum at Skive, are discussed. Special measurements of interest are examined in the last part of the article.—*Author's English abstract.*

5307. Orlov, Alexandr, On the deformations of the earth according to observations with horizontal pendulums in Tomsk and Poltava [in Russian]: Acad. sci. U. R. S. S. Bull., sér. Géog. Géophys., No. 1, pp. 3–29, Moscow, 1939.

The present paper contains the results of observations with horizontal pendulums made in Tomsk (1914–16) and Poltava (1930–33). In Poltava the pendulums were disposed perpendicularly to each other in the azimuths of 77° and 167°. In Tomsk both of them were arranged for comparison parallel in the azimuth of 82°. The mean sensitiveness of the instruments was, in Poltava 0.023″, and in Tomsk 0.030″ in 1 mm.

The diurnal solar wave of meteorological origin proved to be quite considerable both in Tomsk and Poltava; its amplitude reached 0.02″. The elements of this wave did not remain constant in the course of the year, and hence the determination of the waves K_1 and P in Tomsk and Poltava was impossible. The main lunar semidiurnal wave M_2 could be determined in Tomsk and Poltava with great accuracy. It was found that the ratio (γ_n) of the observed amplitude of this wave to the calculated one is in the meridian greater than in the first vertical (γ_e). In Poltava we obtained: $\gamma_n=0.80$, $\gamma_e=0.69$; in Tomsk: $\gamma_n=0.60$, $\gamma_e=0.48$. Thus in both Tomsk and Poltava $\gamma_n>\gamma_e$, while it is known that according to observations carried out in western Europe $\gamma_n<\gamma_e$. For the diurnal wave O we obtained in Poltava $\gamma=0.42$, whereas the semidiurnal wave M_2 gives us in the mean $\gamma=0.74$. According to Schweydar's theory we should have just the opposite, that is, the diurnal wave should give a greater value for γ than the semidiurnal does. The pendulums arranged in Tomsk parallel to each other showed the same periodic oscillations; but the movement of the zero points of both the instruments was quite different.

The following conclusions are derived from the results obtained:

1. Schweydar's theory of the influence of sea tides on the earth's tides is not confirmed by the observations in Tomsk and Poltava.

2. Tidal deformations of the earth vary at different places and, hence, in order to obtain a true picture of these deformations they must be observed at many places of the earth.

3. The daily tides K_1 and P cannot be used for the determination of the coefficient γ because of the disturbances of meteorological origin; for this purpose there should be used only the wave O, which may be observed the best in polar regions.

4. The difference which is obtained for γ in different directions does not depend on the apparatus used.

5. At present there is no reason to change the classic value of the coefficient γ, namely, $\gamma=\frac{2}{3}$.—*Author's English abstract.*

5308. Slotnick, M. M., Gravimetric and seismic methods in exploration geophysics [abstract]: Geol. Soc. America Bull., vol. 50, No. 12, part 2, December 1939.

The two most important methods in use by petroleum geophysicists are the gravimetric and seismic. Although these methods as exploration tools are less than 20 years old, their success and develop-

ment have been remarkable. The underlying ideas of the torsion balance and gravimeter and of the refraction and reflection seismographs are described in this paper. Some of the related mathematical treatments leading to the geological interpretations are discussed.

5309. Somigliana, C., Il campo gravitazionale della terra [Gravitational field of the earth] [in Italian and French]: Scientia, vol. 67, No. 333–1, pp. 1–10, Bologna, January 1, 1940.

Theories for studying the terrestrial gravitational field as proposed by Newton and Clairaut are reviewed. According to Stokes' theory, which is discussed, the problem is considered independently from the law of distribution of the interior mass. Solutions derived by Stokes himself, as well as by G. Darwin and Helmert, are reviewed. The general form of Pizzetti's potential function and its solution for the ellipsoidal geoid by means of harmonic functions is considered. Finally, a summary of properties is given from which the expression of gravity in a final form may be derived as the extension of Clairaut's theorem and as its development into series according to the method proposed by the author.—*Author's abstract, translated by W. A.*

5310. Tsuboi, Chuji, Relation between gravity anomalies and the corresponding subterranean mass distribution, part 3: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 351–384, 1939.

In his earlier papers (see Geophys. Abstracts 92 and 96, Nos. 4119 and 4764), Tsuboi developed a direct method for estimating the subterranean mass distribution from the gravity anomalies observed in a certain region. The solution of the problem was possible, of course, only after several physical assumptions were made. The assumptions underlying the present method are that gravity anomalies are caused by an undulation of the boundary surface between crustal and denser subcrustal materials and that so far as resulting gravity anomalies are concerned this undulation is such that the inequality of the mass caused by it could be replaced by a mass concentrated at the average depth of the boundary. The fundamental principle of this method is that the distributions, both of gravity anomalies Δg and of responsible masses Δm, which are assumed to be concentrated on a single subterranean plane, if expressed in harmonic series of the coordinates, result in a simple mathematical relation between the corresponding harmonic coefficients of the two series.—*W. A.*

5311. Tsuboi, Chuji, Kaneko, Tutuiti, Miyamura, Setumi, and Yabasi, Tokutaro, Relation between gravity anomalies and the corresponding mass distribution, part 4. Isostasy in the United States of America: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 385–410, 1939.

The present article deals with the application of Tsuboi's method in interpreting gravity anomalies, particularly those observed in the United States. The serial published by the United States Coast and Geodetic Survey, entitled "Principal facts for gravity stations in the United States," is the source of the materials discussed in this study. Although the conclusions arrived at by the present method differ little from those that J. H. Hayford, W. Bowie, and W. Heiskanen have already found by the customary trial and error method, they could be obtained by simpler numerical computations.—*W. A.*

5312. Wegener, Kurt, Bemerkungen zu dem vertikalen Gradienten der Schwere [Remarks concerning the vertical gradient of gravity]: Zeitschr. Geophysik, vol. 15, No. 5/6, pp. 247–249, Braunschweig, 1939.

The gradient of gravity dg/dz should be determined inasmuch as its value may give some clue as to the depth of a disturbing mass. So far, measurements of dg/dz have been made in towers by weighing a mass at different heights. But owing to the disturbing interference of the tower, values of $\Delta g/\Delta z$ obtained in this way have been smaller, as a rule, than values calculated theoretically.

A new method and apparatus for measuring dg/dz is described. An attempt to test the apparatus failed because of the destruction of the large glass vessel of the apparatus during the experiment. However, the apparatus is interesting, and the experiments may be repeated after some improvements have been completed.—*W. A.*

5313. Yamaguti, Seiti, The structure of the earth's crust near the Japan trench, off Sanriku, and also near the Inland Sea of Japan: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 429–442, 1939.

Investigations into the problem of determining the subterranean mass distributions direct from the corresponding gravity anomalies observed on the earth's surface have already been made by Tsuboi and Fuchida (see Geophys. Abstracts 92 and 96, Nos. 4119 and 4764), who gave examples of actual gravity anomalies near Java and North America. In this paper, the configurations of the earth's crust near the Japan trench, off Sanriku, as well as near the Inland Sea of Japan were calculated by the same method. The object of the investigation was to ascertain the part of the crust in which earthquakes are most frequent. The results of investigations are summarized in tables and diagrams.—*W. A.*

2. MAGNETIC METHODS

5314. Bartels, J., Heck, N. H., and Johnston, H. F., The 3-hour range-index measuring geomagnetic activity: Terres. Magn. and Atmos. Electr., vol. 44, No. 4, pp. 411–454, Baltimore, Md., 1939.

Geomagnetic activity, the frequency and intensity of magnetic disturbance, is supposed to indicate the influence of solar corpuscular radiation on the earth. Various schemes for measuring the fluctuations of this phenomenon are in operation, but in connection with direct ionospheric studies by radio methods it was found necessary to provide a new scheme using smaller time units than a day or half a day. A 3-hour range-index K based on the "Potsdamer erdmagnetische Kennziffer" was therefore provisionally adopted by the International Association of Terrestrial Magnetism and Electricity, at Washington, D. C., United States of America, in September 1939. Each collaborating observatory is to assign, to each 3-hour interval beginning at 0^h, 3^h, etc., *GMT*, one of the integers 0 to 9 as range-index K; their averages K_m carried to half-units, express the new measure. Scales for K are determined by assimilation of frequency curves so that each observatory within a year, for instance, has approximately the same number of intervals with $K=0$, or with $K=1$, etc. The principles and the practices of scaling K are described. The magnetic variations are regarded as superpositions of K-

variations (to be measured), and of non-K-variations (such as regular daily variations on quiet days, to be eliminated); this is illustrated by typical cases. For January to June 1938, tables for K and K_m are given based on eight observatories. From K_m, daily indices B for 24-hour intervals are derived, also equilavent ranges A. High correlations are found between K at the different observatories and K_m. The effect of the persistence tendencies on these and other correlations is studied and provides examples of general interest in statistics. In general, the correlation-coefficient r increased with the length of the time unit used; for instance, for the daily-index B and the international character-figure C, r is 0.95 for single days, but it reaches 0.98 for 4-day averages. Incidently, a geomagnetic solar-flare effect was found preceding the outbreak of the intense storm on January 16, 1938; the time-interval suggests 22 hours as an upper limit for the travel of the solar corpuscles.—*Authors' abstract.*

5315. Bartels, J., and Johnston, H. F., Main features of daily magnetic variations at Sitka, Cheltenham, Tucson, San Juan, Honolulu, Huancayo, and Watheroo: Terres. Magn. and Atmos. Electr., vol. 44, No. 4, pp. 455–470, Baltimore, Md., 1939.

Uniform sets of graphs are given expressing the average daily magnetic variations at seven observatories as influenced by season, sunspot-cycle, and magnetic activity. The effect of disturbance on the daily mean values of the magnetic elements is discussed. International disturbed days are shown to be more disturbed around Greenwich noon than during the rest of the day. This second-order effect must be considered in studies of the disturbance field.—*Author's abstract.*

5316. Duvall, C. R., Magnetic declination in the Pacific from observations by the *Galilee* and *Carnegie*: Terres. Magn. and Atmos. Electr., vol. 44, No. 2, pp. 115–136, Baltimore, Md., 1939.

The declination is expressed by a rational, integral algebraic function of the second degree of the latitude, longitude, and time, and the observations used were those of the first, second, and third cruises of the *Galilee* and of the second, fourth, fifth, sixth, and seventh cruises of the *Carnegie*. All the observations of both ships were given equal weight, and the observations at over 2,000 stations were used. The whole work is summarized in a table of coefficients and other data referring to the particular squares into which the Pacific was mapped. A declination map of the Pacific shows the small oval near the middle where the declination has a minimum value of 8° E. for the 160° meridian, the increase, north and south to over 30° E., and the 0° isogonal in the west. The annual change of declination is expressed by differentiating the first equation with respect to time. This gives, for a given square, the isopors of declination within the square. The results of analysis of observations for the different squares are also tabulated. Five magnetic observatories lay within the limits of the squares, and it was thus possible to compare the sea and land observations. In general, the sea value was higher than the land value. The differences in these are discussed.—*G. E. A., Sci. Abstracts, vol. 42, No. 501, 1939.*

5317. Galbraith, F. M., and Hart, R. C., Geophysics in exploration at Falconbridge: Canadian Min Met. Bull., Trans., No. 330, vol. 42, pp. 527–531, Montreal, Quebec, 1939.

The surface of the area under investigation is largely covered by glacial drift composed of sand and gravel and is spread unevenly to depths of 300 feet. The ore deposits are essentially massive sulfide bodies composed chiefly of pyrrhotite with small amounts of pentlandite and chalcopyrite and with decimal percentages of magnetite, marcasite, pyrite, sphalerite, galena, and a variety of arsenides and sulfarsenides of iron, nickel, and cobalt. Magnetic work is most effective where glacial drift is substantially thick. The amount of ore correlates quantitatively with the intensity of magnetic disturbance. A profile accompanying the article shows both the abrupt drop in magnetic intensity at the footwall side of the buried outcrop and the gradual decrease in intensity in the hanging wall. Thus, it is expected that an ore body in this district, with the highest point about 500 feet below the surface, might be revealed by magnetic work. A Hotchkiss superdip magnetometer was used.—*W. A.*

5318. Gutmans, Marger, and Vageler, Paul, Zur Kenntnis der magnetometrischen Anomalien Zentralbrasiliens [Contribution to the knowledge of the anomalies of magnetic intensities in central Brazil]: Zentralbl. Mineralogie, Geologie u. Paläontologie, Abt. B, No. 10, pp. 417–426, Stuttgart, 1939.

A brief description is given of the results of magnetic measurements in the State of São Paulo in 1938 for the purpose of estimating depths and boundaries of basaltic rocks. Determinations of magnetic anomalies were made along a 2,000-km. route. The regional magnetic data are the first obtained in this region and are considered to be of promise and of interest for disclosing the general geologic structure of the country. Detailed magnetic surveys were planned for 1939.—*W. A.*

5319. Heiland, C. A., Magnetic methods: Finding and producing oil, American Petroleum Institute, 1st ed., pp. 51–52, Dallas, Tex., 1939.

The writer discusses briefly the magnetic methods and the magnetic instrument (Schmidt-Askania vertical magnetometer) used predominantly in oil exploration. He examines the practical application of field results represented by (1) lines of equal magnetic anomaly (isoanomalies), (2) magnetic profiles, (3) peg models, (4) isometric anomaly charts, (5) anomalous vectors, and (6) magnetic gradients for interpreting magnetic data in geologic terms. A typical profile made from a magnetometer survey is given as an illustration.—*W. A.*

5320. Jenny, W. P., Magnetic-gradient maps for Illinois and southern Michigan: Oil Weekly, vol. 95, No. 9, pp. 22–31, Houston, Tex., 1939.

Magnetic-gradient maps reveal practically the same magnetic information as magnetic-vector maps, previously published by the writer for several States that produce oil (see Geophys. Abstracts 46, 59, and 98, Nos. 1208, 1803, and 5023, respectively). However, on account of the simplicity of the gradient, the gradient maps should be more easily understood and more useful for interpreting geologic structure. Magnetic interpretation of gradient maps is illustrated. Magnetic-gradient maps for Illinois and southern Michigan are given. In discussing the practical application of gradient maps, the author indicates that they

should be of much assistance in the detailed magnetic surveys of local structural features, inasmuch as the maps give a fair picture of the extent, location, and size of regional and semiregional anomalies in the general area to be investigated. Through their regional magnetic information, the maps should also greatly assist in a correct structural and stratigraphic interpretation of local magnetic anomalies.—*W. A.*

5321. Jones, W. M., Magnetic surveys in north Auckland: New Zealand Jour. Sci. Technology, vol. 21, No. 2b, pp. 77b–89b, Wellington, 1939.

The results are described of some surveys of the variations of vertical intensity in parts of north Auckland, mainly in the Maungaru, Tokatoka, Mahurangi, and Waiwera survey districts. The regional anomaly previously found to extend between Pahi and Pukehuia was found to connect directly to the Maungaru-Tangihua doleritic body and is considered to be due to the extension southward below the surface of this type of rock. Areal anomalies were also located in the Kaukapakapa-Silverdale district. Some detailed studies were made of the effects produced by dolerite bodies at Kirikopuni and Tiruwhiri, by the hornblende andesite of Tokatoka, the serpentinites of the Warkworth-Silverdale district, and by some quartz porphyrites and basalts.

The possibilities of application of a magnetic survey to some practical problems, especially structural geology and water supply, are discussed.—*Author's abstract.*

5322. Kalinin, Y. D., On the question of Bauer's residual field [in Russian]: Acad. Sci. U. R. S. S. Bull., sér. Géog. Géophys., No. 1, pp. 53–68, Moscow, 1939.

The author assumes that Bauer's residual field can be explained by the heterogeneous structure of the earth. (See Bauer, L. A., The assumed normal magnetization and the characteristics of the resulting residual field: Terres. Magn., vol. 4, No. 1, 1899, pp. 33–52.)

Formulas are derived for the following two assumptions: (1) Inside the earth a spherical inclusion is magnetized homogeneously, and (2) a "pseudo-spheroid," that is, a body resembling a spheroid of rotation, is magnetized by induction by the central core.

Results of calculations of these two assumptions agree well for the Asiatic anomaly, the depth of the inclusion being of the order of $0.5a$, in which a is the radius of the earth. The conclusion is therefore made that Bauer's field is, in its main part, a field of depth rather than of the earth's crust.—*Author's abstract, translated by W. A.*

5323. Kazansky, A. P., On the determination of the elements of a mineral bed according to magnetometric data [in Russian]: Acad. sci. U. R. S. S. Bull., sér. Géog. Géophys., No. 2/3, pp. 215–239, Moscow, 1938.

Mathematical expressions of the components of magnetic forces are studied for layers of infinite extent and any form of cross section. Formulas are obtained that make it possible to find the following data from the observed profiles of components of the magnetic force: (1) The area of the cross section of the layer, if the intensity of magnetization is known; (2) the coordinates of the center of gravity of the cross section of the layer; and (3) the tangent of the angle of inclination of the cross section of the layer with respect to the axis of the abscissa. A theoretical example is computed.—*W. A.*

5324. Kelly, S. F., Geophysics through ice and snow: Canadian Min. Jour., vol. 60, No. 10, pp. 609–614, Gardenvale, Quebec, 1939.

The area geophysically studied (by electrical and magnetic methods) is about half a mile wide and 3,500 feet long and is a part of some claims lying wholly beneath the waters of Kelly Lake, about 1.5 miles south of the town of Copper Cliff. Although the area is well mantled with glacial drift and alluvium, it has enough outcrops to indicate the lithology and strike of bedrock formations. The general distribution of rock formations is shown on a map. The work was done in February and March 1938 while the lake was frozen over, and observations could therefore be taken on the ice. An Askania vertical variometer with a temperature-compensated magnetic element was used for the magnetic work, and a ground comparator was used for measuring by the electrical method the resistivity ratios of bedrock formations. Results of both surveys are shown on a map, and the following interpretations are made from the results. The positions and courses of two olivine diabase dikes have been defined, and the continuation of a quartz diorite dike has been traced for a certain distance beneath the lake. The probable contact between a conglomerate bed and the underlying slates and quartzites and the probable contact between the conglomerate and the overlying quartzite have been traced for a certain distance. From a miner's point of view the results show that no major concentrations of pyrrhotite or other sulfides can be expected in conjunction with the quartz diorite dike within the area surveyed. The cost of the geophysical survey was about $2,500. To have obtained the same information by drilling might easily have cost $10,000 or $15,000. The present example is a clear demonstration of how geophysical methods can be applied to exclude barren parts of mining prospects.—*W. A.*

5325. Labrouste, M. and Mme. Henri, Étude statistique du cycle undécennal de la componante diurne de la déclinaison magnétique [A statistical study of the 11-year cycle of diurnal component of the magnetic declination]: Acad. sci. Paris Comptes rendus, vol. 209, No. 15, pp. 565–568, 1939.

Variations of the diurnal component of magnetic declination were measured at 22 stations between geomagnetic latitudes −48° and +64°. The variations in hourly mean phase and amplitude are shown in curves. The amplitude of the 11-year solar and magnetic variations changes from one station to another, and for any one station it varies with time and position of the globe in consequence of other long-period variations, but it increases with geomagnetic latitude to 50° and appears stationary or even decreases from 50° to 64°. The 11-year-phase component is sensibly in accord with the solar variation except for Huancayo and Apia, but its distribution in longitude has a positive anomaly for American stations and a negative anomaly for European stations.—*W. A.*

5326. Nagata, Takesi, A "free-air" reduction of local magnetic anomalies: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 411–422, 1939.

In a previous paper (see Geophys. Abstracts 96, No. 4774) the author gave a method for determining the subterranean structure directly from the distribution of magnetic anomalies on the earth's surface due to the subterranean anomalous mass distribution. The method proved

valuable in analyzing actual local magnetic anomalies under the assumption that the earth's surface is a nearly horizontal plane. If the earth's surface cannot be taken as a horizontal plane the method cannot be applied directly to results of observations, and observed values must be reduced by the use of a suitable correction formula to values on a horizontal plane. In this paper the author describes the theory and gives an actual example of a method for reducing observed values on an undulating surface to those on a horizontal plane with the aid of Fourier's analysis of undulation in two-dimensional examples.—*W. A.*

5327. Sucksdorff, E., Giant pulsations recorded at Sodankylä during 1914–38: Terres. Magn. and Atmos. Electr., vol. 44, No. 2, pp. 157–170, Baltimore, Md., 1939.

Giant pulsations are a kind of regular sinusoidal oscillations which appear at times in magnetic and earth-current records. During 25 years there were on the average six pulsations per year at Sodankylä. These were grouped round two particular times, namely, 1 hour (about 3 hours local time) and 8 hours G. M. T. The groups are distinguished as *A* and *B*. The pulsations of group *A* are the most regular and most frequent; those of group *B* generally last longer. Distinct maxima occur at the equinoxes, and there is a secondary maximum in summer (July). The occurrence of the pulsations appears to be connected with the cycles of solar activity, and the number per year is greater (8) during years of minimum than during years of maximum activity (4.8). Their duration varied between 10 minutes and 4 hours 25 minutes. The period of the pulsations ranged between 46 and 152 seconds. Although the pulsations are, as far as is known, local phenomena, the giant pulsation of April 1938 was recorded simultaneously at six European observatories. The pulsations for the given period are tabulated in detail, their shapes are recorded, and graphs of their daily and yearly distribution are drawn.—*G. E. A., Sci. Abstracts, vol. 42, No. 501, 1939.*

5328. Vacquier, Victor, A proposed geophysical method for orienting cores: Geophysics, vol. 4, No. 4, pp. 292–299, Menasha, Wis., 1939.

A new method of orienting cores is suggested, in which a fluid suspension of magnetic particles is made to solidify and adhere firmly to the formation at the bottom of the well. While the substance is still liquid the magnetic particles line up in the direction of the earth's magnetic field so that, upon solidifying, a magnetized body is tightly cemented to the rock. The formation is then cored and the topmost core carrying an inclusion of the polarized material is oriented by means of a magnetometer. When such a core is recovered there can be no doubt as to the fidelity of the result.—*Author's abstract.*

3. SEISMIC METHODS

5329. Blake, Archie, Mathematical problems in seismology [abstract]: Geol. Soc. America, vol. 50, No. 12, part 2, p. 1975, Washington, D. C., December 1939.

The principal mathematical problems of instrumental seismology are to work out theories of instruments (e. g. the algebra of the galvanometric seismograph) and to aid in the development of new instruments best suited to meet specific needs (seismographs capable of giving more quantitative results, strong-motion seismographs, strainmeters, ro-

tation seismographs, and tiltmeters). The problem of the earth's interior consists principally of the extension of elastic theory to new boundary and initial conditions, inhomogeneous and anisotropic media, and finite strain. An important advance is the method of Pekeris and Slichter, in which the variation of density can be obtained as a function of the depth by measuring the form of the wave on the seismogram, as well as its arrival time. Other problems are the mechanism of occurrence of deep earthquakes and the calculation of the elastic constants within the core.

The strong-motion problem is simple in conception: To study the response expected of various kinds of structure to earthquakes, with a view to obtaining data for earthquake-resistant design. Complexities and mathematical problems enter in designing instruments to measure ground motion, reducing the records obtained, and taking account of interactions among the modes of oscillation, finite strain, and yielding of the ground. A comparatively new branch, statistical seismology, opens up a wide variety of mathematical problems.

Finally, there is a need for new calculating machines to lighten the labors of seismologists and workers in other fields and encourage them to undertake calculations which they now evade.

5330. Bullard, E. C., Submarine geology: Sci Progress, vol. 34, No. 134, pp. 237–248, London, 1939.

The form, nature, and structure of the ocean floor are studied. The first requirement of submarine geology is to develop instruments and methods suitable for collecting information about submerged rocks. The writer discusses the present means of studying submarine topography (sounding) and of obtaining information about the ocean floor itself by taking cores. The seismic method is considered to be one of the most promising methods for obtaining information below depths that can be cored. The seismic method has been used already to a depth of about 100 fathoms. The writer gives a brief description of the application and results of the seismic method as used on ships, in explosive charges, and with geophones, and he mentions another possible method, that of gravity measurements as devised by Vening Meinesz, which was valuable in surveys made in the East Indies and West Indies.—*W. A.*

5331. Bungers, R., Die Überlagerung zweier Wellen verschiedener Herkunftsrichtung [The superposition of two waves of different direction of origin]: Zeitschr. Geophysik, vol. 15, No. 5/6, pp. 321–332, Braunschweig, 1939.

The superposition of two plane waves that originate from different directions is studied and is based on observations of waves producing ground disturbances. The values of measurement of partial waves that may be obtained from an analysis of the picture of superposition at a firm place are shown in part 1 of this article. A geometrical method of analyzing oscillations is given, and a conception of "ellipse of oscillation" (Schwebungsellipse) is introduced. In part 2, current relations of the phases are examined, and phase velocities are studied. A complicated change in value as well as in direction results from the period of oscillation. Part 3 deals with the theory of the "ellipses of oscillation" in a horizontal plane. It is shown that the direction of the major axis of the ellipse of oscillation varies periodically with

the period of oscillation, a phenomenon that has been observed also in the waves of the oscillation of the ground.—*Author's abstract, translated by W. A.*

5332. Byerly, Perry, Speeds of seismic waves and earth structure in central California [abstract]: Geol. Soc. America Bull., vol. 50, No. 12, part 2, pp. 1947–1948, Washington, D. C., Dec. 1, 1939.

Least-square adjustments of observations of waves of the P groups indicate the speed of $\overline{P}$ to be 5.61 km./sec. ±0.05; that of P_n to be 8.02 km./sec. ±0.05, and that of P in the intermediate layer to be 6.72 km./sec. ±0.02. The speed of $\overline{S}$ is 3.26 km./sec. ±0.09. The depth of focus of the Berkeley earthquake of March 8, 1937, is fixed at 2.9 km., which allows the following determination of the average thicknesses of the upper layers of the earth's crust in the vicinity of the stations: Granite, 9 km.; intermediate, 23 km. The data from various earthquakes are interpreted as indicating a thickening of the granite layer south of the Berkeley region, the value of the thickness being 21 km. in the vicinity of San Benito and 24 km. in the vicinity of Parkfield. An explanation of the Z phenomenon is that P and S may have different foci, although for all but one of the shocks studied the Z phenomenon can probably be explained by errors. A reconsideration of the P_n data of the Nevada earthquake of December 20, 1932, together with new data, leads to the conclusion that the root of the mountain mass under the southern Sierra projects into the mantle beneath the surface layers by an amount between 6 and 41 km.

5333. Caloi, Pietro, Graphic methods for determining epicentric conditions of near earthquakes: Ricerca Scientifica, vol. 10, pp. 645–663, Rome, July–August 1939.

Two simple geometrical methods for finding epicentric coordinates and hypocentric depth of a near earthquake are described. The methods, although rapid, do not sacrifice precision, as is shown by examples.—*W. A. R., Sci. Abstracts, vol. 42, No. 504, 1939.*

5334. Campbell, F. F., Dip reflections on two faults in the Gulf coast: Geophysics, vol. 4, No. 4, pp. 260–270, Menasha, Wis., 1939.

Two examples of dip-reflection work on faulted structures in the Gulf coast are presented. In one example a large fault is clearly shown by geophysical data alone, and in the other example the assistance of geological data is required to prove the existence of a small fault which the geophysical data alone did not show. The problem of whether misclosure in dip-reflection traverses is due to observational errors or faulting is not resolved finally, but suggestions are offered which may lead toward a solution in any particular case.—*Author's abstract.*

5335. Demenitskaia, R. M., Prospects of seismic survey by the method of refracted waves in the region of the Ust-Eniseisk port [in Russian]: Problemi Arktiki, No. 5, pp. 81–92, Leningrad, 1939.

The seismic-refraction method of prospecting was used in the region of the Ust-port in 1936 and 1937–38. A brief and an interesting description is given of the geologic structure of the region. The purpose of the geological and geophysical surveys was to determine structures favorable to the accumulation of oil. Eight seismograms obtained from the surveys in 1937–38 are given. As continuation of

the experimental work is desirable, it is recommended that three component seismographs be used and that a study of waves selected by frequency and direction be made. This may make it possible to develop a new seismic-refraction method suitable for this region, where the ground is permanently frozen to a great depth.—*W. A.*

5336. Dix, C. H., Refraction and reflection of seismic waves, part 2. Discussion of the physics of refraction prospecting: Geophysics, vol. 4, No. 4, pp. 238–241, Menasha, Wis., 1939. (For part 1, see Geophys. Abstracts 98, No. 5038.)

There are five principal factors governing the intensity of the refracted wave of "refraction prospecting." It is shown that a clear understanding of this process can lead to decided improvements in the geophysicist's interpretation of refraction data.—*Author's abstract.*

5337. Gamburtsev, G. A., On the possibility of separation of reflected transversal waves in seismic prospecting [in Russian]: Acad. sci. U. R. S. S. Bull., sér. Géog. Géophys., No. 2, pp. 155–173, Moscow, 1939.

The author discusses the possibility of separating transversal and longitudinal reflected waves when the recording of seismic oscillations is made by a horizontal seismograph that is oriented both along and across the profile. When geologic conditions are simple (one border of discontinuity) and observations are made at short distances from the point of explosion, waves of P_1S_1 and S_{11} type will have the greatest intensity. The author examines the influence of intermediate surfaces of discontinuity on the distribution of energy of reflected waves of different types, and he indicates the suitability of special methods of excitation and recording of oscillations. He gives a brief account of the results of first experiments in separating transversal and longitudinal reflected waves, by which the main points of the fundamental conclusions were confirmed.—*Author's abstract, translated by W. A.*

5338. Gamburtsev, G. A., On the theory of electromagnetic damping in induction seismographs [in Russian]: Acad. sci. U. R. S. S. Bull., sér. Géog. Géophys., No. 1, pp. 31–34, Moscow, 1939.

The author discusses the corrections that should be introduced in the theory of electromagnetic damping in an induction seismograph if the self-induction of the electromechanical transformer of the seismograph is taken into consideration. He shows that the system has two boundaries of aperiodicity, within which the domain of aperiodical solutions is enclosed, and he determines the condition by which aperiodic damping may be obtained.—*Author's abstract, translated by W. A.*

5339. Gardner, L. W., An areal plan of mapping subsurface structure by refraction shooting: Geophysics, vol. 4, No. 4, pp. 247–259, Menasha, Wis., 1939.

Under suitable geologic conditions, arrival events of refraction-wave trajectories following a relatively high-speed "marker horizon" may be observed and identified, and the associated traveltimes may be measured on refraction set-ups having detectors located at suitable distances from shot-point locations. On each refraction set-up, the sum of the two "delay times" at positions offset from the shot point and detector position may be determined. Depth of the marker horizon and the location of the "offset position" at which this depth applies are dependent on and determinable from "delay time" if the seismic-wave speeds in the geologic section overlying the marker horizon are known. By arrang-

ing two or more refraction set-ups angularly disposed so that they have a common location for one offset position of each set-up, differential delay times and corresponding differential depths at the free offset positions may be determined. By a geometrical arrangement of three set-ups in a triangular manner such that each offset position of each line is coincident with one offset position of another line, absolute delay times and depths at the common offset positions may be determined. By coordinating these two types of geometrical arrangements in shooting over an area, the depths and undulations of the marker horizon may be determined.—*Author's abstract.*

5340. Grenet, Georges, Un séismographe vertical universel [Universal vertical seismograph]: Acad. sci. Paris Comptes rendus, vol. 209, No. 24, pp. 895–896, 1939.

The author has developed a new vertical seismograph of the Wenner type to complete the equipment of seismograph stations, most of which have only horizontal seismographs with mechanical amplification. By applying a spring made of specially treated elinvar, he could adjust the pendulum to a period of 10 sec. Using this period, he obtained registrations by horizontal seismographs with mechanical amplification that could be completed by registrations of vertical movements of the ground. Good results were obtained by the new apparatus from the earthquake of November 21, 1939, the epicenter of which was about 700 km. from Clermont-Ferrand.—*W. A.*

5341. Gutenberg, Beno, Tsunamis and earthquakes: Seismol. Soc. America Bull., vol. 29, No. 4, pp. 517–526, Berkeley, Calif., 1939.

Tsunamis ("tidal waves," "maremotos") may be produced by submarine volcanic eruptions, submarine slides started by earthquakes, submarine faulting, or atmospheric conditions. The hypothesis that at least some of the largest tsunamis have been produced by submarine slides with earthquake waves as a trigger force has been advanced by a notable number of those seismologists who have studied tsunamis. The macroseismic as well as the microseismic data of the Atacama earthquake of November 11, 1922, indicate clearly that the fault movement occurred inland; the tsunamis originated from a submarine slide near a relatively feebly shaken stretch of the coast where the surface slopes steeply to a considerable depth. On gently sloping coasts, such as those of California, large tsunamis are rare, and the relatively small tsunamis there are probably produced by faulting at the bottom of the ocean.—*Author's summary.*

5342. Gutenberg, Beno, and Richter, C. F., New evidence for a change in physical conditions at depths near 100 km.: Seismol. Soc. America Bull., vol. 29, No. 4, pp. 531–537, Berkeley, Calif., 1939.

Seismograms of South American earthquakes at depths down to 260 km., recorded at Huancayo, Peru, are used to confirm and extend the conclusion that a slight decrease in the velocity of longitudinal waves occurs at a depth of about 80 km.—*Authors' summary.*

5343. Gutenberg, Beno, and Richter, C. F., New evidence for change in physical conditions at depths near 100 km. [abstract]: Geol. Soc. America Bull., vol. 50, No. 12, part 2, p. 1950, Washington, D. C., December 1, 1939.

Seismograms of normal earthquakes show amplitudes for the direct longitudinal waves, which decrease rapidly with distance to about

1,500 km.; beyond this there is a sudden increase. Together with the corresponding traveltimes, this implies a decrease in velocity with depth at about 80 kilometers below the surface, which may possibly indicate a transition from the crystalline to the glassy state. The station of the Carnegie Institution of Washington at Huancayo, Peru, records numerous earthquakes at short distances, many of which have focal depths from 50 to 250 km. The amplitudes of longitudinal waves on these seismograms have been compared with each other and with those on records of the same shocks written at Pasadena. In this way the extent of the "shadow zone" of small amplitudes can be determined for various focal depths. For example, a shock distant 1,300 km. at a depth of 90 km. shows very small amplitudes, whereas a shock at the same distance but 110 km. deep, records with unusually large amplitudes. There is a limiting focal depth, apparently between 150 and 200 km., such that earthquakes originating below this limit do not show the "shadow zone." The results extend and confirm the previous conclusions from normal earthquakes and indicate that a slight decrease in velocity of longitudinal waves, either gradually or suddenly, occurs at a depth of about 80 km. below the surface. Traveltimes and amplitudes indicate that at greater depths the velocity again increases with increasing depth.

5344. Gutenberg, Beno, Zur Entwicklung der seismischen Aufschlussmethoden [On the development of seismic methods of prospecting]: Ergebnisse der Kosmischen Physik, vol. 4, pp. 169–218, Berlin, 1939.

A brief presentation is made of seismic methods of prospecting, with details on instruments and with many examples: (1) Historical development, (2) organization of seismic investigations, (3) refraction method, (4) instruments used with the reflection method, (5) explosion charge and its ignition, (6) examples, (7) methods of calculation, and (8) list of 57 references on literature.—*H. Israel's abstract in Zeitschr. Geophysik, vol. 15, No. 5/6, 1939, translated by W. A.*

5345. Heinrich, R. R., Note on the *P*-curve of a South American deep-focus earthquake: Seismol. Soc. America Bull., vol. 29, No. 4, pp. 527–530, Berkeley, Calif., 1939.

Attention has been given in recent years to seismological studies that are based on comparisons of traveltime curves for particular phases of unique earthquakes with average curves for the same phases. In the light of these studies, attempts have been made to interpret the crustal structure in specific localities and at the same time to find out the significance of the apparent azimuthal distribution of energy in certain phases. This paper presents a few data that may be of interest in such comparison.—*W. A.*

5346. Herrmann, A., Piezoelektrische Beschleunigungsmesser hoher Empfindlichkeit ohne Verstärker [Piezoelectric accelerometers of high sensitiveness without amplifier]: Veröff. Reichsanst. Erdbebenforsch., No. 34, pp. 25–72, Jena, 1938.

Piezoelectric effectiveness of a crystal element is defined, and the relation of this effectiveness to the attainable sensitiveness in acceleration is obtained for a given inert mass, for steepness of the converter pipe, and for sensitiveness of the recording instrument. Quartz rods subjected

to a stress parallel to the neutral axis and Rochelle salt rods perpendicular to the *b*-axis are especially suitable. The switch arrangement of a piezoelectric accelerometer of high sensitiveness working without an amplifier is shown also.—*Seidl's abstract in Zeitschr. Geophys., vol. 15, No. 5/6, 1939, translated by W. A.*

5347. Houston, C. E., Seismic paths, assuming a parabolic increase of velocity with depth: Geophysics, vol. 4, No. 4, pp. 242–246, Menasha, Wis., 1939.

This paper discusses the paths of seismic waves, assuming that the velocity increases parabolically with depth. A graph of the reflection time-distance curves, in dimensionless coordinates, is included.—*Author's abstract.*

5348. Kanai, Kiyoshi, Theory of the aseismic properties of the brace strut (Sudikai) in a Japanese-style building, part 1: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 233–252, 1939.

The dynamical theory of the aseismic properties of complex brace struts is ascertained by mathematical investigation. Even where no moment of force is at the panel points, the addition of brace struts is just as effective on the aseismic properties of the structure as if beams of infinite stiffness were added to that structure. Although in a braceless structure the vibrational frequency does not change much with increase in the number of spans, in a braced structure, on the other hand, the frequency is fairly increased with increase in the number of spans, so that the aseismic properties are more pronounced in multispans. In a two-storied structure, aseismic properties of brace struts are also pronounced. But if brace struts were added to only one of the storeys, the condition of the over-stiff struts would be rather equivalent to that of a single-storied braceless structure. The author is now examining a special two-storied structure, in which the floor is without stiffness, which exactly corresponds to a brace strut whose lower end is hinged to the intermediate point of a column of a single-storied structure, the result of which will be published in the near future.—*Author's summary.*

5349. Martin, Henno, Empfindlichkeit und Frequenzcharakteristiken eines neuen elektrodynamischen Erschütterungsmessers [Sensitiveness and frequency characteristics of a new electrodynamic seismometer]: Physikal. Zeitschr., vol. 40, No. 18, pp. 577–582, Leipzig, 1939.

After a brief mathematical discussion of the theory of a new (horizontal) seismometer developed by the author, a description is given of two seismometers, one with a mass of 0.5 kg. to 1.0 kg. and another with a mass of 20 to 30 g. Their characteristics of frequency and their sensitivities are illustrated. Finally, an electrodynamic seismometer provided with an oil-damping device that is suitable for seismic stations is demonstrated. Conclusions on the practical application of the new instrument are as follows: (1) Suitable selection of the constants of the instrument makes it possible to attain frequency characteristics within large limits; (2) two galvanometers may be inserted in the same circuit; (3) the seismometer may be provided with two coils; and (4) the double recording of the same quake with different elements of oscillation is an advantage.

It would be easy to provide existing station seismometers with the new arrangement of a coil swinging within a split-ring magnet (Rings-

spaltmagnet), and it would be possible to obtain in this way a galvanometric registration in addition to a smoked-paper registration. Such seismometers may be very convenient for the investigation of oscillations caused by traffic, as well as for seismic surveys, as they are always ready for measurements without amplifiers. Their small cost makes it possible to provide many stations with the same kind of instrument.—*W. A.*

5350. Martin, Henno, Systematik der Einschwingvorgänge [Systematics of onset phenomena]: Veröffentl. Reichsanst. Erdbebenforsch., part 1, No. 34, pp. 7–24, Jena, 1938.

This is the first part of "Systematics of onset phenomena," in which the following are discussed: (1) An oscillating system is put in motion by means of an exciting force (galvanometer, oscillograph), and (2) a heavy mass remains as much as possible at rest (seismograph). In both, the differential equation of the process of oscillation is derived, and the theory of the onset phenomenon is developed. A discussion of the experimental investigation of curves resulting from the theory follows. The author describes a device that records the onset and the decoy curves and gives several curves obtained by this device.—*Päsler's abstract in Zeitschr. Geophysik, vol. 15, No. 5/6, 1939, translated by W. A.*

5351. Martin, Henno, Zur Frage Schwingweg-Geschwindigkeits-oder Beschleunigungsmesser [On the question of the vibration-path indicator, velocity meter, and accelerometer]: Zeitschr. Geophysik, vol. 15, No. 5/6, pp. 260–267, Braunschweig, 1939.

Several examples show what errors are to be considered in nonsinusoidal movements of the ground when values of velocity and acceleration are calculated from the curve of an indicator of the paths of vibration, or when it is desired to obtain values of the paths of vibration and of velocity from the recordings of an accelerometer.—*Author's abstract, translated by W. A.*

5352. Menzel, H., Dispersion von seismischen Oberflächenwellen [Dispersion of seismic surface waves]: Gerlands Beitr. Geophysik, vol. 54, No. 4, pp. 348–369, Leipzig, 1939.

A dispersion curve for transverse waves was derived from the records of the Wiechert seismographs at Copenhagen and Gross-Raum. Mathematical treatment of the dispersion equation for a two-layered medium shows that the observed dispersion curve can be brought into agreement with the theoretical by interpreting the wave velocities as group velocities.—*Author's abstract.*

5353. Murphy, F. M. G., Cope, S. T., and Jones, J. H., A mobile seismic recording unit; Philos. Mag. and Jour. Sci., vol. 28, No. 188, pp. 370–380, London, 1939.

After a brief description of the principles of the seismic-reflection method of surveying, details are given concerning requirements of the apparatus (seismic detectors, filters, amplifiers, camera and recording oscillographs, auxiliary circuits, and supplies), its assembly, and field tests. The unit described has been used during a period of 2 years in oil-exploration surveys in eastern England. A few typical seismograms are reproduced to illustrate some of the particular features of the unit.

The unit has been used also in an experimental seismic-refraction survey in Lincolnshire, and excellent seismograms have been obtained at distances of 5 miles with a charge of 200 pounds of gelignite.—*W. A.*

5354. Nelson, J. H., and McComb, H. E., New instruments and equipment at cooperative seismograph stations of the United States Coast and Geodetic Survey; Seismol. Soc. America Bull., vol. 29, No. 4, pp. 549–557, Berkeley, Calif., 1939.

This paper reports on the establishment of a new seismograph station at Lincoln, Nebr., and describes the new seismographic equipment at Chicago, Ill., Salt Lake City, Utah, and Bozeman, Mont.—*W. A.*

5355. Nishimura, Genrokuro, and Takayama, Takeo, Stationary vibrations due to an obliquely incident transversal wave of harmonic type of the surface layer of an elastic earth's crust (1st paper): Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 319–350, 1939.

In a previous paper (see Geophys. Abstracts 92, No. 4168) the authors studied the forced oscillation of the surface layer of an elastic earth when an infinite train of harmonic dilatational waves is obliquely incident on its bottom surface and obtained several theoretical facts helpful in studying the seismic oscillation of a surface layer of the earth's crust, especially its resonance conditions. The present paper gives results of the authors' attempts to study the theory of the properties of the stationary oscillation of the surface layer excited by a distortional wave that is obliquely incident on the bottom surface of that layer.—*W. A.*

5356. Nishimura, Genrokuro, and Takayama, Takeo, The vibration due to an obliquely incident longitudinal wave of harmonic type of a surface stratum adhering closely to the subjacent medium, and the properties of its resonance conditions (2d paper): Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 253–307, 1939.

In the present paper, which is the continuation of a previous one (see Geophys. Abstracts 92, No. 4168), the authors deal with vibrations of the surface layer for various incidence angles θ (90°, 80°, 70°, 45°, 30°, 20°, 15°, 10°, 5°, 0°) of a primary dilatational wave of harmonic type, and they study the resonance properties of that layer. The conditions of elasticity that are dealt with in the present paper are: (1) The surface layer adheres closely to the subjacent medium at its bottom surface, its top surface being free; (2) both media—the surface layer and the subjacent medium—satisfy Cauchy's condition; (3) densities of the materials are the same for both media; and (4) the ratio of the rigidity of the surface layer to that of the subjacent medium is 1:10. Diagrams and tables are given.—*W. A.*

5357. Nishimura, Genrokuro, and Takayama, Takeo, Vibrations due to obliquely incident longitudinal waves of shock type of a surface layer of an elastic earth's crust: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 308–318, 1939.

The present paper is the continuation of a previous one (see Geophys. Abstracts 87, No. 3343), in which general expressions were obtained for free-wave motion in a surface layer of an elastic earth when a dilatational wave of any wave form, such as $F(x, y)$, where x and y are the rectangular coordinates, is obliquely incident on the bottom surface

of the surface layer. In the present paper the following are shown graphically: (1) Time variations in the movements of particles on the top and bottom surfaces of the surface layer when a dilatational wave of shock type is obliquely incident on its bottom surface, the angle of incidence of that wave being assumed as 45°; and (2) the loci of vibrations of the same particles on the same two positions in the surface layer.

General expressions are discussed mathematically, and a numerical example is given.—*W. A.*

5358. Popescu-Cernăuti, I., Sur les épicentres des tremblements de terre ressentis en Dobrudja [On the epicenters of the earthquakes felt in Dobrudja]: Inst. sci. Roum. Comptes rendus, vol. 3, No. 2, pp. 166–171, 1939.

Regions affected by three earthquakes in Dobrudja in 1891, 1901, and 1908, are marked on maps and are briefly discussed in connection with geologic conditions.—*Schmerwitz's abstract in Zeitschr. Geophysik, vol. 15, No. 5/6, 1939, translated by W. A.*

5359. Ramanathan, K. R., and Mukherji, S. M., A seismological study of the Baluchistan (Quetta) earthquake of May 31, 1935: Records of the Geological Survey of India, vol. 73, part 4, pp. 483–513, Calcutta, 1938.

The times of arrival of the *P* waves from the Quetta earthquake at different observatories throughout the world have been analysed, and the position of the epicentre has been determined to be 29.6° N., 66.5° E., and the epicentral time to be $30^d21^h32^m58.5^s$ G.M.T. Among the prominent features of the seismograms were the gradual increase of amplitude interrupted by larger and larger impulses and the large amplitudes of the long waves compared with those of the preliminary, suggesting block movement and a shallow depth of focus. An analysis of the *S–P* residuals using Jeffreys and Bullen's normal tables showed that its mean value was about +3 sec., suggesting a depth of focus definitely less than the normal depth (10 km.) and possibly also a complex process at origin. The energy of the earthquake is estimated to be about 10^{21} e. The phases of the aftershocks as noted in the Agra seismograms have also been tabulated.—*Authors' abstract.*

5360. Rybner, Jörgen, Extensions and corrections to "The determination of the instrumental constants of the Galitzin seismograph in presence of reaction": Geod. Inst., Meddelelse No. 11, pp. 303–313, Copenhagen, 1939.

A numerical error in the above-mentioned paper (see Geophys. Abstracts 93, No. 4339) is corrected. The formulas for the determination of the instrumental constants are extended to include terms in δ^4, so that a suitable accuracy can be obtained even if the coupling coefficient is comparatively large. Finally a new method is described, intended to replace method one in case the galvanometer has no extra winding through which an impulse can be applied.—*Author's abstract.*

5361. Schmerwitz, Gerhard, Berechnung der Dicke der Erdkruste und einiger physikalischer Eigenschaften aus mitteleuropäischen Nahbebenaufzeichnungen [Calculation of the thickness of the earth's crust and of some physical properties of near-earthquake records made in central Europe]: Zeitschr. Geophysik, vol. 15, No. 5/6, pp. 268–303, Braunschweig, 1939.

Thorough examination of the hypothesis of the existence of a two-layered earth's crust is considered necessary, as well as the interpre-

tation of P^x waves, especially as the hypothetical P^x-layer of seismics is used in physical geodesy for calculations of isostatic adjustments and of the figure of the earth. Traveltimes are derived for one and two layers and are applied in three examples of near-earthquakes. A detailed numerical calculation shows that the P^x-layer cannot exist in the form hitherto supposed. Similar to these three examples, six other traveltime adjustments of direct waves can be explained only for an earth's crust that is 50 km. thick, as originally assumed by Mohorovičić. A new explanation is given for the P^x-onsets, occurring only occasionally. They are caused by limited horizontally extending deposits, which are irregularly distributed within the p-layer of the seismically defined earth's crust and which consist of material of high velocity. The advantage and value of the adjustment is proved by comparison with results secured otherwise.—*Author's abstract, translated by W. A.*

5362. Schmerwitz, Gerhard, Messergebnisse mitteleuropäischer Erdbebenstationen und ihre physikalische Auswertung [Results of measurements made at earthquake stations in central Europe and their physical evaluation]: Physikal. Zeitschr., vol. 40, No. 19, pp. 611–615, Leipzig, 1939.

Knowledge of the interior of the earth and of its crust depends to a great extent on the possibility of applying modern physical methods of measurement. The writer examines these methods from the following two viewpoints: (1) That of the stratification of the earth's crust, and (2) that of conditions by which the elastic tension within this crust is produced.

He discusses these two viewpoints, which are based on results of observations obtained from many seismic measurements made on the difference in the modulus of elasticity of various layers, as manifested by the propagation of elastic waves through them.—*W. A.*

5363. Sezawa, Katsutada, and Kanai, Kiyoshi, Microseisms caused by transmission of atmospheric disturbances, part 1: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 190–207, 1939.

Mathematical investigations are made on (1) the causes of periodicity of microseismic oscillations, (2) the nature of atmospheric waves, (3) the equations of motion, (4) the solution for a disturbance originating in the layer, (5) the solution for a disturbance originating in the upper atmosphere, (6) the calculation of amplitudes of pressure waves generated from the original disturbance of the same intensity, (7) the amplitude of waves is maximum if their length is twice the thickness of the layer, (8) the microbarometric oscillations of longer and shorter periods, (9) the possible existence of microseisms transmitted through a layer, outside of or within which is a steady air current, and (10) the probability of elastic surface waves and that of microbarometric waves causing microseismic oscillation. Remarks conclude the article.—*W. A.*

5364. Sezawa, Katsutada, and Kanai, Kiyoshi, On the packet velocity of dispersive elastic waves of irregular form: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 208–232, 1939.

From a few mathematical examples it is ascertained that, even should the wave form be irregular, the energy of waves is transmitted with a

special group velocity. If the sinusoidal components composing the irregular waves have different group velocities, it is likely that the centroid of the wave energy, that is, the centroid of the energy of the wave packet, will be transmitted with the group velocity that corresponds to waves of infinite length involved in the irregular waves. If the group velocity differs according to the difference in length of the sinusoidal waves, even should the disturbance be of sine form of finite extent, the centroid of the same disturbance is still transmitted with group velocity of sinusoidal waves of infinite length. It does not matter whether or not the group velocity of the longest wave is higher than that of any shorter wave. It is likely that in the irregular wave form, the velocity of change in the form of phase waves concerns the velocity of phase waves of infinite length. Inasmuch as the examples discussed are likely to correspond to those of relatively long and relatively short waves, both for Rayleigh and Love waves, the results in the present paper can be adapted to a rather wide range of dispersion conditions of waves of irregular form.—*Authors' summary, condensed by W. A.*

5365. Sezawa, Katsutada, and Kanai, Kiyoshi, The requisite condition for Rayleigh waves for transmission through an inner stratum of the earth: Tokyo Imp. Univ., Earthquake Research Inst., Bull., vol. 17, No. 2, pp. 179–189, 1939.

In a previous paper (Bull. Earthquake Research Inst., vol. 16, pp. 85–91, 1928) the authors showed that it is possible for Rayleigh-type waves to be transmitted through an inner stratum of the earth at velocities ranging from those of distortional waves in the stratum to those of the same waves in outer media. The condition implies that the velocity of bodily waves in the stratum should invariably be less than in outer media. Until recently the idea was maintained that if the condition in question were reversed, the transmission would become very complex. However, recent investigations on the anomalous dispersion of elastic surface waves suggest that even with the condition reversed, it is probable that transmission of waves occurs in the manner stated. In this article the authors give a mathematical discussion of (1) the important parts of the solution of the problem, and the velocity equation, (2) the condition for the existence of the waves, and (3) the nature of the wave dispersion in various examples. Concluding remarks are offered.—*W. A.*

5366. Shepard, E. R., The seismic method of exploration applied to construction projects: Military Engineer, vol. 31, No. 179, pp. 370–377, Washington, D. C., 1939.

This paper outlines the usefulness of the seismograph as applied to problems of shallow exploration and examines some of the more important factors involved in such problems. A discussion is given of (1) the theory of seismic exploration (apparatus, procedure, determination of velocity in rock, slope of interface, relation of shooting distance to depth of exploration), (2) the characteristics of velocity in different materials, with a table showing the speed of propagation of seismic waves in subsurface materials, and (3) the application of the seismic method to types of subsurface formation, as illustrated by a few typical graphs prepared from actual operations in the field.—*W. A.*

5367. Simon, Béla, Geologic map adapted to the purposes of earthquake research [in Hungarian]: Földtani Közlöny, vol. 68, No. 10–11, pp. 229–237, Budapest, 1939.

The writer discusses some viewpoints, on the basis of which, according to him, a geologic map of Hungary adapted to purposes of earthquake research should be prepared. This map should contain the specific types of rocks that form the subsoil, according to their location and extension. Rocks practically identical with regard to their elastic properties and weathering conditions may then be tabulated.—*A. Vendl's German abstract in Neues Jahrb. Mineralogie, Geologie u. Paläontologie, No. 4, 1939, translated by W. A.*

5368. Slichter, L. B., Seismic studies of crustal structure in New England by means of quarry blasts [abstract]: Geol. Soc. America Bull., vol. 50, No. 12, part 2, p. 1934, Washington, D. C., December 1, 1939.

During the past year observations of five large quarry blasts have been made at about 30 different locations in New England by means of a group of 12 three-component portable seismographs. Instruments were spaced at suitably chosen intervals at distances between 1,500 feet and 350 km. from the blasts. The orientation of the instruments was also adjusted to the direction of the source. To insure a precise time-scale radio, second signals were simultaneously recorded on all records. The records may be read to a precision of 0.05 second or less, if desired, which renders the identification of phases unusually certain. In the Connecticut Valley, after a superficial layer of low-velocity sediments was penetrated (near Meriden a local thickness of about 2 km. and a velocity of the compressional wave of 4.33 km./sec. is indicated), a layer of uniform wave velocity 6.32 km./sec. persists until a depth of 23.5 km., when the velocity increases to 7.82 km./sec. Comparisons between results obtained at different localities will be shown. The work is being continued, and most recent data will be presented.

Slotnick, M. M., Gravimetric and seismic methods in exploration geophysics. *See* Geophys. Abstract 5308.

5369. Szalkay, F., Die mikroseismische Unruhe in Budapest [Microseismic disturbance in Budapest]: Földtani Közlöny, vol. 68, No. 10–11, pp. 238–246, Budapest, 1939.

Waves of disturbance as recorded in the stations near the North Sea are mostly of great irregularity, whereas the records of Budapest always show successions of regular wave trains. A wave train consists of 5 to 20 sinusoidal waves. At the beginning of the wave train the amplitude usually increases, and after having reached the maximum value it decreases. Wave trains follow one another at an average of 1 minute. The regular disturbance in Budapest is not so great as to interfere with the evaluation of the records. This is especially valid for surface waves. But it happens sometimes that the measuring of the start of the *P* and *S* waves as well as of their amplitudes is impossible, owing to the disturbance.—*A. Vendl's German abstract in Neues Jahrb. Mineralogie, Geologie u. Paläontologie, No. 4, 1939, translated by W. A.*

5370. Tams, Ernst, Zur Frage der regionalen Verkoppelung von Erdbeben, part 2 [On the question of the regional coupling of earthquakes]: Zeitschr. Geophysik, vol. 15, No. 5/6, pp. 249–260, Braunschweig, 1939.

The author continues his investigation (see Geophys. Abstracts 97, No. 4937), which is based on data obtained from earthquakes that oc-

curred in Bosnia and Herzegovina (1896–1912) and in Italy (1700–1929). He constructs a frequency curve of repetition from data selected from this material and examines it. He applies Poisson's theoretical formula of probability and derives and discusses the mean variation square. The conception of the existence of regional coupling of earthquakes is confirmed by the results of investigation. He mentions some characteristic Italian earthquakes that prove directly the opinion expressed by the author.—*Author's abstract, translated by W. A.*

5371. Trajić, G. N., Analysis of earthquakes from their epicentral distances and depths [in Serbian]: Annales Géol. Péninsule Balk., vol. 15, pp. 415–432, Belgrade, 1938.

This is a study of seismic waves, especially of those reflected and refracted from the surface of the earth's core, which is based on the interpretation and comparison of 10 long-distance and mean-distance earthquakes. Data concerning these earthquakes are given in a table. The epicentral distances are calculated according to the well-known formula from spherical trigonometry. The oblateness of the earth is not taken into consideration. The earth is assumed to be a sphere with a radius of 6,370 km. The results of investigation are verified by several methods (impetus, stereographic projection, least squares, and displacement of the epicenter). In order to be able to draw conclusions by comparison, the writer has divided earthquakes into three groups: (1) Those with phases that coincide with the phases of the odochrone, (2) those with phases all of which show an increase with regard to the hours of the odochrone, and (3) those with phases all of which show a retardation with regard to the hours of the odochrone. The following phases of earthquake waves are studied: P, $P^1(PKP)$, $PR_1(PP)$, $PR_2(PPP)$, $ScPcS(SKS)$, $ScPcPcS(SKKS)$, PS, $PR_1S(PPS)$, $PR_2S(PPPS)$, $PcPcS(PKS)$, $SR_1(SS)$, $SR_2(SSS)$, pP^1, sP^1, sP_2^1, $pPR_1(pPP)$. A brief designation of all the waves is given.—*W. A.*

5372. Trommsdorff, Fro., Untersuchungen über die natürliche Bodenunruhe (Mikroseismik) mit transportablen Dreikomponentenstationen [Investigations of natural disturbances of the ground (microseismic) by means of transportable three-component stations]: Zeitschr. Geophysik, vol. 15, No. 5/6, pp. 304–320, Braunschweig, 1939.

Propagation of the natural disturbance of the ground is investigated by means of transportable two- and three-component stations. A portable vertical apparatus with adjustable period (1 to 12 sec.) is described. The apparent velocities and original directions vary periodically depending on the period of oscillations. Velocities determined from the maximum of oscillation were of the order of 3,000 m./sec. The corresponding original directions may be brought into agreement with the position of cyclones. An attempt is made to explain the disturbance of the ground by the superposition of two partial waves of different frequencies and directions.—*Author's abstract, translated by W. A.*

5373. Wegener, Kurt, Die Laufgeschwindigkeit c der Longitudinalwellen als Funktion der Temperatur [Velocity of propagation c of the longitudinal waves as a function of temperature]: Zeitschr. Geophysik, vol. 15, No. 7/8, pp. 390–393, Braunschweig, 1939.

The importance of changes in temperature in connection with the velocity of propagation of seismic waves is shown by a few examples.—*W. A.*

4. ELECTRICAL METHODS

5374. Blondeau, E. E., Shallow resistivity survey at South Elton, La.: Geophysics, vol. 4, No. 4, pp. 271–278, Menasha, Wis., 1939.

A direct-current resistivity survey covering about one and one-half townships adjacent to the South Elton oil field is described. The contour map, based on data taken 100′ from a current electrode, shows many near-surface anomalies; while that based on data taken 1,000′ from a current electrode is comparatively uniform. Conclusions reached were: First, that Eltran and direct-current data show good qualitative agreement; second, that the large observed variations in near-surface resistivity can hardly be attributed to mineralization emanating upward over structure; and third, that the number of anomalies found is so great that their direct association with deep structure is highly improbable.—*Author's abstract.*

5375. Deussen, Alexander, and Owen, K. D., Correlation of surface and subsurface formations in two typical sections of the Gulf coast of Texas: Am. Assoc. Petroleum Geologists Bull., vol. 23, No. 11, pp. 1603–1634, Tulsa, Okla., 1939.

The writers offer two typical sections of the Texas Gulf coast, one from Fayette County to Matagorda County, and another from McMullen County to Nueces County, based on the electrical logs of wells drilled in the line of the sections. Correlation from well to well is based on the electrical characters of the several formations, in addition to their foraminiferal content. The several formations are traced through in the respective sections from the deep underground to the surface. Attention is called to the presence of the marine-shale Oligocene wedge in the subsurface not represented in the surface section. Attention is likewise called to the inaccurate correlation of the so-called subsurface Frio with surface Frio formation. Suggestion is made that the four stratigraphic units disclosed by the subsurface section, not present in the surface section, be properly named.—*Authors' abstract.*

5376. Fritsch, Volker, Radio propagation methods in applied geophysics: Archiv für technisches Messen (ATM), No. 96, V65–14, Munich, June 1939.

Near a radio transmitter the variation of field strength over the ground depends on the underlying geological structure, hidden watercourses, ore inclusions, etc. A brief account of the methods used to measure such field variations is given; and examples of the types of field-strength curves which results from various underground formations are shown diagrammatically.—*J. P. A., Sci. Abstracts, vol. 42, No. 501, 1939.*

5377. Fritsch, Volker, and Wiechowski, W., Beitrag zu den Grundzügen der Funkmutung nach dem sogenannten Antennenersatzkapazitätsverfahren [Contribution to the fundamentals of radio prospecting according to the so-called antenna compensation-capacity method]: Hochfrequenztechnik u. Elektroakustik, vol. 53, No. 4, pp. 129–134, Brünn, 1939.

(1) Fundamental problems for linear antennae, (2) Calculation of equivalent duplex conductor, (3) Method of measurement, (4) Altitude method, (5) Base-line method, and (6) Method of *C*-constants. The altitude method is applied for detailed investigation, the other two methods are for investigation of larger areas.—*Riewe's abstract in Zeitschr. Geophysik, vol. 15, No. 5/6, 1939, translated by W. A.*

5378. Hawthorn, D. G., and Owen, J. E., Mechanical practicability of electrical logging while drilling: Petroleum Engineer, vol. 11, No. 4, pp. 71–78, Dallas, Tex., 1940.

The system discussed in this article is an advanced application of electrical logging. Special equipment necessary for giving a continuous record at the well head while drilling is in progress is described. The results obtained on six wells demonstrate the feasibility of the new system. Among the chief advantages of continuous electrical logging are: (1) It is an invaluable aid in conducting an intelligent coring program, (2) contact points and breaks in the formation can be instantly detected as the bit drills by, (3) data that indicate the nature and characteristics of the formation being drilled are continuously and instantly available for subsurface correlation while drilling is in progress.—*W. A.*

5379. Ivanov, A. G., Effect of electrification of earth layers by elastic waves passing through them: Acad. sci. U. R. S. S., Comptes rendus (Doklady), vol. 24, No. 1, pp. 42–45, Moscow, 1939.

The application of the so-called seismo-electric effect for recording oscillations is well known. American geophysicists (Blau, Statham, Thompson) believe that this effect is displayed within rocks, particularly in the immediate vicinity of the electrodes. Other investigators (Thyssen, Hummel, Rülcke) assign this effect to the electrochemical process that takes place on the surface of electrodes immersed in an electrolytic solution.

From his experiments made in 1938, the author of this article established the existence of a hitherto unknown effect of electrification of rocks when elastic oscillations were passed through them. This effect was different from the above-mentioned seismo-electric effect. Experiments that help to prove this new effect are described. It is concluded that data obtained from the new effect may offer definite advantages for studying physical properties of rocks if it is compared with existing methods.—*W. A.*

Kelly, S. F., Geophysics through ice and snow. *See* Geophys. Abstract 5324.

5380. Klipsch, P. W., Recent developments in eltran prospecting: Geophysics, vol. 4, No. 4, pp. 283–291, Menasha, Wis., 1939.

Early difficulties encountered relative to measuring the wave form of the detected potential by means of a predistorted opposing wave have been eliminated by introducing several novelties. These comprise a new mixing circuit, novel means for synchronizing the opposing wave with the detected wave, and simplified predistorting networks. A calibration scheme is outlined to maintain the detection apparatus at a constant level of performance.

A simplified method of measuring the detected wave form obviating the synthetic opposing wave, useful in certain areas, is shown. Essentially it comprises subjecting the detected wave to the further distorting action of a simple circuit, the adjustment of which produces a standard wave shape consisting of straight lines in the oscilloscope. The adjustment of this circuit necessary to bring the wave shape to this standard value constitutes the measure of the time constant of the detected wave.—*Author's abstract.*

5381. Leonardon, E. G., Electrical logging: Finding and producing oil, American Petroleum Institute, 1st edition, pp. 53–54, Dallas, Tex., 1939.

A brief description is given of the process of electrical logging that has been introduced by Conrad and Marcel Schlumberger since 1929. A section of a Schlumberger log illustrates the interpretation of electrical logging.—*W. A.*

5382. Mills, Brad, Simultaneous and continuous electric logging and drilling achieved: Oil Weekly, vol. 96, No. 4, pp. 16–20, Houston, Tex., January 1, 1940.

The writer describes the method of continuous electric logging of formations while regular oil-field drilling operations are conducted simultaneously. The bit is used as an electrode. The circuit consists of a battery connected with a meter, which in turn is connected with leads running to the derrick. The main lead runs up the standpipe, around the rotary hose, to a brush box containing an ordinary collector ring and a set of brushes. The circuit is then taken past the kelly by a special conductor. Thence, it leads down the drill pipe through special connections to the drill-collar assembly, which consists of an insulated bakelite section above the bit, a testing switch, and a special steel drill collar to provide weight and rigidity. The earth potential and the impedance (resistance) are recorded on meters at the surface. The various implements for carrying the circuit to the bottom of the hole are illustrated.—*W. A.*

5383. Semenov, A. S., and Vladimirov, O. K., Method of sliding contacts [in Russian]: Razvedka Nedr, vol. 10, No. 9, pp. 24–27, Moscow, 1939.

The writers propose a method by which the electrical conductivity of rocks that are penetrated by boring can be examined continuously by means of a system of electrodes fixed to a special device that slides along the walls of the borehole. The method was applied (1) to determine the magnitude and depth of sulfide veins in boreholes, (2) to disclose small veins overlooked during the boring, and (3) to orient veins. In all three the application of the method was very successful. A detailed description of the apparatus is given. Diagrams obtained by the new method and by the usual method of electrical logging are shown for comparison.—*W. A.*

5384. Thompson, R. R., Electrical prospecting for oil: Finding and producing oil, American Petroleum Institute, 1st edition, p. 57, Dallas, Tex., 1939.

In electrical exploration for petroleum deposits, almost all methods in use involve the measurement of artificially produced electrical quantities as distinguished from the measurement of those produced naturally. These methods are concerned with measuring electric or magnetic fields produced at the surface of the earth by an electric current in an "energizing circuit" and with subsequently interpreting the measurements in terms of electrical properties of the earth. This, in turn, may give useful information about the geology of the subsurface.

A typical map shows the location of faults and subsurface-structure contours, which were determined by an electrical geophysical survey.—*W. A.*

5385. Wantland, Dart, Geophysical survey answers some questions: Mining Jour., vol. 23, No. 10, pp. 2–5, 14, Phoenix, Ariz., 1939.

A description is given of a geophysical investigation involving a typical problem that confronts many mine operators. In general terms the problem is: If it is known that two shafts are about 400 feet apart, and if it is presumed that they are on one main vein that is well within the boundaries of a property, discover if possible (1) any intersecting veins, and (2) any ore bodies beyond either of the two shafts. The geophysical survey on the property of the Gold Center Mining & Milling Co., of Idaho Springs, Colo., illustrates such a problem and what was accomplished in connection with a characteristic vein of the Idaho Springs-Central City district. The equipotential-line method was used. Recommendations were made for further mining operations based upon the findings. The article is illustrated by (1) a topographic and geologic map of the area, (2) a map showing the location of the geophysical survey, (3) a diagram of the equipotential-line survey, and (4) a photograph showing the equipment of the operator.—*W. A.*

5386. White, G. E., A note on the relation of suddenly applied direct-current earth transients to pulse-response transients: Geophysics, vol. 4, No. 4, pp. 279–282, Menasha, Wis., 1939.

From some work by Carson, the relation between the earth response to a Heaviside function voltage and the response to an impulse is pointed out. A method of obtaining all other electrical measurements from the impulse response is indicated. It is suggested that a new experimental method might yield more accurate measurements of the electrical earth responses than can be had from suddenly applied direct-current transients, or any of the steady-state measurements.—*Author's abstract.*

5. RADIOACTIVE METHODS

5387. Baudisch, Oscar, and Brewer, A. K., Geochemistry of the Saratoga basin—The radioactivity of Saratoga Spring waters and rocks: Am. Jour. Sci., vol. 237, No. 11, pp. 811–817, New Haven, Conn., 1939.

In 1914, R. B. Moore and C. F. Whittemore tested the various waters and deposits at Saratoga Springs for radioactivity. The conventional emanation electroscope was used. Radon, but no thoron, was found in the waters and gases. The waters and deposits were also observed to contain radioactive salts. Due to excessive pumping, the water level at the time their measurements were made was very low compared to the present day. Saratoga Spring waters have now been reexamined for radioactivity. The method employed is entirely different from that used by Moore and Whittemore. In the present experiments the beta ray emission is measured by means of a special beta ray counter. The only radioactive elements detected in the deposits or dissolved salts are radium and potassium. The potassium is the same as ordinary potassium to within 10 percent. The concentration of dissolved radium is very nearly the same as that observed by Moore and Whittemore. This indicates that time and the hydrostatic level of the waters have produced only minor changes in the radioactivity.—*Authors' abstract.*

5388. Garrigue, Hubert, Mesures de radioactivité et de température dans la région du Lyngmarksbraeen (Groenland septentrional) [Measurements of radioactivity and of temperature in the region of Lyngmarksbraeen (northern Greenland)]: Acad. sci. Paris Comptes rendus, vol. 208, No. 1, pp. 45–47, 1939.

Lyngmarksbraeen is a glacier in the southern part of Disco Island, on the western coast of Greenland. The subsoil is basaltic rock. Measurements were made of the radioactivity of the air close to the ground under a layer of snow and at a depth of 2 m. on the glacier. The method of measurement is briefly described. One table shows the chief results of the measurements; another shows temperatures measured at the same points. From previous measurements (see Geophys. Abstracts 88 and 91, Nos. 3618 and 4052) in the Pyrenees and Vosges Mountains, and elsewhere in France, the content of radon in the air enclosed under a layer of snow often attained a value of about 10^{-9} Curie per liter. From measurements of ionization on the glacier and at various other places, under normal conditions of pressure and temperature, the radioactive radiation of terrestrial origin was very small, probably less than a fraction of 1 ion per cubic centimeter per second.—*W. A.*

5389. Kaiser, H. F., Portable radioactivity meter requiring no h. v. battery: Rev. Sci. Instruments, vol. 10, No. 7, pp. 218–219, Lancaster, Pa., 1939.

By using a simple valve-oscillator circuit for generating the necessary high potential for operating a Geiger-Müller tube, the use of a h. v. battery can be avoided. Other advantages of the arrangement are a simplified counting-rate meter, compactness, flexibility, and complete portability.—*F. C. C., Sci. Abstracts, vol. 42, No. 501, 1939.*

5390. Piggot, C. S., and Urry, W. D., The radium content of an ocean-bottom core: Washington Acad. Sci. Jour., vol. 29, No. 10, pp. 405–409, Menasha, Wis., 1939.

The development of the new ocean-bottom sampler has made available a number of cores, one of the objects of the apparatus being to probe below the ocean-bottom surface and to determine the radioactive relationship between the ocean troughs and the continents. One of the Atlantic cores is extremely uniform in composition both chemically and lithologically and was chosen as the most suitable core to examine preliminarily in order to ascertain, if possible, the radioactive-equilibrium relations before proceeding to the more complex cores exhibiting wider variations in composition. Determination of the radium content at various depths in the core shows: (*a*) No decrease in the radium content with depth; (*b*) a radium content corresponding approximately to that of the granites. The conclusions based on this exploratory investigation, which must be limited to this particular core, are: (1) That, with regard to the length of time here represented, the presence or absence of uranium has no bearing on the radium content; (2) that the ionium is probably present in an amount corresponding roughly to radioactive equilibrium with the radium; and (3) that in view of the widely different chemical properties of ionium (thorium) and radium, chemical deposition plays no role in the radioactivity of this particular core. This does not exclude the possibility that chemical deposition may be important in other instances.—***Authors' abstract.***

5391. Shankland, R. S., and Tindal, C. H., The efficiency of Geiger-Müller counters: Philos. Mag. vol. 28, No. 190, pp. 562–570, London, 1939.

Experiments were carried out to determine the influence of voltage and counting rate on the efficiency of the Geiger-Müller counter and to obtain further knowledge of the phenomena of the counter discharge. High voltage was supplied to the counter by a rectifier and voltage stabiliser circuit, and the counter discharges were amplified by three stages of resistance-capacity amplification. The impulses were fed into a scale of 16 circuit operating a Cenco impulse recorder. Curves are given showing the counter efficiency as a function of applied voltage for six counting rates ranging from 29 to 5×10^5 per minute. The efficiency for all counting rates drops to zero at a threshold of 1,175 v. For slow counting rates the efficiency reaches a value of 96 percent at about 1,300 v., above which there is little improvement. At high counting rates the efficiency increases steadily with the applied voltage, the curves being essentially straight lines with a slope inversely proportional to the counting rate and only showing saturation at very high overvoltages sufficient to make all pulses large enough to be amplified. The counter efficiency depends also on the constants R and C of the coupling circuit. The efficiency for either single or coincidence measurements will be considerably increased for high counting rates if a vacuum tube is used in place of the high resistance normally used to quench the counter discharge.—*A. W., Sci. Abstracts, vol. 42, No. 504, 1939.*

6. GEOTHERMAL METHODS

5392. Halbouty, M. T., Temperatures affecting crude-oil production: Oil Weekly, vol. 96, No. 3, pp. 15–19, Houston, Tex., 1939.

Part 1 of this report, published in the preceding issue of Oil Weekly, discusses temperatures that affect oil-well drilling. Part 2, presented in this issue, describes effects of temperature on crude-oil production and discusses the geothermal gradient in oil fields along the Gulf coast. A comprehensive study of the relations of geologic structure in oil-producing areas and their geothermal gradients was inaugurated in 1936 by the American Petroleum Institute, with C. E. Van Orstrand in charge.

Two cross sections are given: One, a section of the north side of the Humble salt dome, shows geologic and geothermal relations; the other, a section from north to south of the Grand Saline salt dome, shows the relation of the isogeothermal surfaces to the geologic structure of the south side of the dome. Examination of these two sections indicates that the circulation of ground waters in contact with the salt mass accounts for the decrease in temperature at intervals of depth along the flank and at a distance from the salt mass. The temperature-gradient lines have a close similarity to the dip of the surrounding formations that have been uplifted because of the intrusion of the salt mass.

A recent survey of measurements of maximum temperature made with regard to the producing formation in 75 oil fields in Texas is given in a table, which lists the productive formations, the sub-sea depth at which they are encountered, the average temperature, the geothermal gradient, and the type of structure.—*W. A.*

5393. Lowan, A. N., and King, Frederick, Note on the evaluation of the earth's temperature arising from radioactivity: Phys. Rev., vol. 54, No. 12, pp. 1109–1110, Lancaster, Pa., 1938.

Completing a previous article on the same subject (see Geophys. Abstracts 65, No. 2093), the authors represent in this article a change of temperature with depth in an infinite series and determine, to a depth of 1,500 miles, the error that is introduced by truncation of the series at 10, 15, 20, and 25 terms. The error increases with depth, but after 25 terms it remains less than 1° C. below the depth mentioned.—*H. Israël's abstract in Zeitschr. Geophysik, vol. 15, No. 5/6, 1939, translated by W. A.*

5394. Schmidt, E. R., The underground geothermal gradient in Budapest, on the left side of the Danube [in Hungarian]: Bányászati és Kohászati Lapok (Hungarian Min. Met. Jour.), vol. 71, pp. 221–222, Budapest, 1938.

Results are given for measurements of temperature in a borehole in Városliget at 16 different depths, down to 1,256 m. From the data of these measurements the average geothermal gradient was determined to be equal to 18 m. a degree centigrade. This agrees well with results of measurements in other deep boreholes of the Hungarian lowland.—*A. Vendl's German abstract in Neues Jahrb. Mineralogie, Geologie u. Paläontologie, No. 4, 1939, translated by W. A.*

5395. Tikhonov, A. N., On the thermal conditions in the deep borehole of the Skovorodino station, located over permanently frozen ground [in Russian]: Acad. sci. U. R. S. S. Bull., sér. Géog. Géophys., No. 1, pp. 35–52, Moscow, 1939.

Thermal conditions in a 28-m. borehole of the Skovorodino station were studied. Tables show the temperatures in this borehole for 10-day periods of observation from June 1931 to September 1937. The layers were from 10 to 28 m. deep.

The conclusion is drawn that thermal conditions of the borehole at Skovorodino, notwithstanding the most careful investigation, differ greatly from natural thermal conditions. The methods applied give, in general, indications of perturbing influences.—*W. A.*

5396. Van Orstrand, C. E., Observed temperatures in the earth's crust: Physics of the earth, vol. 7, Internal constitution of the earth, edited by Beno Gutenberg, ch. 6, pp. 125–151, McGraw-Hill Book Co., New York, 1939.

Our knowledge of the elevations of the isogeotherms in continental masses is very incomplete, for as a rule observations have been concentrated in oil fields and mining areas in which the geological conditions are highly abnormal. Observations lead us to expect, however, that lower temperatures, and probably very much lower temperatures, prevail in the large synclines surrounding the relatively small areas on which domes and anticlines are located; and, furthermore, because of the transfer of enormous quantities of hot water to the surface of the earth in metalliferous areas, it is to be expected that, with sufficient lapse of time since the waters reached the surface, the isogeotherms in these areas are depressed below their normal positions. In areas of sedimentation, the isogeotherms tend to reflect the depths to the basement rocks. In central Oklahoma, for example, the isogeotherms immediately above the basement rocks tend to parallel the basement floor. In general, then, the isogeotherms in sedimentary strata are usually elevated over domes and anticlines, whereas in the

adjacent synclines they are depressed and their distribution in the vertical is related to the depths to the basement rocks in the sense that the temperatures diminish as the depths to the basement rocks increase. In some areas, this relationship implies that high temperatures and positive gravity anomalies are related to each other.

In the course of geological ages, as a result of subsidence, elevation, and erosion, the gradients have oscillated back and forth through a wide range of values so that an average gradient is more nearly a measure of anomalies than lapse of time as determined by a uniformly cooling globe. Only a rough estimate can be made of an average gradient in the sedimentary areas of a continent; but in the United States the reciprocal of the average gradient is almost certainly greater than 60 feet per degree Fahrenheit (32.9 m. per degre centigrade) and possibly as large as 110 feet per degree Fahrenheit (60.4 m. per degree centigrade).

Undisturbed strata and age of rocks are prerequisites for greatly depressed isogeotherms, as exemplified by the sedimentary strata in the southern Appalachians and the Permian basin and, in areas of metalliferous deposits, by Grass Valley, northern Ontario, northern Michigan, and Witwatersrand.

Tables 18 to 21 show that a rate of about 50 feet per degree Fahrenheit (27.4 m. per degree centigrade) is found either at the surface or at a depth of 1 or 2 miles over a considerable portion of the sedimentary areas of the globe. In areas of old rocks, this high rate is probably the result of radioactivity and the combined effects of subsidence, elevation, and erosion. Not much is known about the trends of the depth-temperature curves in the low-temperature areas of metalliferous deposits; but tables 20 and 21 show that these trends are apparently maintained from 2,000 feet to the greatest depths at which temperatures are recorded. This result is consistent with the hypothesis that long intervals of time have elapsed since the lavas and hot waters were brought to the surface of the ground.—*Author's summary.*

7. UNCLASSIFIED METHODS, AND TOPICS RELATED TO GEOPHYSICS

5397. Becker, Ludwig, Die Bewegung der Kontinente und die Köppen-Wegenersche Polkurve [Movement of continents and the Köppen-Wegener pole-curve]: Zeitschr. Geophysik, vol. 15, No. 7/8, pp. 379–390, Braunschweig, 1939.

The author, using the simplest assumptions as a basis, shows that the Köppen-Wegener pole curve, as well as the movements of continents, result from centrifugal force. He discusses the pole-curve in detail by introducing resistance centers. From signs of the calculated moments of rotation it is possible to determine which continents were solidly connected with Europe and Africa. It is noteworthy that the calculated moments of release of single parts of the continents are in good agreement with Wegener. The author discusses his reasons for assuming that during the most recent epochs the continents did not move in hydrostatic equilibrium. The direction of the movement of continents and not the velocity of movement is treated in this article because data concerning the internal friction of sima (basic material) are not available.—*Author's abstract, translated by W. A.*

5398. Current, Eugene, Comparison of geophysics and other exploration: Mines Mag., vol. 29, No. 10, pp. 515–518, Denver, Colo., 1939.

This paper compares the costs of geophysical explorations with other forms of exploration, such as core drilling, trenching, and actual prospecting. Several examples illustrate the advantages in reducing expenses of exploration by the use of geophysical methods. The writer concludes that in every type of survey or exploration, the investor who uses geophysical methods can make substantial savings.—*W. A.*

5399. Fritsch, Volker, Die Aussichten der angewandten Geophysik in den Gebieten der ehmaligen Tschechoslowakei [Prospects of applied geophysics in regions of former Czechoslovakia]: Bohrtech. Zeitung, vol. 57, No. 4, pp. 63–65, Vienna, 1939.

The writer emphasizes the importance of applying geophysical methods for prospecting in regions of former Czechoslovakia, especially for investigating fissures that run through an area of well-known medicinal springs.—*W. A.*

5400. Gilchrist, Lachlan, Use of mathematics in the delineation of magnetic and electric anomalies [abstract]: Geol. Soc. America Bull., vol. 50, No. 12, part 2, pp. 1979–1980, Washington, D. C., December 1939.

There appear to be two classes of magnetic anomalies: (*a*) Those due to a difference in permeability of the earth's field in masses of homogeneous materials. In this case Z, the vertical component of the earth's field at a point in the meridian plane directly above a massive body of material of rectangular section, is given by the formula:

$$Z=\frac{CV_E}{R^3(x\sin\alpha-d\cos\alpha)^2}(R^2\cos\alpha(x+R\cos\alpha)+xd(x\sin\alpha+d\cos\alpha).$$

Where d is the distance from the origin to the top of the body; x is the coordinate perpendicular to d; $R^2=x^2+d^2$; α=angle of dip; C=constant. (*b*) Those in which a large but finite number of consequent poles are to be found in the material and for which there is a resultant equivalent magnet in the form of a rectangular parallelopiped. The formula representing this case is definite but somewhat cumbersome.

Two sets of difficulties are encountered in electric anomalies: (*a*) Since the equation of distribution of applied potential for a steady flow in an extensive homogeneous conductor implies continuity, the location of the boundaries of anomalies can only be approximate. The condition is further complicated by the necessary dual electrode character of the application of the potential. (*b*) Portions of the earth, through which there flows an electrical current, form a "leaky condenser" of finite capacity, and therefore reactance as well as ohmic resistance must be taken into account.

The difficulties associated with (*a*) may be met partly by the following lay-outs: (1) The central current-line electrode method on the surface of the ground, and (2) a central point of application of potential at depth which is a center of symmetry to two parallel current-line electrodes of the surface of the earth.

The formula for the specific resistance of a homogeneous medium is simple and for media containing anomalies in general very complex. The difficulties associated with (*b*) may be met partly by the use of a comparator of a reactance-free standard resistance. The results of

measurements by methods (1) and (2) will give a fair comparison of the resistivity of adjacent portions of underground heterogeneous material of not too great complexity.

5401. Karly, F., Die Bodenanalyse im Dienste der Erdölforschung [Soil analysis as an aid in prospecting for oil]: Bohrtech. Zeitung, vol. 57, No. 10, pp. 175–182, Vienna, 1939.

The writer outlines the theory of soil analysis as applied in prospecting for oil. He distinguishes the following phases of the work: (1) Taking samples in the field, (2) analyzing samples in the laboratory, (3) making mathematical calculations and drawing diagrams, and (4) making conclusions on the possibilities of the accumulations of oil and of the depth of these accumulations. He discusses and illustrates by diagrams the details of the work, especially the interpretations of the results of soil analysis.—*W. A.*

5402. Kelly, S. F., Geophysical exploration: Mining and Metallurgy, vol. 21, No. 397, pp. 41–44, New York, 1940.

A marked decrease in the number of seismic crews employed in geophysical exploration in the Gulf coast area was observed during 1939. The gravity meter is definitely replacing the torsion balance. In the last 2 years torsion-balance crews in the United States are reported to have decreased from 30 to 3, whereas gravity-meter crews have increased from 18 to 75. The increase in gravity meters has more than offset the decrease in torsion balances and the practical elimination of the pendulum. A new technique for investigating deep-lying formations, which has been developed by the Schlumberger organization, utilizes natural earth-currents to deduce patterns for the basement complex. Deep penetration by means of artificial currents passed through the ground is being attained in Blau's electrical-transient method of prospecting. Schlumberger's method of electrical well logging continues to be a highly useful tool. A drill has been developed that is equipped with electrodes to obtain an electrical log as drilling progresses. Gamma-ray logging is being used more widely. Magnetic methods continue to be employed in the reconnaissance survey of potential oil-producing areas. Soil analysis in petroleum prospecting continues to attract a good deal of attention; progress has been made in analyzing for solid hydrocarbons in the soil and in correlating such anomalies with gaseous hydrocarbon anomalies and with oil fields. Geothermal measurements are becoming increasingly recognized as a useful adjunct in exploration, particularly for petroleum. The increased governmental attention to geophysical methods of exploration is mentioned.—*W. A.*

5403. LeBaron, Milton, Determining presence of oil by estimation of hydrocarbon content of soil: Oil and Gas Jour., vol. 38, No. 35, pp. 43–47, Tulsa, Okla., 1940.

The writer presents various methods for determining necesary data. He also discusses allied phenomena and divides his discussion as follows: (1) Subsoil and surface-soil wax determinations, (2) methods of sampling, (3) total volatile hydrocarbon content, (4) separation of methane from higher constituents, and (5) absorption characteristics. He briefly outlines the salient points involved in a systematic research of this type.—*W. A.*

5404. Lorenz, H., Ermittlung des Zustandes des Erdinneren aus dem Energieinhalt [Determination of conditions in the interior of the earth from the energy content]: Zeitschr. Geophysik, vol. 15, No. 7/8, pp. 371–379, Braunschweig, 1939.

The gravity potential of layers of the earth and of the whole earth is calculated with reference to a mass unit. The following subjects are discussed: Small influence of different laws of density; contracting of a monatomic gas ball thrown from the sun, the energy content of this gas ball being lost by radiation; calculating the temperature of the center of the gas ball and of the earth depending on the condensation at that point; determining from this the gas constants and the atomic weight of the earth's nucleus and the gas ball; and conclusions concerning conditions of the sun.—*Author's abstract, translated by W. A.*

5405. Lundberg, Hans, and Grimes-Graeme, R., How geophysics aids the geologist: Mining and Metallurgy, vol. 20, No. 395, pp. 498–500, New York, 1939.

This is a general discussion concerning the scope of geophysics in connection with geologic exploration.—*W. A.*

5406. Martin, Henno, Das Aufsuchen nutzbarer Lagerstätten mit den neuen Geophysikalischen Verfahren [Prospecting for useful deposits by new geophysical methods]: Beitr. Geologie Thüringen, vol. 5, No. 3, pp. 203–208, Jena, 1939.

The writer discusses briefly and from a practical viewpoint the methods of applied geophysics as aids in discovering ore deposits, and he gives as examples several magnetic and gravimetric profiles measured by him. Maps indicate the results of measurements.—*Schmerwitz's abstract in Zeischr. Geophysik, vol. 15, No. 5/6, 1939, translated by W. A.*

5407. Rosaire, E. E., Geochemical prospecting [abstract]: Am. Assoc. Petroleum Geologists Bull., vol. 23, No. 12, p. 1877, Tulsa, Okla., 1939.

Geochemical prospecting can be divided into surface and subsurface geochemical prospecting. The former relies upon the analyses of soil samples collected along the surface of the earth at shallow depths and yields two-dimensional information and maps. Surface geochemical anomalies are associated with the presence and areal extent, but not the depth or the relief or favorable structure. Surface geochemical prospecting is further divided into topsoil and subsoil geochemical prospecting.

Subsurface geochemical prospecting relies upon the analyses of well cuttings and cores. It yields information in one dimension, along the vertical, and is commonly referred to as geochemical well logging. These various forms of geochemical prospecting are discussed and their salient features described. The geochemical data permit the correlation of various geological and geophysical phenomena which previously appeared unrelated and in addition have brought to light, for the first time, other phenomena of economic as well as theoretical interest.

5408. Scheffen, Walther, Wellenbewegungen der Erdkruste. Von älteren und neuren Versuchen zur Klärung der Gebirgsbildung [Wave motion of the earth's crust. Concerning old and new attempts to explain the formation of mountains]: Natuurk. tijdschr. Ned.-Indië, vol. 98, No. 6, pp. 294–303, Hamburg, 1938.

This is a presentation of the theory of undulation and of wave motion of the earth's surface within geologic periods of time by van Bemmelen, who represents the view that the formation and disappearance of continents and mountains are based on the vertical-wave motion of the earth's crust. These theories may serve as an adjustment between the Wegener drift theory and the Vening Meinesz undercurrent theory.—*Schmerwitz's abstract in Zeitschr. Geophys., vol. 15, No. 5/6, 1939, translated by W. A.*

5409. Templeton, J. C., Notes on the progress of geophysical prospecting: Petroleum Times, vol. 42, No. 1090, pp. 575–577, 583, London, 1939.

This is a detailed abstract from a recent address by the author to the Oil Industries Club in London. Many instrumental improvements, the development of new types, and improvements in field technique are discussed. Misapplication of geophysical methods, importance of selecting suitable methods, and geological training and experience are the items of the first part of this abstract. The second part deals with geophysical (gravitational, seismic, magnetic, and electrical) methods and their use and value in oil prospecting. It is concluded that prospecting for oil is now largely made by geophysical methods and that no oil company can afford to disregard them.—*W. A.*

5410. Todd, J. D., Mississippi looms as nation's major 1940 geophysical play: Oil Weekly, vol. 96, Nos. 6, 7, pp. 15–20, 20–25, Houston, Tex., 1940.

The rising interest in Mississippi after an accidental finding of oil in the Tinsley field, where drilling was carried on in search of gas, is now evidenced by an increase of geophysical work. As many as 63 crews, the largest number thus far, were working in the State the last week in December. The extent to which the activity has increased is shown both in a diagram representing the weekly trend of acreage purchased in the Mississippi-Alabama area and in a list of companies maintaining geophysical crews in this area. Types and locations of geophysical crews by counties in Mississippi are shown on a map.

The second part of the article includes a brief survey of current geophysical (magnetic, gravitational, and seismic) methods in use in Mississippi, with comments on the advantages and deficiencies of each method. Examples of recent geophysical work are included, and suggestions as to some of the geophysical problems of the State of Mississippi are given.—*W. A.*

8. GEOLOGY

5411. Easton, H. D., Mississippi oil discovery indicates vast new reserve: Oil Weekly, vol. 95, No. 9, pp. 13–14, Houston, Tex., 1939.

Much of the north two-thirds of Mississippi offers possibilities of production in the Upper Cretaceous in connection with local structures, as in the case near Yazoo City. In addition, there are Lower Cretaceous

and Permian possibilities under ordinary structural conditions. For prospecting in the underlying beds, there are stratigraphic traps consisting of steeply inclined edges around salt domes, shorelines, and truncated edges. It is very likely that Mississippi will yield many oil pools.—*Author's summary.*

A map showing regional structural features of the Mississippi Valley and a sketch showing stratigraphic traps, shorelines, truncated edges, and also possibilities of production in the Lower Cretaceous and big lime sections in central Mississippi, are added.—*W. A.*

5412. Hammer, E. J., Amelia oil field, Jefferson County, Tex.; Am. Assoc. Petroleum Geologists Bull., vol. 23, No. 11, pp. 1635–1665, Tulsa, Okla., 1939.

The Amelia oil field, 5 miles west of Beaumont, Jefferson County, Tex., was discovered in 1936. Geophysical evidence of this structure led to the discovery but was rather indefinite as to true structural conditions. No surface geological indications of structures are present. The subsurface conditions are those of an elliptical flat dome, probably underlain by a deeply buried salt core, and further complicated by a large normal fault striking almost parallel with the long axis of the dome. Amelia was one of the forerunners of a new type of coastal oil field, dominated by a big fault having production on the downthrown side while the upthrown side is dry. The producing sand, locally known as the "Langham sand," is a member of the middle Oligocene Frio formation, and is found productive of oil and gas from 6,694 to 6,785 feet although only the last 20 feet shows oil. The sand is a thick, blanket sand body literally surrounded by salt-water sands and has an extensive gas cap above the oil zone. The field has a proved area of 1,220 acres and had produced 2,644,642 barrels of oil to January 1, 1939, which gives an average of 2,168 barrels per acre. The present daily allowable under strict proration is 4,414 barrels from 115 producing wells. The Humble Oil & Refining Co. operates 112 wells, or 98 percent of the entire field, the only other operator being the Normandie Oil Corporation with 3 wells. Drilling development, on the basis of present known conditions, is entirely finished. The development of this field was interesting, not only from the disclosure of its peculiar geological features but also from the standpoint of unusually difficult well-completion problems. A new method of completing low gas-oil ratio wells employing squeeze cementing was introduced at Amelia and has since been used extensively in other fields throughout the Gulf coast region.—*Author's abstract.*

5413. Polutoff, N., Der geologische Bau des Volga-Emba Erdölgebiets und seine wirtschaftliche Bedeutung [Geologic structure of the Volga-Emba oil region and its economic importance]: Kali, vol. 33, Nos. 18, 19, 20, pp. 178–181, 189–192, 199–205, Halle, 1939.

A map of the Emba oil region shows the location of (1) oil fields in operation, (2) salt domes proved by gravimetrical surveys, (3) salt domes with external indications of oil, (4) known salt domes without external indications, (5) occurrences of gas, and (6) axes of synclines. The stratigraphy and tectonics of the region are described.

Two main types of oil accumulation are proved by borings: (1) Summit deposits (Scheitel lager), and (2) contact deposits (Kontakt

lager). Summit deposits occur in all the most important fields, where oil is found at the highest parts of the saddle. Contact (peripheral) deposits are formed by the breaking of salt masses through oil-conducting layers, which lean rectangularly against the steep wall of the salt dome. Recently, oil was found also in the so-called "fault-deposits" (Verwerfungs-lager), which are formed near the limits of the fold.

Places of oil deposits are enumerated, and oil reserves of the Emba district are tabulated. The total reserves are estimated according to the following four categories:

A (actual reserves), 30.6 million tons; *B* (evident reserves), 1.3 million tons; C_1 (probable reserves), 618.5 million tons; C_2 (possible reserves), 540 million tons; or a total of 1,190.4 million tons.

Oil production of the Emba district has been as follows (in 1,000 tons): 1911, 18; 1913, 117.6; 1917, 255.9; 1920, 30.3; 1931, 325.7; 1932, 247; 1933, 196.4; 1934, 241.6; and 1935, 274.4. Unfavorable transportation is the main difficulty in the economic development of the Emba district.—*W. A.*

9. NEW PUBLICATIONS

5414. Annual reviews of petroleum technology, vol. 4, covering 1938, 478 pp., Institute of Petroleum (formerly, Institution of Petroleum Technologists), London, W. C. 2, The Adelphi, 1939. Price, 11s.

The present volume is the fourth of a series of annual reviews that have appeared in book form. Each issue is a symposium reviewing the literature and noting the progress in various departments of petroleum technology during the preceding year.—*W. A.*

5415. Atlantisheft [Atlantis number]: Geologische Rundschau, vol. 30, Heft 1–4, 400 pp., figs., 6 pls., Stuttgart, Ferdinand Enke Verlag, 1939.

Following is a list of papers published in the Atlantis number: 1. Geophysical basis of the drift theory, pp. 3–5, by Kurt Wegener; 2. The source of the earth's energy, pp. 6–7, by Bailey Willis; 3. The problem of the continental drift, pp. 8–9, by W. A. J. M. van Waterschoot van der Gracht; 4. The permanence problem on the basis of the undation theory, pp. 10–20, by R. W. van Bemmelen; 5. Tectonics of the Atlantic basin, pp. 21–27, by Friedrich Nölke; 6. Tectonics of the Atlantic Ocean, pp. 28–51, by R. A. Sonder; 7. Source of volcanic energy and origin of sial, pp. 52–60, by A. Rittmann; 8. Upper Cretaceous alkali magmas along the Atlantic margin of Africa, pp. 61–63, by E. Krenkel; 9. Stratigraphic and faunal foundation for the geologic history of the south Atlantic region, pp. 64–79, by H. Gerth; 10. Episodes in the process of formation of the south Atlantic region, pp. 80–85, by E. Hennig; 11. Fossil land faunas and the Atlantis problem, pp. 86–88, by F. von Huene; 12. The Atlantis problem in the light of new data of Quarternary geology, pp. 89–94, by H. de Terra; 13. Paleontology and the drift hypothesis, pp. 95–99, by E. H. Egmont Kummerow; 14. Biogeographic research and the Atlantis question, pp. 100–111, by Otto Wittmann; 15. Geographic objections to Wegener's theory of continental drift, pp. 112–120, by Walter Behrmann; 16. The surveying of morphologic features of the sea bottom by means of echo-sounding, pp. 121–131, by A. Defant; 17

Major bottom features of the deep Atlantic basin, pp. 132–137, by Georg Wüst; 18. The origin of the Atlantic-Arctic Ocean, pp. 138–147, by A. L. du Toit; 19. The "Gondwanids" of Argentina, pp. 148–249, by H. Keidel; 20. Atlantis (Geology of the South Atlantic Ocean), pp. 250–283, by Georg Knetsch; 21. Remarks on the Atlantis convention in January 1939, p. 284, by A. Rittmann; 22. Tentative analysis of the greater movements of the earth's crust, pp. 285–296, by W. H. Bucher; 23. Remarks on the Atlantis convention, pp. 297–302, by W. A. J. M. van Waterschoot van der Gracht; 24. The problem of transoceanic continental connections, p. 303, by S. von Bubnoff; 25. Movements of the continents according to the Wegener theory, pp. 304–308, by Ludwig Becker; 26. Discussion of paper by Kirsch, by H. Reich; 27. Discussion, p. 310, by G. Kirsch; 28. Work of the German Iceland Expedition, 1938, pp. 312–314, by Oscar Niemczyk; 29. Cordilleran-Atlantic interrelations, pp. 315–342, by Hans Stille; 30. Trans-Atlantic fold connections, pp. 343–345, by H. Stille; 31. Eastern Mexico, the northwest end of the Mediterranean orogenic zone, pp. 346–351, by Walter Staub; 32. "Pingen" investigation and the Wegener theory, p. 352, by K. Lehmann; 33. Tectonics and lithogenesis, pp. 353–356, by Kurt Leuchs; 34. Iceland and the problem of continental shifting, pp. 357–358, by F. Bernauer; 35. On the paper by W. Bierther, "Investigations in northeast Greenland," p. 357, by H. G. Backlund; 36. Discussion of the general account of continental movement, by G. Knetsch, p. 359, by H. G. Backlund; 37. Terrestrial reptiles of the Karroo and Gondwana fauna, p. 359, by F. von Huene; 38. A criterion for corroborating or refuting the Wegener drift theory, p. 360, by F. von Huene; 39. Method in trans-Atlantic comparisons, p. 361, by Hans Cloos; 40. Tropical American Tertiary faunas and continental drift, pp. 362–372, by R. Rutsch; 41. Progress in making a submarine map, scale 1:5,000,000, pp. 373–381, by Theodor Stocks; 42. Paleogeography and Atlantic deep-sea sediments, p. 382, by W. Schott; 43. Oral discussion of the oceanographic papers, p. 383, by O. Pratje; and 44. Remarks on the Atlantis problem made in connection with the three oceanographic papers, pp. 384–386, by Carl Troll.

A list of authors mentioned in the Atlantis number is added.—*W. A.*

5416. Hager Dorsey, Fundamentals of the petroleum industry, 445 pp., 133 illus., New York, McGraw-Hill Book Co., 1939. Price, $3.50.

This book presents an introduction to all phases of the petroleum industry and is intended for those who want a check on effective methods of management and of engineering in producing and marketing oil. Contents: (1) Petroleum's contribution to national well-being, (2) history and romance of oil, (3) individual operators, oil companies, and oil-field workers, (4) world distribution of oil, (5) petroleum reserves, (6) acquiring oil lands and royalties on oil lands, (7) engineering in the search for oil, (8) drilling for oil, (9) drilling (continued), (10) production methods—well completion, (11) production methods—well spacing, (12) transportation and storage, (13) refining of oil, (14) marketing, (15) the business of oil, (16) oil securities, (17) the oil industry and legislation, and (18) future trends.—*W. A.*

5417. Hager, Dorsey, Practical oil geology, 5th revised ed., 466 pp., illus., New York, McGraw-Hill Book Co., 1939. Price, $4.

Descriptive and reference materials are combined to cover every phase of prospecting for oil and of exploiting oil fields in which geologic science may be applied. Chapter headings: (1) Petroleum—its origin and accumulation, (2) chemical composition of petroleum, (3) stratigraphy, (4) fossils and their uses, (5) structural geology, (6) prospecting and mapping, (7) selecting drill-hole sites, (8) factors in oil-well drilling, (9) factors in oil production, (10) water and its relationship to oil, (11) natural gas—natural gasoline, (12) oil shales, (13) geological field methods and instruments in use, (14) geophysics, and (15) what the geologist has done for the oil business.—*W. A.*

5418. Legget, R. F., Geology and engineering, 1st ed., 650 pp., 224 illus., New York, McGraw-Hill Book Co., 1939. Price, $4.50.

A foreword by Prof. P. G. H. Boswell of London states: "This book is the work of an engineer with the additional training of a geologist, and I am convinced that it is planned on the right lines because it has the proper background. The necessary viewpoint can be attained only with great difficulty by a geologist even when experienced as a consultant on engineering problems. The present volume will, therefore, fill a long-felt want and may well serve as a foundation for other works on similar lines."

The book is divided into three main parts. Part 1, An introduction to geology, chapters 1–4: (1) Geology, an outline of the science, (2) the composition of the earth's crust, (3) the structure of the earth's crust, and (4) geological field work and mapping. Part 2, Geology as applied in civil engineering, chapters 5–20: (5) The civil engineer and geology, (6) preliminary and exploratory work, (7) applied geophysics and civil engineering, (8) tunnels, (9) open excavation, embankment fills, and retaining walls, (10) earth movements and landslides, (11) transportation routes, (12) the foundation of bridges and cofferdam problems, (13) the foundation of dams, (14) reservoirs and catchment areas, (15) erosion and silting, (16) water supply, (17) groundwater, (18) building foundations, (19) materials of construction, and (20) soils and soil mechanics. Part 3, Reference section: (*A*) Glossary of geological terms commonly encountered, (*B*) geological surveys of the English-speaking world, (*C*) geological societies and periodicals, and (*D*) references cited in the text, and index.—*W. A.*

5419. Lobeck, A. K., Geomorphology, an introduction to the study of landscapes, 731 pp., fully illus., New York, McGraw-Hill Book Co., 1939. Price, $4.50.

This is a study of the face of the earth; of mountains, rivers, and plains; of rivers under the earth, caves, springs, and volcanoes. Table of contents: (1) Introduction, (2) rocks and structures, (3) weathering, (4) underground water, (5) streams in general, (6) young streams, (7) mature streams, (8) alpine glaciation, (9) continental glaciation, (10) waves, (11) wind, (12) organisms, (13) coastal plains, (14) plains and plateaus, (15) dome mountains, (16) block mountains, (17) folded mountains, (18) complex mountains, (19) volcanoes, and (20) meteor craters.—*W. A.*

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5420. Mather, K. F., and Mason, S. L., A source book in geology, 686 pp., illus., New York, McGraw-Hill Book Co., 1939. Price, $5.

This book, by presenting significant passages from outstanding geological contributors, gives a comprehensive view of the development of geological science during the past four centuries.—*W. A.*

5421. Petroleum development and technology, 1939, by Petroleum Div., Am. Inst. Min. Met. Eng. Trans., vol. 132, 625 pp., illus., New York, Institute, 29 West Thirty-ninth Street. Price, $5 net.

The annual volume for 1939, the fourteenth of the series, contains the papers and discussions presented before the petroleum division at meetings held in San Antonio, Tex., October 5–7, 1938; in Los Angeles, Calif., October 20–21, 1938; and in New York City, February 13–16, 1939. Chapters: (1) Production engineering, 7 papers, 92 pages; (2) engineering research, 8 papers, 103 pages; (3) petroleum economics, 3 papers, 34 pages; (4) production, domestic and foreign, and reserves, 31 papers and 286 pages on domestic production by States; 23 papers and 80 pages on foreign production by countries, excluding Bolivia and Japan but including Union of Soviet Socialist Republics; 1 paper and 4 pages on "Estimate of world oil reserves;" and (5) refining, 1 paper, 5 pages.—*W. A.*

5422. Porter, W. W., The practical geology of oil, 142 pp., 21 figs., Houston, Tex., Gulf Publishing Co., 1938.

Contents, by chapters: (1) Geological problems, (2) geological names, (3) introduction to rocks, (4) minerals, (5) rocks, (6) erosion, (7) geological time, (8) fossils, (9) sedimentation, (10) the crust of the earth, (11) structural geology—folding and faulting, (12) concentration of oil, (13) unconformities, (14) how wells are drilled, (15) geology of the hole, (16) geological exploration, (17) geological maps, (18) what price oil fields, and (19) sources of geological information.—*W. A.*

5423. Twenhofel, W. H., Principles of sedimentation, 1st ed., 610 pp., 44 figs., New York, McGraw-Hill Book Co., 1939.

Contents, by chapters: (1) Introduction, (2) environmental factors, (3) classification and consideration of environments, (4) origin of inorganic sediments, (5) interrelations of organisms and sediments, (6) transportation and deposition of sediments, (7) classification of sediments and sedimentary rocks and minerals, (8) the clastic sediments, (9) sediments of chemical deposition—the carbonate sediments, (10) sediments of chemical deposition—siliceous, ferruginous, and manganese sediments, (11) sediments of chemical deposition—the carbonaceous sediments, (12) sediments of chemical deposition—evaporites, (13) sediments of chemical deposition—miscellaneous sedimentary products, (14) structural features of sedimentary origin, and (15) textures and colors of sediments. Index.—*W. A.*

5424. Uren, L. C., Oil-field exploitation, revised, enlarged, 2d ed., 741 pp., illus., New York, McGraw-Hill Book Co., 1939. Price, $6.

This is a volume designed to serve the needs of executives, investors, technologists, and others who are interested in the petroleum-producing industry and who seek an orderly review of the methods and equipment employed and of the physical principles controlling the recovery of petroleum from its reservoir rocks.—*W. A.*

10. PATENTS

5425. Thermometric method of locating the top of the cement behind a well casing; Conrad Schlumberger, Paris, France, assignor, by mesne assignments, to Schlumberger Well Surveying Corporation, Houston, Tex., a corporation of Delaware: U. S. patent 2,050,128, issued August 4, 1936.

In accordance with this invention, in order to determine the height which the top of the cementing has reached, continuous thermometric measurements are taken in the water over the whole depth of the hole by means, for example, of a thermometric coil. The latter is connected with an insulated cable, which runs off a winch. The variations of the resistance of the coil corresponding to the variations of temperature within the hole are recorded by a suitable apparatus. Claims allowed, 12.

5426. Apparatus for recording earth-current transients; Ludwig W. Blau and Louis Statham, Houston, Tex., assignors to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,079,103, issued May 4, 1937.

This invention relates to apparatus for geophysical exploration, comprising means for passing an electric current through a given volume of the ground, a resistance operatively connected in parallel with the resistance for receiving an indication of the transient of the current as modified by its passage through the ground. Claims allowed, 7.

5427. Method and means for determining magnetic polarity; Edward D. Lynton, Glendale, and Henry N. Herrick, Berkeley, Calif., assignors to Standard Oil Co. of California, San Francisco, Calif., a corporation of Delaware: U. S. patent 2,104,752, issued January 11, 1938.

This invention relates to a method of determining the magnetic polarity of a body of weakly magnetized material having a generally known magnetic-axis arrangement, comprising the steps of placing said body within the influence of a magnetic system of known magnetic characteristics in such a position that the magnetic lines of force of the known magnetic system are substantially at right angles to the magnetic lines of force of the weakly polarized object; rotating said object about an axis substantially parallel to the magnetic axis of said magnetic system; and measuring the reaction between the two magnetic systems during said rotation. Claims allowed, 10.

5428. Rock-sampling method; Victor V. Vacquier, Oakmont, Pa., assignor to Gulf Research & Development Co., Pittsburgh, Pa., a corporation of Delaware: U. S. patent 2,140,097, issued December 13, 1938.

In the art of rock sampling during deep drilling, this invention relates to the improvement which comprises the steps of introducing into the rock to be sampled a body of ferromagnetic particles in such a state as to be susceptible of polar orientation under the influence of the earth's magnetic field; allowing said particles to become so oriented; fixing the particles to the rock while so oriented; and removing a sample of rock containing the fixed particles; thereby providing a magnetic index by means of which the original position of the sample in the earth can be determined after removal. Claims allowed, 7.

5429. Electromagnetic wave-pickup instrument; Frank F. Reynolds, Houston, Tex., assignor to Seismic Explorations, Inc., Houston, Tex., a corporation of Louisiana: U. S. patent 2,147,060, issued February 14, 1939.

This invention relates to a means and method for securing critical damping of an electromagnetic pick-up instrument. In an electromagnetic sound-wave pick-up device, the combination of a frame; a mass; a spring plate; a resilient bar therein; means to connect said mass with the center of said bar; side bars on said plate each of said bars having its ends attached to the ends of said first-mentioned bar; and means to connect the centers of said side bars with said frame whereby resiliency is obtained due to the flexibility of one-half the length of each of said bars. Claims allowed, 6.

5430. Method for determining directional orientation of materials; Randall Wright, San Buenaventura, Calif.: U. S. patent 2,147,942, issued February 21, 1939.

This invention relates to the directional orientation of core samples taken from subsurface strata in the course of drilling. The described method consists in suspending a core sample from above by a single yielding element with its original top and bottom disposed upwardly and downwardly and so it is free to rotate horizontally; subjecting the suspended core to the magnetic influence of energized magnetic means arranged adjacent the core so as to induce horizontal rotation thereof; noting the maximum point of rotary movement; deenergizing the magnetic means; accurately repositioning the deenergized magnetic means relative to the sample and again energizing the magnetic means to induce rotation of the suspended core sample; noting the maximum point and direction of rotational movement relative to said first-mentioned maximum point and the degree of deflection; again deenergizing the magnetic means and moving the latter horizontally through an arc about said suspended core sample to a point intermediate of the previously noted maximum points of rotary movements of the core sample, where one of the poles of the magnetic means directly faces the opposite pole of the core sample. Claims allowed, 2.

5431. Apparatus for comparing a plurality of oscillatory systems; Ludwig W. Blau and Andrew B. Bryan, Houston, Tex., assignors to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,148,678, issued February 28, 1939.

This invention relates to improvements in apparatus for comparing a plurality of oscillatory systems. In a system for observing gravitational forces, an oscillating pendulum; means for setting up by the motion of said pendulum a corresponding train of electrical impulses, the fundamental frequency of which is the same as that of the pendulum; means for setting up mechanical vibrations by a harmonic of said train of electrical impulses; means for setting up by said mechanical vibrations a corresponding train of electrical impulses, the fundamental frequency of which is the same as that of said mechanical vibrations; means for obtaining a harmonic of said second-mentioned train of electric impulses; and means for observing the frequency of the harmonics as the fundamental frequency changes. Claims allowed, 6.

5432. Use of high frequencies in measuring change in electrical impedance; Ludwig W. Blau, Robert R. Thompson, and Whitman D. Mounce, Houston, Tex., assignors to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,148,679, issued February 28, 1939.

This invention relates to the use of high frequencies in detecting variations in the resistance of the ground caused by earth vibrations. In an apparatus for measuring changes in electrical impedance of the ground due to seismic disturbances, a source of oscillating current of given high frequency; a transformer the primary of which is connected to the source; a second transformer the primary of which is connected to the secondary of the first-mentioned transformer; spaced electrodes in the ground connected in parallel with the adjoining secondary and primary windings of the transformers, whereby current of given frequency passes between the electrodes through an extended volume of the ground, and change in the impedance of the ground due to the seismic disturbances varies the amount of electric energy flowing through the volume; a detector in the circuit connected to the secondary of the second-mentioned transformer; means connected to the detector for amplifying audio frequencies; and means connected to said amplifying means for exhibiting the change in current. Claims allowed, 6.

5433. Galvanometer; Fabian M. Kannenstine, Houston, Tex.: U. S. patent 2,149,442, issued March 7, 1939.

This invention relates to oscillographs and more particularly to the current-responsive elements thereof, which comprises the reflection type of galvanometer having a movable loop which oscillates in accordance with the amplitude and frequency of a flow of current. What is claimed as new is: A current-responsive instrument comprising a substantially U-shaped magnet having spaced pole pieces; a housing positioned between said pole pieces; magnetic inserts embedded in the opposite walls of the housing adjacent said pole pieces to form an air gap in the plane of the magnet; a galvanometer element suspended between said inserts and within said housing; and means outside the air gap and movable with said galvanometer element for indicating displacement of the element within said magnetic field. Claims allowed, 5.

5434. Logging device; Carl W. Cooper, Duncan, Okla., assignor to Halliburton Oil Well Cementing Co., Duncan, Okla.: U. S. patent 2,156,052, issued April 25, 1939.

This invention relates to an apparatus for logging a well, including sound-producing means; sound pick-up means and a recorder; said sound-producing means and said apparatus including a unitary construction adapted to be lowered into the well and having said sound pick-up means therein; said sound-producing means having sound-directing means associated therewith to cause the passage of sound vibrations into the formation of the well; and said sound pick-up means having sound-collecting means associated therewith to cause the sound pick-up means to be particularly responsive to the echo or rebound of the vibrations from the formations of the well. Claims allowed, 2.

5435. Method of locating metals and minerals in the ground; Nils Brundin, Romford, England: U. S. patent 2,158,980, issued May 16, 1939.

This invention relates to a method of detecting the presence and location of metals and ores in the ground, which comprises the steps of taking samples of vegetable material of the same species at substantially regular intervals along lines distributed over the area to be investigated; ashing the samples; subjecting the ash to spectographic analysis; and plotting the results obtained in the form of a graph or map of the area investigated so as to exhibit areas of greatest concentration of the metal. Claim allowed, 1.

5436. Method and apparatus for electrical exploration of the subsurface; John Jay Jakosky, Los Angeles, Calif.: U. S. patent 2,162,087, issued June 13, 1939.

This invention relates to a system of electrical exploration of the subsurface, in which a measurement is taken involving the potential difference created between two spaced points by the flow of an energizing current through the earth; the method of eliminating the effect of natural earth potential on such measurement, which comprises introducing a potential in opposition to the natural earth potential between said two spaced points and controlling said introduced potential in accordance with the natural earth potential between two spaced points, which are so positioned with respect to the path of said current that the potential difference therebetween is substantially unaffected by said current. Claims allowed, 17.

5437. Gas mapping; George S. Bays, Tulsa, Okla., assignor to Stanolind Oil & Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,165,440, issued July 11, 1939.

This invention relates to a method of soil-gas surveying comprising determining hydrocarbon content of soil-gas samples from various soils and determining the relative sorptive abilities of said soils to provide a basis for more accurate correlation of data obtained by the determination of the hydrocarbon contents of said various soils. Claims allowed, 5.

5438. Locating water strata in oil wells; Daniel Walter Elliott, Long Beach, Calif., assignor, by mesne assignments, to Lane-Wells Co., Los Angeles, Calif., a corporation of Delaware: U. S. patent 2,167,066, issued July 25, 1939.

This invention relates to an electrical device for determining the relative proportions of droplets of substantially immiscible conductive and nonconductive fluids in a column within a well bore; a pair of electrodes having proximal serrated edges; means for positioning said pair of electrodes at various levels in said column; an electric circuit having its ends connected to said electrodes; and means for measuring variations of current in said circuit. Claims allowed, 22.

5439. Gas-analysis apparatus; William J. Sweeney, Westfield, N. J., assignor to Standard Oil Development Co., a corporation of Delaware: U. S. patent 2,170,435, issued August 22, 1939.

The present invention is directed to a method for detecting and measuring minute concentrations of normally gaseous hydrocarbons in gas mixtures. The invention relates to a process for detecting minute amounts of ethane and higher hydrocarbons in soil gases, which com-

prises subjecting the hydrocarbons in the soil gas to combustion; passing infrared rays through the combustion products; and observing the amount of energy absorbed from a band of rays from which carbon dioxide has the power to absorb energy. Claims allowed, 6.

5440. Method and apparatus for electrical exploration of subsurfaces; John Jay Jakosky, Los Angeles, Calif.: U. S. patent 2,174,343, issued September 26, 1939.

This invention relates to a method of determining the geological nature and characteristics of the subsurface, which comprises passing an electric current in a path through the earth between a pair of spaced electrodes having a known spacial arrangement on the surface of the earth; changing the spacial arrangement of said electrodes and passing current therebetween at different spacial arrangements thereof so as to vary the angle of penetration of the mean path of said current with respect to the surface of the earth and produce corresponding variations in the ratio between the values at two positions adjacent one of said electrodes, and also in the ratio between the values at two positions adjacent the other of said electrodes, of an electrical variable created by the flow of said current and influenced by said variations in angle of penetration; and determining variations in each of said ratios for the different spacial arrangements of said electrodes. Claims allowed, 9.

5441. Method and apparatus for electrical survey of the formations cut by a borehole; Conrad Schlumberger, Paris, France; Ann Marguerite Louise Doll, administratrix of said Conrad Schlumberger, deceased, assignor to Société de Prospection Électrique, Procédés Schlumberger, Paris, France, a corporation of France: U. S. patent 2,174,638, issued October 3, 1939.

This invention relates to a method of electrical survey of the strata in the neighborhood of a borehole at the part thereof not yet lined with casing but filled with water, which method consists in passing into the ground at various depths a periodically interrupted current and measuring the potential differences thus created in the borehole, first during the passages and second during the interruptions of current. Claims allowed, 8.

5442. Method and arrangement for determining the direction and the value of the dip of beds cut by a borehole; Henri Georges Doll, Paris, France, assignor to Société de Prospection Électrique, Precédés Schlumberger, Paris, France, a corporation of France: U. S. patent 2,176,169, issued October 17, 1939.

This invention relates to the method of determining the direction of the dip of the formation cut by a borehole, which comprises the steps of measuring and comparing the spontaneous potential differences existing in the borehole in the vicinity of contact between porous and nonporous beds and more generally between more and less porous beds in zones situated away from the axis of the borehole and having different orientations in relation to the axis in question. Claims allowed, 35.

5443. Depth-measuring apparatus; Hans Kietz, Bremen, Germany, assignor to Atlas-Werke Aktiengesellschaft, Bremen, Germany: U. S. patent 2,179,509, issued November 14, 1939.

This invention relates to a system for measuring distance by the time-of-travel method including a plurality of differently tuned transmitters adapted to transmit wave energy in the same medium; a

plurality of receivers responsive respectively each to only one transmitter; an indicating device responsive to said receivers adapted to indicate the distance; means associating said indicating device with said receivers; and means for transmitting at separated intervals successive signals from the separate transmitters. Claims allowed, 8.

5444. Electrical method and apparatus for determining the characteristics of a geological formation traversed by a borehole; John Jay Jakosky, Los Angeles, Calif., assignor to Schlumberger Well Surveying Corporation, Houston, Tex., a corporation of Delaware: U. S. patent 2,179,593, issued November 14, 1939.

This invention relates to a method for determining the nature and thickness of the strata traversed by a drill hole at different depths, which comprises measuring the changes in potential between an electrode within the drill hole and an electrode distant from the drill hole, when said electrode within the drill hole is at different depths below the surface, said second-named electrode being located at a distance from said drill hole greater than one-third the depth of said first-named electrode below the surface. Claims allowed, 22.

5445. Apparatus for determining gravity; Axel Rudolf Lindblad, Stockholm, Sweden, assignor to Bolidens Gruvaktiebolag, Stockholm, Sweden, a joint stock company limited of Sweden: U. S. patent 2,179,892, issued November 14, 1939.

This invention relates to an apparatus for measuring directly the variations in the force of gravity comprising in combination a condenser; means operable by gravimetric force for varying the capacity of said condenser; a closure of heat-conducting material for said condenser; an electrical heating coil without but in contact with said closure; and an automatic thermoregulator intimately connected with said closure and adapted to control the current supplied to the electric heating coil to maintain a substantially constant temperature within the closure. Claims allowed, 4.

5446. Method and apparatus for continuous exploration of boreholes; John Jay Jakosky, Los Angeles, Calif., U. S. patent 2,181,601, issued November 28, 1939.

This invention relates to an electrical method and apparatus for determining the character of the strata encountered at different depths by a drill bit during the drilling of a borehole. It is claimed: In the drilling of a borehole with a drilling apparatus comprising a drill stem extending within the borehole and a drill bit electrically connected to said drill stem at the lower end of said drill stem, the method of determining the character of the strata encountered at different depths by the drill bit during the drilling of said borehole, which comprises passing a controlled electric current through an electric circuit including the drill stem and the drill bit as one electrode, another electrode connected to the earth at a position removed from the borehole, and the portion of the earth included electrically between said electrodes; taking a measurement involving the potential difference between two points whose potential difference changes with variations in the path of the current flowing between said electrodes; and repeating such measurement with said drill bit located at different depths within the borehole, while maintaining a liquid medium in the borehole around

said drill stem, said drill stem being exposed to electrical contact with said liquid medium throughout substantially its entire length and said other electrode being sufficiently removed from the borehole so that changes in the electrical characteristics of the formation adjacent the drill bit will produce variations in said measurements. Claims allowed, 7.

5447. Method of measuring gravity; Johan David Malmqvist, Boliden, Sweden, assignor to Bolidens Gruvaktiebolag, Stockholm, Sweden, a joint stock company limited of Sweden: U. S. patent 2,182,298, issued December 5, 1939.

This invention relates to a method of locating and determining the extent of ores or the like by measuring relative plummet deflections that are affected by the horizontal components of gravitational force that comprises the steps of fixedly locating a telescope having a scale associated therewith; positioning a plummet having a reflective surface thereon for playing upon said scale at selected points over the terrain under observation while maintaining said telescope in fixed position; noting the variation in the deflection of the plummet as manifested on said scale while the plummet is located at each test station; and utilizing the variations in the plummet deflection as an index of the subsurface formations. Claim allowed, 1.

5448. Procédé électrique et appareil pour la détermination des terrains traversés dans les sondages [Electrical method and apparatus for determining the subsoil penetrated by boreholes]; Société de Prospection Électrique (Procédés Schlumberger) of France (Seine): French patent 678,113, issued March 19, 1930.

This method relates to electrical coring assigned to replace the mechanical coring. The method consists of measuring the electrical resistivities of rocks at various depths inside a borehole and of drawing a diagram based on the values obtained. The method is accomplished by lowering an electrode into the water of the nontubed part of the borehole, the said electrode being connected by means of an insulated cable with a source of electric current, the other pole of this electric current being connected with the surface of the ground. The difference of potential between two points inside of the borehole near the first electrode is then measured by means of two electrodes arranged at different levels by means, for example, of a potentiometer. Claim allowed, 1.

5449. Procédé et appareillage pour la reconnaissance géologique des terrains et plus particulierement des couches poreuses recoupés par un sondage [Method and apparatus for geological prospecting of the ground and especially of porous layers penetrated by boring]; Société de Prospection Électrique, Procédés Schlumberger of France (Seine): French patent 723,592, issued April 11, 1932.

This invention relates to a method of geological investigation of the ground, especially of porous layers of it penetrated by boring. The method consists of measuring the differences of potential existing spontaneously at various depths in muddy waters filling the borehole. The apparatus used contains essentially a potentiometer placed on the surface of the ground and joined by insulated cables to two nonpolarizable electrodes, one of the latter being connected with the ground near the opening of the borehole and the other being lowered into the muddy

water of the hole to various depths; the two electrodes being eventually both lowered simultaneously into the borehole maintaining a constant difference in level between them. Claim allowed, 1.

5450. Improvements in or relating to electrostatic instruments for detecting seismic vibrations; Dr. Béla Pogány, Budapest, Hungary, and Jenö Fekete, Budapest, Hungary: British patent 509,783, issued July 20, 1939.

This invention is concerned with electrostatic instruments for detecting seismic vibrations, that is, instruments which convert the energy of natural or artificially produced seismic ground waves into periodic capacity variations: A capacitative detector for seismic vibrations comprising a multiplate condenser arrangement with those plates which are suspended elastically, and preferably by means of a diaphragm, forming with the corresponding fastening means the inertia mass of the detector. Claims allowed, 11.

5451. Gravity meter; Naamlooze Vennootschap de Bataafsche Petroleum Maatschappij of 30, Carel van Bylandtlaan, The Hague, Holland, a body corporate under the laws of Holland, assignees of John McDonald Ide, of 2302 Swift Boulevard, Houston, Tex., a citizen of the United States of America: British patent 511,918, issued August 25, 1939.

This invention relates to a gravity meter with a substantially horizontal thread, to which at least one rigid body is fastened, the center of gravity of which is radially offset with regard to the axis of the thread, means being provided to move the center of gravity of said body against the action of the gravitational force by twisting the thread, characterized in that the casing to which the ends of the thread are connected is freely suspended from two points lying substantially in the vertical plane passing through the axis of the thread. Claims allowed, 5.

5452. Improvements in or relating to gravity meters; Askania-Werke Aktiengesellschaft vormals Centralwerkstatt Dessau und Carl Bamberg, Friedenau, Berlin-Friedenau, Germany: British patent 513,654, issued October 18, 1939.

This invention relates to a static gravity meter comprising a mass mounted for displacement in vertical direction and elastically supported by spring means; a photoelectric cell system adapted to transform the vertical displacement of said mass into electrical current or tension dependent on said displacement; and means for indicating said current or tension. Claims allowed, 17.

5453. Vorrichtung zur Bestimmung der Richtung und Grösse des Einfallens der von einem Bohrloch durchschlagenen Erdschichten [Arrangement for determining the orientation and value of dip of the layers traversed by a borehole]; Marcel Henri Emile Schlumberger of Paris, France, assignor to Société de Prospection Electrique, Procédés Schlumberger, Paris: German patent 673,640, issued March 25, 1939.

This invention relates to apparatus for determining the orientation and value of dip of the layers traversed by a borehole comprising a coring tool carrier; means for lowering the carrier into the borehole; a coring tool connected to the carrier; means for causing the coring tool to penetrate the rock surrounding the borehole; and means integral with the support for determining the orientation of the coring tool at the instant at which it is actuated to penetrate the rock. Claims allowed, 4.

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