# Geophysical Abstracts 143 October-December 1950

(Numbers 12340–12513)

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GEOLOGICAL SURVEY BULLETIN 976-D

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*By* MARY C. RABBITT *and* S. T. VESSELOWSKY

GEOLOGICAL SURVEY BULLETIN 976-D

*Abstracts of world literature contained in periodicals, books, and patents*


UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1951

UNITED STATES DEPARTMENT OF THE INTERIOR

Oscar L. Chapman, *Secretary*

GEOLOGICAL SURVEY

W. E. Wrather, *Director*

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
Price 20 cents (paper cover). The printing of this publication has been approved by the Director of the Bureau of the Budget, February 1948.

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# GEOPHYSICAL ABSTRACTS 143, OCTOBER-DECEMBER, 1950

By MARY C. RABBITT and S. T. VESSELOWSKY

## INTRODUCTION

Geophysical Abstracts are prepared by the Geophysics Branch of the Geological Survey, United States Department of the Interior, as an aid to those engaged in geophysical research and exploration. Periodicals, books, and patents are regularly searched for material dealing with geophysical exploration and with basic earth physics as represented by the fields of gravity, magnetism, electricity, seismology, radioactivity, and heat.

Abstracts in this issue have been grouped in three sections dealing with earth physics, exploration geophysics, and patents. The first section has been further divided into sections on gravity, magnetism, seismology, electricity, radioactivity, heat, volcanology, tectonophysics and the internal constitution of the earth. The section on exploration geophysics covers gravimetric, magnetic, seismic, electric, and radioactive methods, well logging, and technical aids. Within each group the order of the abstracts is as follows: general papers, bibliographies, and reviews; theory; instruments; methods and techniques; observations.

As many readers may not have ready access to the source material, an effort is made to include all significant new material in these abstracts. Where geographic names quoted differ from the decisions of the United States Board on Geographical Names, the latter are added in brackets.

Geophysical Abstracts 1–86 and 112–127 were issued as Information Circulars by the Bureau of Mines, and 87–111 were issued as Bulletins of the Geological Survey. Beginning with 128, Geophysical Abstracts are published as Bulletins of the Geological Survey.

All Geophysical Abstracts published as Information Circulars are now out of print. Geophysical Abstracts issued as Bulletins of the Geological Survey (except Nos. 87 and 88 which are out of print)

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*Acknowledgments.*—Special thanks are due James R. Balsley, Jr., David F. Barnes, Gordon D. Bath, William J. Dempsey, Roland G. Henderson, H. R. Joesting, Jack L. Meuschke, Irwin Roman, Nancy Ann Smead, and Isidore Zietz who have prepared the abstracts signed J. R. B., D. F. B., G. D. B., W. J. D., R. G. H., H. R. J., J. L. M., I. R., N. A. S., and I. Z.

## EARTH PHYSICS

### GRAVITY

12340. Sergeev, M. N. Potential produced by an elliptic lamina of negligible thickness [in Russian]: TSentral'nyĭ nauchno-issledov. Inst. geodezii, aeros"emkiikartografii, Trudy, no. 51, pp. 112–116, 1948.

A new method of solution for the value of Newton's potential in points lying on the central perpendicular to the elliptic lamina is given in a form more convenient for application. This problem was previously solved by Riemann who treated the membrane as a limiting case of a triaxial ellipsoid of a very small height, Reimann's solution being given in the form of elliptic integrals of the first and the third kind.—*S. T. V.*

12341. Júdice, António. La determination de la pesanteur normale en géodesie [The determination of normal gravity in geodesy]: Geofis. Pura e Appl., v. 16, fasc. 1–2, pp. 7–12, 1950.

The usual method of determining the reference ellipsoid by dividing the sphere into curvilinear rectangles, forming the average value of the gravity anomalies obtained at the points inside of any rectangle and forming a series of spherical functions with a number of terms corresponding to the desired precision, is reviewed. It is concluded that this procedure is fully justifiable and insures the necessary accuracy of the results.—*S. T. V.*

12342. Júdice, António. A problema da figura da terra [The problem of the figure of the earth]: Sindicato Nacional dos Engenheiros Geógrafas Publicacões, Ser. 1, no. 1, 121 pp., 1950.

A critical analysis is made of the methods for determining the figure of the earth from gravitational measurements. The study is theoretical in its approach.

The theory of Pizzetti-Somagliana is formulated and proven, as the following theorem: if a volume of mass endowed with gravitational property, rotating with a known angular velocity, is bounded by an equipotential surface, the gravitational potential created by the mass in the exterior space is uniquely determined and is independent of the inner structure of the mass. In the derivation of this theorem, a development in series of spherical functions is employed. The formula of Stokes is discussed and different methods used in reduction of gravimetric observations, such as reduction in free air, reduction by suppressing masses exterior to geoid—the Bouguer generalized method, suppressing exterior masses while simultaneously assuming the volumes of oceans fitted to a density equal to that of the earth's crust, the method of Helmert, and the method of Rudzki.

The method of the determination of the geoid best fitted to observations and the formula of Burns is also presented. The methods of the determination of the reference ellipsoid are discussed.—*S. T. V.*

12343. Takeuchi, Hitoshi. On the earth tide of the compressible earth of variable density and elasticity: Am. Geophys. Union Trans., v. 31, no. 5, pt. 1, pp. 651–689, 1950.

A theoretical study of earth tides is presented in which several earth models with internal constitutions inferred from recent seismological studies are employed. The equations of motion of a material point in an initially stressed, self-gravitational earth, together with the Poisson equation form the fundamental differential equations of the investigation. The numerical integration is carried out in detail for elastic deformation by tidal action under various hypotheses as to elasticity and density distributions.

The values of Love numbers, $k$ and $h$, and Lambert's number, $l$, calculated for the model earth agree quite well with those obtained from observations on earth tides. It is concluded that the static elastic constants determined by the study of earth tides can be regarded as the same as the dynamic elastic constants determined by seismologic studies. The largest value for the rigidity of core compatible with the observations is believed to be $10^9$ to $10^{10}$ c.g.s. units.—*R. G. H.*

12344. Magnitskii, V. A. Reductions of the gravity force [in Russian]: TSentral'nyĭ nauchno-issledov. Inst. geodezii, aeros"emki i kartografii, Trudy, no. 51, pp. 46–61, 1948.

Reductions of gravity measurements important in the studies of the structure of the earth's crust are considered. In such problems, the Fayé reduction is of no use because it results simply in displacing downward all disturbing masses without changing the general gravitational pattern. The same is true of the Poincaré-Pray reduction. The topographic reduction, as applied by Hayford and Bowie, has the advantage of eliminating the gravitational effect of external relief, but it is affected by the unavoidable assumption of ground density, never exactly known. Another drawback is that it displaces disturbing masses downward through distances varying from point to point. Various isostatic reductions represent an approach to a geological reduction. They are useful in separating the influence of remote masses from local ones. In this process, it is important to take into account the geologic history of the region, often using information from seismologic and other sources.

Formulas are determined for the effect of masses, composing the external relief features, for masses distributed at great distances, vertical or horizontal, and for masses lying in the vicinity of the station, the most interesting to the geologist.

Use of sea level as the basic surface for the reductions is not important. Any confocal ellipsoid containing the same mass, can be used as a base surface, producing the same external effect.

Formulas are also derived for the anomalies of a region as a function of the heights of the corresponding geoid and as functions of the deviations of the plumb line.—*S. T. V.*

12345. Evseev, S. V. Reduction of gravity force in mountainous regions [in Russian]: TSentral'nyĭ nauchno-issledov. Inst. geodezii, aeros"emki i kartografii, Trudy, no. 51, pp. 83–111, 1950.

The author points out the scientific and practical advantages of isostatic reductions, as compared with others such as the Fayé, Bouguer, or topographic reductions, but he also shows the necessity of applying to every geophysically

isolated region its own, specifically modified, isostatic reduction. This modification should be made in accordance with the known or assumed distribution and density of underground masses, thickness of sialic layer, and similar features. The Caucasus has never been investigated in this way. The author analyzes his own computation methods and those of Hayford-Pratt; Heiskanen, who previously investigated a portion of the Caucasus; Vening-Meinesz, and emphasizes that the boundary of the regional compensation, other data, are to be tentatively chosen.

One hundred gravitational stations, between 41° and 44° N. latitude were selected, thus covering the main Caucasus Mountains. The following isostatic reductions and anomalies were calculated: local, according to Hayford, with $T$=96 km. and density $\mu$=0.267; local, according to Airy-Heiskanen, with normal depth $T_A$=60 km., density $\mu$=0.267 and density variation $\Delta\mu$=0.6; regional, according to Heiskanen, assuming radii of the compensating region as 166.7, 38.9 and 871.1 km.; anomaly, using the Vening-Meinesz reduction. The smallest standard deviation was found for the regional reduction with the radius of 871.1 km. This radius also gave good reductions for the various stations as far as their independence from the respective altitudes is concerned. The results are presented in tables and on a map showing the isostatic anomalies of the region.

The necessity of isostatic reductions is indicated in the establishment of the formula for the standard gravity force, when using Stokes' formula, and in cases of interpolation or extrapolation of the gravity values to points where no gravitational determinations were made. In mountainous countries these points are always the inaccessible peaks of the mountains.—*S. T. V.*

12346. Melchior, P. J. Sur l'influence de la loi de répartition des densités à l'intérieur de la terre dans les variations lunisolaires de la gravité en un point. [On the influence of the distribution of density in earth's interior on the lunisolar variations of gravity at a point]: Geofis. Pura e Appl., v. 16, fasc. 3–4, pp. 105–116, 1950.

Observations of lunar and solar variations of gravity at various points of the earth show that it is necessary to distinguish three different controlling factors: the gravitational effect of the two celestial bodies determined by Newton's law and changing with their position relative to the point of observation, deformation of the earth, and the variation of the gravitational potential at the point of observation owing to this deformation. The deformation of the earth is evidently determined by its rigidity. Love's equation connecting the rigidity $\delta$ with $h$, the amplitude of the tide in the earth's crust and with $k$, the ratio of the variation of the potential owing to deformation to disturbing potential is $\delta=1+h-3/2\ k$.

Gravity variations are very difficult to observe because of their smallness. Results obtained by different scientists do not agree among themselves and with the Love relation. The increase of density toward the center of the earth increases the effect of elasticity, and the factor $\delta$ in Love's equation is related to the deviations of the plumb line caused by displacement of terrestrial masses. By assuming four different laws of density variation in the earth's interior, proposed by Haalck and Bullen, discrepancies among the different results can be eliminated and good agreement between computed and observed values obtained. However, Love's equation must be considered only as approximation because other factors such as displacement of the pole also cause gravity variation at a point of another periodicity.—*S. T. V.*

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12347. Voit, H. Über die beste Dimensionierung des Bifilargravimeters [The optimum dimensions of the bifilar gravimeter]: Geofis. Pura e Appl., v. 15, fasc. 1–2, pp. 90–110, 1949.

To determine the optimum conditions controlling the operation of the gravimeter, equations are derived determining its sensitivity as the function of different constants of the instrument. From the analytical expression of the sensitivity, optimum conditions are determined in terms of the dimensions and properties of different members. This is followed by the determination of mechanical stresses produced in the springs which should be reduced as much as possible to avoid permanent deformations, inevitably causing the drift of the zero point. The sensitivity of the gravimeter is estimated as 1 mm. deflection for gravity variation of $5.116\times10^{-10}g$. Such sensitivity should be sufficient to make noticeable the influence of the tides on the gravity force. Temperature inside the instrument housing must remain constant within $\pm10^{-5}$° C., but this condition can be attained by the use of sufficient thermal insulation and by thermostatic heating.—*S. T. V.*

12348. Tsuboi, Chuji. Thickness of the isostatic earth's crust in various parts of the United States of America: Tokyo Univ., Geophys. Inst., Geophys. Notes, v. 3, no. 5, 37 pp., 1950.

The thickness of the isostatic earth's crust in the United States has been determined as approximately 120 km. if the Pratt hypothesis is adopted and about 60 km if Airy hypothesis of isostasy is assumed. Because it can be proved mathematically that the underground mass distribution conforming to the Pratt hypothesis of isostasy with depth of compensation $D$ produces the same gravity field on the earth's surface as does that conforming to the Airy hypothesis with the crustal thickness $D/2$, there can be no preference so far as gravity data alone are concerned.

In most determinations of the thickness of the isostatic earth's crust, the thickness is assumed uniform throughout the area in question. In the present study the attempt is made to determine whether or not the thickness of the crust, according to Airy's hypothesis, is uniform throughout the United States by using the harmonic-series method of the writer in which the thickness of the crust can be found directly from the Bouguer anomalies and topography. The conclusions may be applied to Pratt hypothesis as well.

The usual method for determining the thickness $d$ of the crust is to find the value which will make the sum of squares of the isostatic anomalies calculated for that $d$ a minimum. The alternative is to find the value $d$ which makes the squares of the isostatic anomalies integrated over the region in question a minimum.

The whole area of continental United States can be divided in nine equal rectangles, with the number of gravity stations in each ranging from 23 to 130. The most probable values of $d$ for each rectangle range from about 47 to 133 km., on the assumption of perfect isostasy.

No comparison of the results obtained from gravitational considerations with seismologic evidence is possible for the total area of the United States. However, in the rectangle in the Sierra Nevada where $d$=47, Chakrabarty and Richter have calculated a thickness of 42 km., from seismological observations.—*S. T. V.*

12349. Beer, Michael. Measurements of gravity in the Canadian Arctic and Greenland: Canadian Jour. Research, Sec. A., v. 28, no. 5, pp. 535–541, 1950.

During the summer of 1948, determinations of gravity were made with the Dominion Observatory pendulum apparatus at Goose Bay, Labrador (981.312 gals); Thule, Greenland (982.923 gals); Resolute Bay, Cornwallis Island (982.876 gals); and Frobisher Bay, Baffin Island (982.167 gals). Free air anomalies are −0.046, −0.003, +0.019, and −0.033 milligals respectively and are similar to Bouguer anomalies because of the low elevation of the stations. Anomalies at Thule and Resolute Bay are not large enough to indicate any great departure from isostasy or from theoretical gravity as given by the International formula. Anomalies at Goose Bay and Frobisher Bay, though moderately large, are not larger than many that have been observed in other parts of the country. Nørgaard's determination at Thule is confirmed.—*M. C. R.*

12350. Norges Geografiske Oppmålings virksomhet. Beretning 1949 [Norway Geogr. Survey activity. Annual report for 1949], 42 pp., 1950.

During the year gravimeter measurements were made to tie the Oslo Observatory to the National Physical Laboratory at Teddington, the Rikets Allmanna Kartverk in Stockholm, and the Geodaetisk Institut of København. Absolute gravity determinations were made at Oslo, København, and Teddington using pendulum apparatus. Gravimetric measurements were made along several previously surveyed profiles, establishing eleven first order stations. Precise leveling has been carried out in different regions of southern Norway over a total length of 221 km. Norwegian and Swedish geodetic networks were tied by first order triangulation with 13 Norwegian stations involved. These observations are to be used in the construction of the European network in accordance with decisions of the International Geodetic Association. Extensive topographic work, covering some 3,000 sq. km., was done using photogrammetric methods.—*S. T. V.*

12351. Bogdanov, A. A., Gurevich, B. L., and Shereshevskaia, S. IA. Gravity anomalies and their relation to the principal tectonic elements in the western regions of the Ukrainian S. S. R. [in Russian]: Akad. Nauk SSSR Izv., Ser. geog. i geofiz., v. 14, no. 3, pp. 223–231, 1950.

Gravitational investigations of the eastern portion of the Carpathian Mountains were begun over fifty years ago. Between 1932 and 1936 determinations of high precision were made at 42 stations. Since 1947 numerous gravimetric determinations have been made. Important data were obtained in 1948 on three profiles extending across the main ridge of the Carpathian Mountains, along the lines from Uzhgorod to L'vov, from Mukachevo to L'vov, and from Solotvin to Galich. All three gravity profiles are similar and are characterized by large negative anomalies, with minima (after Bouguer reductions) below the main ridge of −60 mgal. along the Uzhgorod-L'vov profile and −95 mgal. along the other two.

These gravity minima cannot be explained by assuming a lower density of the upper layers, and it is therefore concluded that the real causes of these anomalies are the deep displacements of subcrustal masses which took place at the depth of many tens of kilometers.—*S. T. V.*

12352. Cook, A. H. Measurements of gravity in Ireland: Dublin Inst. for Advanced Studies, Geophys. Mem. no. 2, pt. 1, 28 pp., 1950.

A detailed report is given of the measurements of gravity made in 1949 in Cambridge, Dublin, Sligo, Galway, and Cork. The instrument used was the Cambridge pendulum apparatus designed by Sir Gerald Lenox-Conyngham, consisting of two pendulums of period about 1.01 sec. swinging together with equal amplitude and opposite phase. To reduce damping, the pendulums were enclosed in containers in which air pressure was reduced to about 30 mm. of mercury. The pendulums are of invar and have hard steel knife edges resting on agate planes. The timing arrangements consisted of beams of light reflected from mirrors on the pendulums and recorded photographically with time marks controlled by the crystal frequency standard, oscillating at 10,000 cycles per second. The report contains a detailed description of the measurements and calculations of the errors and corrections.

Dunsink Observatory, about four miles northwest of Dublin, has been chosen as the base station for Ireland. Its coordinates are 53°23′13.1″ N. lat., 6°20′16.5″ W. long., elevation 80.8 m. above mean sea level. Differences of gravity from Cambridge were found by least squares as: Dunsink Observatory, +120.84 mgal. ±0.56; Sligo Courthouse, +197.28 mgal. ±0.82; Galway University College, +96.91 mgal. ±0.64; Cork University College, −22.51 mgal. ±0.87.—*S. T. V.*

12353. Lejay, Pierre. Étude gravimétrique des Iles Philippines [Gravimetric survey of the Philippine Islands], 130 pp., Imprimerie de T'ou-se-we, Shanghai, 1939.

A gravimetric survey of the Philippine Islands was made in 1938, using two Holweck-Lejay pendulums. About 190 stations, forming over 20,000 km. of profiles, were occupied at elevations ranging from sea level to 2,400 m. above sea level. Significant positive anomalies were found along mountain ridges in contrast to the findings of a previous survey on the continent of Asia. Results of the gravity determinations are given in a table and as a map of Bouguer anomalies.—*S. T. V.*

12354. Vening Meinesz, F. A. Gravity expeditions at sea 1923–1938: Netherlands Geodetic Comm. Pub., v. 4, 233 pp., 1948.

This publication contains the complete results of the gravity expeditions at sea made by the Netherlands Geodetic Commission up to the year 1938. Data are included for 844 stations, isostatically reduced according to the Hayford-Bowie method and according to the Airy-Heiskanen method, based on the hypothesis of a floating rigid crust 40 km. thick, and also under the assumption of regional compensation for crustal thicknesses of 20 and 30 km.

Methods of reduction are discussed in relation to views on the constitution of the upper layer recently formed from a study of gravitational and seismological data. Special chapters are devoted to the results of gravity surveys in the Indonesian Archipelago, over and near volcanic islands, over the continental margins, and over the oceans in general. Gravity profiles discussed in the text, maps with calculated isostatic anomalies, a geological map constructed from these data, and two bathymetric charts are included.—*S. T. V.*

## MAGNETISM

12355. Alfvén, Hannes. On the origin of the terrestrial and solar general magnetic field: Arkiv för Fysik, Band 2, Häfte 3, p. 221, 1950.

There is good evidence for the assumption that the terrestrial and solar magnetic fields are due to internal electric currents. The problem is to devise a self-exciting electric generator to be made of elements existing in the interiors of the earth and sun.

A system of whirls in the interior of the earth may give the same effect as a homopolar inductor which, surrounded by a system of rotating cylinders, acts as a self-exciting electric generator and produces a magnetic field that, outside the generator, is approximately of dipole type. A simple calculation shows that even very slow internal motions are enough to produce a field of the observed order of magnitude.—*N. A. S.*

12356. Truesdell, C. On the effect of a current of ionized air upon the earth's magnetic field: Jour. Geophys. Research, v. 55, no. 3, pp. 247–260, 1950.

An equation governing the perturbation field induced by the motion of a conducting fluid in a uniform magnetic field is derived and a general solution for the steady state case is presented. From the study the following facts concerning local magnetic disturbances produced by upper atmospheric winds are deduced: The first-order perturbation problem is purely magnetic. Any given component of magnetic perturbation field may be analyzed independently of the others. It is futile to conjecture the nature of the upper atmospheric winds and the extent of the ionization of the air as an infinite number of different conjectures can lead to any one perturbation field. In the static case, each component of the perturbation field is a Newtonian potential and hence any static perturbation field arising from a localized disturbance falls off, according to the inverse first-power law for large distances. In the static case a definite center of disturbance and strength of disturbance exist for any given component, and these may be calculated from magnetic observations at large distances from the center.—*M. C. R.*

12357. Blaha, Friedrich. Über eine Methode den magnetischen Kraftverlauf räumlich sichtbar zu machen [A method of making visible the spatial pattern of magnetic forces]: Zeitschr. Naturf., Band 5a, Heft 4, pp. 233–234 and table 228b., 1950.

The pattern of the magnetic field between pole shoes of arbitrary shape in a machine or an apparatus may be made visible by a method based on the glow discharge produced when an appropriate electric voltage difference is applied under vacuum. Replicas of the pole shoes are prepared, covered with a special lacquer, and put in a conveniently designed container in the predetermined relative position. By maintaining vacuum in the container and applying a sufficiently high voltage difference between the pole shoes, a visible glow discharge can be produced, representing the pattern of the magnetic field.

Seven different configurations are shown by photographs including two oppositely directed conical pole shoes, an acorn placed perpendicular to a plate, and a sharp point directed into a cavity. The disturbing effect of an extraneous piece of iron on the original field pattern may also be made visible and reproduced on a photograph.—*S. T. V.*

12358. Kondorskii, E. I. The theory of magnetic properties of conglomerates and powdered substances [in Russian]: Akad. Nauk SSSR Izv., Ser. geog. i geofiz., v. 14, no. 4, pp. 294–301, 1950.

In prospecting by magnetic methods it often becomes necessary to determine magnetic susceptibility of combinations of magnetic and nonmagnetic substances. Empirical formulas used for this purpose are derived only for certain special cases and are often quite inaccurate. From theoretical analysis of the problem, taking into account the inner demagnetizing effect of magnetic particles, the following formula for susceptibility of a mixture is derived:

$$1/A[\sqrt{(1-BK)^2+2AvK}-(1-BK)], \text{ where } A=8\pi/3(2+v),\ B=4\pi/3(4v-1),$$

$v$ is the volume concentration of the magnetic substance in the mixture and $K$ its magnetic susceptibility. The influence of elastic stresses on the magnetic susceptibility of mixtures is studied and the necessary corrections to the derived formula are given. This phenomena can be noticed in studying the magnetic anomalies of different formations in regions of high seismicity.—*S. T. V.*

12359. Tsubokawa, Ietsume. A new type magnetometer: Jour. Geomagnetism and Geoelectricity, v. 1, no. 1, pp. 10–11, 1950.

A Helmholtz coil is mounted perpendicular to the horizontal and vertical axis of a theodolite. Within the Helmholtz coil a rotating pick-up coil is set perpendicular to the axis of the theodolite. The e. m. f. generated in the pick-up coil is amplified and detected with a magic eye (6G5). Azimuth and dip of the geomagnetic field are determined by orienting the theodolite in horizontal and vertical planes for null as indicated by the magic eye. Horizontal intensity is determined by measuring the horizontal field of the Helmholtz coil necessary to give a zero reading when the axis of the rotating coil is less than 4° from vertical. The potential drop across a standard resistance as measured against a standard cell is used to determine the field of the Helmholtz coil whose constant was determined by comparison with the standard value. Field use on Shikoku for three months in 1948 demonstrated the practicability of this instrument.—*W. J. D.*

12360. Morelli, Carlo. Nuovi criteri per la sistemazione magnetica [New criteria in magnetic investigations]: Annali Geofis., v. 3, no. 3, pp. 349–355, 1949.

With modern instruments, it is possible to measure $D$ with an accuracy of $\pm 0.1'$ and $H$ or $Z$ with an accuracy of $\pm 5$ gammas. In northern Italy, where $I$ averages about 62° and $H$ 21,000 gammas, an error of 0.5′ in the measurement of $I$ involves an error of more than 13 gammas as in $Z$. This imposes the selection of $H$ or $Z$ as initial observation data. To increase the final accuracy measurements should be repeated several times. In general, relative measurements, $\Delta D$, $\Delta H$, and $\Delta Z$ give greater accuracy, are easier to make, and are much more economical.

For a magnetic survey of an area of about 10,000 sq. km., it is suggested that a certain number of absolute stations of the first order be established some 50 to 150 km. distance apart. These stations are superimposed on a network of relative stations of the second order of precision, with some 10–20 km. distance apart, and finally a denser network of relative stations of the third order. As instruments, portable magnetic theodolites for absolute measurements and Schmidt magnetic balance for relative determinations are suggested. (*See* also Geophys. Abstract 11030).—*S. T. V.*

12361. Wasserfall, K. F. A study of the secular variation of magnetic elements based on data for *D*, *I*, and *H* for Oslo, 1820–1948: Jour. Geophys. Research, v. 55, no. 3, pp. 275–299, 1950.

A general view of the secular variation of the more important magnetic elements may be obtained from annual means of *I*, *H*, and *D* at Dombås, Oslo, Rude Skov, and Potsdam. The *H*-curve shows a steady increase of about 13 gammas per year to about 1908 and then an average decrease of about 22 gammas per year. The *I*-curve is more or less parallel to an inverted *H*-curve, decreasing 1.2′ annually to 1908 and then increasing 1.5′ per year. Besides secular progress, there is a more or less periodic variation evidently caused by variation of the sunspots. There is no indication of an 11-year variation in the *D*-curve, but apparently an approximate periodic variation with a period of about 70 years. The secular curve for *D* moves westward with an average rate of 10.5′ annually to the turning point about 1910 and then decreases toward the east with an average rate of 7.1′ per year. Comparison between secular curves for *H* and the corresponding curves for *I* at eleven magnetic stations between geomagnetic latitudes 50° and 60° north show striking similarity.—*M. C. R.*

12362. Howe, H. H. An anomaly of the magnetic daily variation at Honolulu: Jour. Geophys. Research, v. 55, no. 3, pp. 271–274, 1950.

The grouping of months customarily used in computing mean daily variations is not always suitable. Daily variations of *H* at Honolulu from 1902 to 1936 show both maximum and minimum in the "equinox" group of months.—*M. C. R.*

12363. Nagata, Takeshi and Akimoto, Syun'iti. Magnetic transition points of volcanic rocks: Jour. Geomagnetism and Geoelectricity, v. 2, no. 1, pp. 29–33, 1950.

The thermal change of susceptibility of thirty specimens of volcanic rocks was measured by a ballistic method in a weak magnetic field, several times as much as the geomagnetic field. Specimens were heated to about 660° C. and then cooled to room temperature, the susceptibility being measured every 20° C. during both heating and cooling processes. The susceptibility of all specimens becomes apparently zero at about 600° C., but the mode of change with temperature is not simple. Four general types of changes are recognized: the reversible-ordinary type, in which the susceptibility increases gradually to 400° C. and then decreases abruptly, the change in cooling following almost the same curve; the irreversible-ordinary type, in which the change in heating is similar to the preceding but the cooling curve differs; and the reversible- and irreversible-extraordinary types, in which the thermal change of susceptibility is stepwise. The magnetic-transition points depend on the chemical constitution of the rock. The ordinary-type change is attributed to magnetite grains containing some impurities, but the original ferromagnetic mineral in the extraordinary type could not be identified.—*M. C. R.*

12364. Rikitake, Tsuneji. Magnetic anomalies and the corresponding magnetic centres: Jour. Geomagnetism and Geoelectricity, v. 2, no. 1, pt. 1, pp. 20–24; pt. 2, pp. 25–28, 1950.

A method is proposed for finding the position, intensity, and direction of an underground magnetic dipole from the corresponding vertical intensity anomaly observed at the earth's surface. The dipole terms are the most important in the magnetic anomalies that are due to magnetic matter, the shapes of which

do not deviate markedly from a sphere. Application of the method to actual anomalies gives depths of the magnetic centers that roughly agree with the centers of the magnetic matter to which the anomalies are due. From an analysis of the magnetic changes which accompanied the 1940 eruption of Miyakejima volcano, it was concluded that the depth of the magnetic center was 2.9 km., in good agreement with the conclusions of Takahashi and Hirano that the changes were equivalent to those which would result if a sphere with center situated at a depth of 3 km. lost its susceptibility. In Part 2 the method is extended to cases in which the magnetic anomalies are given in dip, and the changes in dip that accompanied the 1935 earthquake are analyzed.—*M. C. R.*

12365. Nagata, Takeshi, Hirao, Kunio, and Yoshikawa, Haruo. Remanent magnetization of "Pleistocene" deposits—Paleomagnetism in Japan: Jour. Geomagnetism and Geoelectricity, v. 1, no. 2, pp. 52–58, 1949.

The intensity and direction of magnetic polarization in the upper 7 meters of the Narita bed, a horizontal layer of Pleistocene age, were measured with an induction-type magnetometer. The direction of magnetic polarization of each part of the layer is, roughly speaking, not much different from the present geomagnetic field although there is some evidence of regular systematic change with depth. The declination shifts westerly with increasing depth to a maximum at about 5 meters. Fluctuations in both declination and dip have periods of approximately 1,500 to 2,000 years (40 to 50 cm.). Examination of the statistical reliability of the apparent direction of polarization and constitution of remanent magnetism indicates that the direction of polarization ought to agree within a few degrees with the geomagnetic force at the time of deposition of the material.—*M. C. R.*

12366. Giorgi, Maurizio, Medi, Enrico, and Morelli, Carlo. Rilievo magnetico regionale nelle Marche per la istituzione di un Osservatorio Magnetico Centrale [Regional magnetic survey of the Marche region for the establishment of an [Italian] Central Magnetic Observatory]: Annali Geofis, v. 3, no. 2, pp. 143–171, 1950.

The Istituto Nazionale di Geofisica, in planning the erection of a new central magnetic observatory, has conducted preliminary magnetic surveys of many regions in central Italy. Extensive regional magnetic anomalies in Italy make many regions poor sites for a magnetic laboratory. The most promising area was the region along the Fabriano-Iesi-Falconara Alta railway where, from December 1949 to March 1950, detailed and very precise magnetic surveys were made. Three Schmidt magnetic balances were used, one remaining at the base observatory. The average precision of the readings was better than ±5 gammas. More than 400 stations were occupied. The results of the survey show that the selected region is well adapted for the erection of the magnetic observatory.

The report contains numerous tables, readings made at 170 stations, determinations of the average errors, graphs of transient variation of the magnetic vector, and maps. The procedures and methods followed in the survey were based on the results of the special study by C. Morelli. (*See* Geophys. Abstract 12360.)—*S. T. V.*

12367. Koshikawa, Yoshiaki. Magnetic survey in the area of topographical deformation of Volcano Usu: Tokyo Univ. Earthquake Research Inst. Bull., v. 27, pts. 1–4, pp. 21–25, 1949.

A magnetic survey was made with a Schmidt-type Askania approximately two months before the June 1944 eruption and two months after the upheaval of the ground at the eastern foot of the volcano. Measurements of the relative intensity of the vertical component were made at 100 stations over a 7-kilometer distance along a north to south road. The magnetic profile showed positive anomalies in the upheaval areas, and a sharp negative in a mineral spring zone. It is concluded that basic rock such as the somma lava, which lies at a depth of 120 meters, was elevated by active magma.—*M. C. R.*

12368. Ferraz de Carvalho, Anselmo. Estudos de geologia e de geofisica [Studies in geology and geophysics], 143 pp., Coimbra Univ. Pub., 1950.

This is a collection of articles and lectures on geological, meteorological, and geophysical subjects. Included are an analysis of modern conceptions and hypotheses of volcanism in connection with different geodynamic phenomena, especially of orogenic nature; the variations of the gravity vector at any point of the earth's surface and of oceanic tides caused by the action of the moon and the sun; seismic phenomena and the methods of their investigation; terrestrial magnetism, methods of studying geomagnetic phenomena, and periodic and spontaneous variations of geomagnetic field. Tables of annual means of geomagnetic vectors, as determined at the Geophysical Institute of the University of Coimbra for the years 1878–1925 and at the observatory of Lisbon for 1858–1898 are also given.—*S. T. V.*

## SEISMOLOGY

12369. Roberts, E. B. and Ulrich, F. P. Seismological activities of the U. S. Coast and Geodetic Survey in 1948: Seismol. Soc. America Bull., v. 40, no. 3, pp. 195–216, 1950.

Activities of the Bureau during 1948 are summarized. Included are tables of 43 earthquakes in western United States of intensity 5 or greater on the Mercalli scale; isoseismal maps of the earthquakes of March 11 in northwest Texas, December 4 in southern California, and December 29 in western Nevada; a list of strong-motion records; tiltgrams from Long Beach and Berkeley; and a seismic probability map for the United States.—*M. C. R.*

12370. Macelwane, J. B. Jesuit Seismological Association Twenty-fifth Anniversary Commemorative Volume, 347 pp., St. Louis, 1950.

This volume is divided into three parts: the first, a sketch of the history of the Association and its Central Station; the second, a series of chapters describing each of the seismological stations or observatories that have at any time been members of the Jesuit Seismological Service or the Jesuit Seismological Association; and the third, a list of publications by personnel at any time connected with the Jesuit Seismological Association or its member stations.—*N. A. S.*

12371. Agarwala, K. S. Studies in seismology in the India Meteorological Department: Jour. Sci. Ind. Research, v. 9, no. 4, pp. 116–118, 1950.

The activities of the India Meteorological Department during the past forty years are reviewed. At present, seismological observatories are maintained at

Colāba, Calcutta, Delhi, and Kodaikānal, and an experimental station at Poona, chiefly devoted to the design and improvement of instruments. These observatories are equipped with Milne-Shaw seismographs, supplemented by Omori-Ewing instruments and several high-magnification Wood-Anderson seismographs. Plans are being made for setting up a first-class seismological observatory at Shillong which is in a region of intense seismic activity.—*S. T. V.*

12372. Broggi, J. A. Ciclo de conferencias sobre sismología [A course of lectures on seismology]: Peru Soc. Ing., Inf. y Mem., v. 51, no. 6, pp. 344–347, 1950.

The Escuela Nacional de Ingenieros has included a course of lectures on seismology in its curriculum. The program includes fundamental knowledge of earthquakes; theory of seismometers and other instruments used in the study of earthquakes; the effect of seismic shocks on different structures; seismic methods of exploration for minerals and for investigation of dam sites.—*S. T. V.*

12373. Savarenskiĭ, E. F., and Kirnos, D. P. The elements of seismology and seismometry [in Russian], 344 pp., Gostekhizdat, 1949. (From the review by E. A. Koridalin in Sov. Kniga, no. 10, pp. 38–41, 1950.)

The book is written in two parts, the first by Savarenskiĭ, on the theory of the propagation of elastic waves through the earth and the methods of interpretation of seismic observations; the second by Kirnos, on the organization of seismological observations and the theory of instruments.—*S. T. V.*

12374. Valle, P. E. Contributo allo studio delle onde di Love [Contribution to the study of Love waves]: Annali Geofis., v. 3, no. 2, pp. 231–250, 1950.

By calculating the spectral distribution of the energy associated with a non-monochromatic Love wave, it is possible to evaluate the intensity at the surface per unit of energy, as a function of the frequency of the wave.

It is found that the energy shows a maximum for a certain value of the frequency, which decreases as the thickness of the overlying layer increases. At frequencies higher than those corresponding to this maximum, the energy decreases rapidly to zero; at lower frequencies, the energy decreases slowly to a finite value. The effect of the dissipation of energy is to reduce rapidly the intensity of high frequencies, thus decreasing, in general, the predominant frequency as the distance increases.

The passage of Love waves from one layer to another causes a redistribution of the spectrum of the intensity at the surface. When the wave passes to a thicker layer, lower frequencies are amplified and the higher frequencies are reduced. The reverse takes place in the transition to a thinner layer. (*See also* Geophys. Abstract 12173.)—*S. T. V.*

12375. Gassmann, Fritz, and Weber, Max. Krystallbeschleunigungswesser des Institut für Geophysik der ETH [The crystal accelerometer of the Institute for Geophysics of the Federal Technical High School]: Schweizer. naturf. Gesell. Verh., 129 Versammlung, pp. 105–107, 1949.

An accelerometer for use in studying industrial vibrations and in seismic surveys has been developed and constructed by the Institut für Geophysik in Zürich. The principal element is a crystal of Rochelle (Seignette) salt which generates an electromotive force under the bending action of inertia forces caused by the acceleration to which it is exposed. This electromotive force is

amplified and measured by an indicator consisting of a similar crystal sensible to torsion provided with a minute mirror, making it possible to record the vibrations photographically.

The sensitivity of the instrument may be as high as 0.05 mm./sec.$^2$ per 1 mm. of the scale. In the frequency range of 1 to 400 c.p.s. the error of the reading is less than 1 percent and the phase displacement is less than 6°. The magnification is $8\times10^4$ for 10 c.p.s. and $8\times10^6$ for 100 c.p.s. The speed of the recording paper may be as much as 3 m./sec.

The equipment has been repeatedly tested in the field, in measuring vibrations of the buildings, paved streets, bridges, and in seismic investigations of dam sites and similar applications.—*S. T. V.*

12376. Sulkowski, E. I. The University of Pittsburgh pen-and-ink recording seismograph: Seismol. Soc. America Bull., v. 40, no. 3, pp. 165–168, 1950.

A system for pen-and-ink recording of the output of a seismometer, such as the Wenner, is described. The light beam is reflected from the galvanometer to an R. C. A. 1P21 phototube placed horizontally in the path of the reflection. A General Electric type C. E. photoelectric recorder is used to transform the output of the 1P21 tube into pen-and-ink recording. Standard recording drums may be used.—*M. C. R.*

12377. Volk, J. A. The photoelectric seismograph: Seismol. Soc. America Bull., v. 40, no. 3, pp. 169–173, 1950.

A visual-recording seismograph, using a photoelectric cell in conjunction with the standard photographic method, has been developed at St. Louis University. A standard 6-volt exciter lamp is used as a light source and the light beam is focused in a V-shaped light wedge after being reflected from the galvanometer mirror. The modulated light beam is received by a type 918 photoelectric cell. Pulses from the photoelectric cell are amplified by means of a standard AF amplifier with linear response from 100 to 1,000 c.p.s. Type 5693 and 6F6 tubes in pentode connection are used in a resistance-coupled amplifier to provide sufficient gain and output, after rectification by a germanium crystal, to drive a standard 0–5 MA ink recorder.—*M. C. R.*

12378. Nasu, Nobuji. Strong motion vibrograph: Tokyo Univ. Earthquake Research Inst. Bull., v. 25, pts. 1–4, pp. 57–60, 1947.

A three-component mechanical seismograph has been designed for measuring strong vibrations such as those of bridges or railway banks resulting from the passage of trains. Horizontal components are inverted pendulums. The movable part of the vertical component is suspended by a pair of helical springs, the lower ends of which are hooked to the pendulum bob. Periods of all components are 0.4 second, and air damping is used. Magnification is seven.—*M. C. R.*

12379. Ikegami, Ryohei. A nomogram for magnification of seismometer: Tokyo Univ. Earthquake Research Inst. Bull., v. 26, pts. 1–4, pp. 55–56, 1948.

A nomogram is given for determination of true amplitude of ground motion when the constants of the seismometer and recorded amplitude and period are known.—*M. C. R.*

12380. Volk, J. A. Microseismic arc light timer: Electronics, v. 23, no. 5, pp. 190–196, 1950. St. Louis Univ. Inst. Technology Pub. no. 45.

A timing marker which makes use of an arc light tube in conjunction with the usual tuning-fork oscillator is described. A circuit diagram is given.—*M. C. R.*

12381. Röthlisberger, Hans. Messung der Geschwindigkeit elastischer Wellen in Sandstein [Measurement of the velocity of elastic waves in sandstone]: Schweizer. naturf. Gesell. Verh., 129 Versammlung, pp. 107–109, 1949.

The velocity of propagation of seismic waves in different rocks of the Swiss Alps was measured using the accelerometer designed by the Institut für Geophysik. (*See* Geophys. Abstract 12375.) At the same time elastic properties and densities were measured in a laboratory.

In the field, explosions of about 40 kg. gum dynamite were electrically produced and recorded. The time of arrival of the first wave was determined at distances greater than 5 meters from the shot point. The accuracy of time recording was about 0.1 millisecond. Determinations of the velocity were made in sandstones that varied slightly in water content, color and other properties. Velocities in general ranged from 2.0 to 2.5 km./sec. with a velocity of 3.075 km./sec. in one place. Where it was possible to determine the time of arrival of the transverse wave, Poisson's ratio was found to be $0.258 \pm 0.005$.

In the laboratory, the measurements were made on sandstone samples of 4 x 4 x 80 cm., which were excited to vibrations after they had been clamped in a vise at one end. The computed values of the velocity were always lower than those found in the field even though corrections for three dimensional stress conditions were taken into account. The causes of these discrepancies are not clear.—*S. T. V.*

12382. West, S. S. Dependence of seismic wave velocity upon depth and lithology: Geophysics, v. 15, no. 4, pp. 653–662, 1950.

Relatively pure clastic sediments have interval velocities given quite closely by the general formula $v=v_0\ (1+cz/v_0^4)$, where $v_0$ is a constant characteristic of the rock and $c$ is 3.3 km.$^3$/sec$^4$. From this equation can be determined a function $v^4=9.5\ cz$ which defines the minimum possible velocity at a given depth and the maximum depth at which a given velocity can occur. An upper limit of velocity is given by data on limestones and by refraction measurements from 8 to 50 km. The limiting curves converge near 150 km. depth toward the function $v^5=180z$ which holds from 200 km. to the boundary of the core at 2,900 km.

It is suggested that velocity increases with decrease of porosity. The lower limit of velocity may correspond to the maximum porosity permitted by a given overburden and the upper limit is the velocity attained at zero porosity. Abnormal velocity functions may indicate a change of grain size in the sediments with depth and thus give a clue to migrations of ancient shorelines.—*M. C. R.*

12383. Kanai, Kiyoshi. On the existence of the $M_2$ waves in actual seismic disturbance: Tokyo Univ. Earthquake Research Inst. Bull., v. 26, pts. 1–4, pp. 57–60, 1948.

To confirm the existence of $M_2$ waves (Rayleigh waves along the boundary between the layer and subjacent medium), seismograms of two shallow earthquakes were analyzed. A phase was identified with minimum group velocity and period in close agreement with those predicted by theory.—*M. C. R.*

12384. Caloi, Pietro, Marcelli, L., and Pannocchia, G. Ancora sulla velocità de propagazione delle onde superficiali per tragitti subatlantici. Tentativo di prospezione profonda del bacino Atlantico, mediante le curve di dispersione delle onde $L_Q$ [Further note on the velocity of surface waves through sub-Atlantic paths. An attempted exploration of Atlantic basin deeps using the dispersion curve of $L_Q$ waves] : Annali Geofis., v. 3, no. 2, pp. 215–222, 1950.

Additional evidence is presented to support the conclusion that the Atlantic basin, at least in its north-central part, is, with respect to the propagation of surface waves, identical with the Pacific basin. A tentative determination of the thickness of the upper layer under the Atlantic Ocean is made on the basis of the dispersion curve of $L_Q$ waves. If the granitic layer is assumed to be absent or of negligible thickness, the thickness of this layer is about 17 km., of the same order as the similar layer under the Pacific Ocean.—*S. T. V.*

12385. Peronaci, Francesco. Determinazione del valore medio dello spessore dello strato di granito per i tragitti Turkestan-Europa [Determination of the average thickness of the granitic layer between Turkestan and Europe] : Annali Geofis., v. 3, no. 3, pp. 407–410, 1950.

From the dispersion of Love waves on the seismograms recorded at eight European observatories for the violent earthquake of November 2, 1946, the average thickness of the granitic layer over the Turkestan-Europe path was found to be 18 km.—*S. T. V.*

12386. Schulze, G. A., and Förtsch, Otto. Die seismischen Beobachtungen bei der Sprengung auf Helgoland am 18 April 1947 zur Erforschung des tieferen Untergrundes [Seismic observations during the explosion on Helgoland on April 18, 1947 for the exploration of the crust] : Geol. Jahrb., Band 64, pp. 205–242, 1950.

Seismic observations of the Helgoland explosion were made at the Leipzig, Jena, and Stuttgart observatories, and at 24 seismic stations, along three profiles south, south-east, and north-east from the source. The velocities of $\overline{P}$ and $\overline{S}$ were 5.40 km./sec. and 2.94 km./sec. indicating a Poisson's ratio of 0.288. The thickness of this layer is 6.0 $\pm$ 1.0 km. The travel time curves of $\overline{P}$ and $\overline{S}$ are straight lines.

The $P^*$ wave appears on seismograms of stations at distances greater than 107 km. The velocity for the first 200 km. is 6.18 km./sec., and then suddenly increases to 6.6 km./sec. The depth of the $P^*$ layer is 9.3 $\pm$ 1.5 km. The velocities of $S^*$ are 3.67 km./sec. and 3.87 km./sec., and Poisson's ratios are 0.228 and 0.238.

At all stations in northwestern Germany, the $P_n$ velocity was 9.32 km./sec. but beyond this region the velocity was 8.14 km./sec. This decrease may be the effect of an inclined boundary surface of the peridotite layer, but gravity measurements contradict this assumption. The $S_n$ velocity is 4.38 km./sec., and Poisson's ratio is 0.283.—*S. T. V.*

12387. Tuve, M. A., Goranson, R. W., Greig, J. W., and Rooney, W. J. Progress report on studies of deep crustal layers by explosive shots: Union géod. géophys. internat., Sec. Séismologie, Travaux sci., Ser. A, fasc. 17, pp. 5–6, 1950.

A preliminary report on the program of the Carnegie Institution of Washington. (*See also* Geophys. Abstract 11098.)—*M. C. R.*

12388. Dobrin, M. B. Submarine geology of Bikini Lagoon as indicated by dispersion of water-borne explosion waves: Geol. Soc. America Bull., v. 61, no. 10, pp. 1091–1118, 1950.

The normal-mode theory of Pekeris has been applied to water-wave dispersion recorded from the seismic-refraction survey of Bikini Lagoon. Investigations of water waves of 50 c.p.s. and higher, in the lagoon within 1-2 miles of reefs, give results compatible with normal-mode predictions for a liquid bottom and with refraction indications. The data show a speed of 1.05 times that of water within 20 feet of the bottom increasing to 1.3 at a depth of about 40 feet. Results of shots farther from the lagoon edge indicate speeds in the bottom much higher than shown by the refraction data. Dispersion patterns from shots in the central part of the lagoon show a discrepancy with the Pekeris theory that is attributed to a lateral variation in sedimentary composition between the edge and center of the lagoon. The Airy waves give information on the structure of the bottom to a depth of about 400 feet. Their group velocity and frequency are as predicted by the Pekeris theory for a bottom velocity of 6,500 ft./sec., which was found in the refraction studies. The fact that the Airy waves agree with the theory and the high-frequency waves do not, for data from shots near the lagoon center, suggests that the lateral change in type of sediment disappears within a depth of 100 feet.—*J. L. M.*

12389. Murphy, L. M. United States Earthquakes 1947: U. S. Coast and Geodetic Survey Serial No. 730, 62 pp., 1950.

This publication summarizes earthquake activity in the United States and regions under its jurisdiction in 1947. Included are noninstrumental reports (felt reports) of 223 earthquakes in the United States, Alaska, the Hawaiian Islands, Panama Canal Zone, and Puerto Rico, a summary of instrumental epicenters for 1945 of earthquakes recorded in the United States, epicenters of the principal earthquakes of the world during 1947, and analyses of strong-motion records. The most severe shocks in the United States in 1947 were those of November 23 in southwestern Montana (intensity 8), April 10 in southern California Manix fault (intensity 7), and October 16 southwest of Fairbanks (intensity 8).—*M. C. R.*

12390. Krinitzsky, E. L. Geological investigation of faulting in the lower Mississippi Valley: U. S. Waterways Experiment Station, Tech. Mem. 3-311, 89 pp., 1950.

The lower Mississippi Valley is a region of not infrequent earthquakes resulting from faulting in the bedrock underlying the Recent alluvium. Between 1915 and 1931, 25 shocks were recorded that centered in Missouri, 16 in Arkansas, and several more in Illinois, Tennessee, Kentucky, and Mississippi. Since October 1909, when the St. Louis seismological station was established, some 30 earthquakes have been observed in the lower Mississippi Valley.

Engineering structures in most of this region may be designed without particular reference to possible future faulting, but when an important structure is to be built in a known or suspected fault area, foundation conditions should be studied with the idea that special earthquake-resistant features may be necessary in the design.—*S. T. V.*

12391. Tercedor, Mariano. Estudio sismotectonico de la vega Granadina [Seismotectonic investigation of lowland of Granada]: Rev. Geofís., v. 9, no. 34, pp. 189–209, 1950.

The seismicity of Andalusia is studied on the basis of seismologic data of 300 earthquakes between 1908 and 1947 recorded at the Osservatorio Geofisico de Cartuja. The following conclusions were reached: because of the lower strength of the upper layer of Quarternary alluvium, shocks propagating through it are not as violent as those in surrounding Miocene strata; tectonic fractures below the Granada lowland extend to a depth of only a few kilometers; along and near the seismotectonically important line that runs across the province along the Río Genil are found the centers of all precisely located earthquakes; a pronounced fault line of probable seismotectonic importance can be established along the boundary of the Sierra Nevada, where gravimetric data indicate the separation of structures characterized by great differences in densities; numerous regularly occurring weak earthquakes suggest periodic readjustments of relatively small blocks accompanied by lesser liberations of energy.—*S. T. V.*

12392. Milosavlevič, R. A. Seismologic characteristics of the Jastrebac region [in Serbian]: Annales Géolog. peninsule Balkanique, tome 18, pp. 231–244, 1950.

Earthquakes in the region of the Jastrebac, an ancient crystalline mass surrounded by Cretaceous and Neogene sediments, are quite frequent but comparatively weak (intensity 6). Their epicenters form several pronounced seismogenic lines. The region is divided by a line crossing the mountain from west to east into two seismically different areas, a more stable southern half and a labile northern one. A map of the region is included.—*S. T. V.*

12393 Galanopulos, A. G. Die seismizität von Messenien [The seismicity of Messenia] [With summary in French]: Gerlands Beitr. Geophysik, Band 61, Heft, 3, pp. 144–162, 1950.

The seismicity of the southern part of Pelóponnisos has been studied on the basis of macroseismic observations collected since antiquity. Seismotectonic evidence indicates that Messenía is divided into two zones of different seismicity. One, bordered on the west and northwest by the Pliocene formations of the upper Elide, on the northeast and east by the valley of Alfiós and by the basin of Megalópolis, and on the south by the deep valley of Dervenion, is free of faults, and the intensities of earthquakes felt there never surpass degree 8 of the Rossi-Forel scale. The rest of Messenía frequently experiences violent earthquakes. Seismic observations confirm Philippson's hypothesis that this area is a typical plane of dislocation. The greatly dissected southern portion of Messenía bears evidence of extreme seismic activity in the past, contrasting with the stability of the mountainous massif of the north. Both the seismicity and the Pliocene downwarping and post-Pliocene rise of the Messenian peninsula decrease towards the south.—*S. T. V.*

12394. Gorshkov, G. P. Earthquakes in the territory of the Soviet Union [in Russian], 118 pp., Moscow, Geografgizdat, 1949. [From the summary by D. G. Panov in Vses. Geogr. Obsch Izv., tom 82, no. 4, 1950].

This is a geographic tabulation and a historical sketch of earthquakes occurring within the boundaries of the Soviet Union. An introductory chapter

contains general information on the causes and the forms of seismic phenomena, methods and instruments for their study, and measurements of the intensity and the energy involved.—*S. T. V.*

12395. Masarskiĭ, S. I. The epicentral zone of the aftershocks of the earthquake in Ashkhabad [in Russian]: Akad. Nauk SSSR Doklady, tom 74, no. 3, pp. 481–483, 1950.

The violent earthquake of October 6, 1948, in Turkestan was followed by a long series of aftershocks. For the precise observation of these aftershocks and for the study of tectonic details of the earthquake, additional instrumental equipment was set up in the nearest seismological observatory in Ashkhabad and five temporary seismic stations established in the area of 50 by 60 km. within degree 9 on the isoseismal map.

Observation of the aftershocks was extended until October 1949. The epicenters of the stronger aftershocks were determined, using Wadati's method, and the focal depths were computed, assuming the velocity of seismic waves in upper layers to be 3.2 km./sec.

The foci were found to lie at depths of not more than 15 km. and in two groups about 40 km. apart. The possibility is suggested that a deep rupture of this length was produced by the initial earthquake, and that the equilibrium is now slowly being restored.—*S. T. V.*

12396. Korn, H., and Martin, Hans. Erdbeben in Südwestafrika [Earthquakes in South-West Africa]: Geol. Rundschau, Band 38, Heft 1, pp. 19–23, 1950.

Data on the seismicity of South-West Africa collected by the Meteorological Institute of Windhoek include 435 observations of 223 earthquakes during the years 1911–1938. No instrumental records are available. The shocks were weak, only 23 reaching intensity 5 on the Mercalli scale, and only 8 causing damage to buildings. During one earthquake, that of October 10, 1925, a crack in the ground about 2 cm. wide and over 1 km. long was observed. Most of the earthquakes occurred in the Windhoek plateau in the elevated portions of the Damaraland, where on the average 8 earthquakes were observed annually. Most of the earthquakes were observed in the second half of the year, especially during August and September. This may be related to the decrease of barometric pressure during that time.—*S. T. V.*

12397. Nasu, Nobuji. Block movement along the seismic fault (1) (Fukui fault and others): Tokyo Univ. Earthquake Research Inst. Bull., v. 27, pts. 1–4, pp. 27–33, 1949.

The fault which was active during the Fukui earthquake was detected by precise triangulation surveys of the Geophysical Surveys Bureau. The fault terminates near the coast line of the Japan Sea and extends about 25 km. in a S. 20° E. direction in the northern part and S. 7° E. in the southern part. In general, there has been uplift on the eastern side and subsidence on the western. The horizontal shift along the fault has been estimated as 230 cm. in the northern part and 167 cm. in the southern. A resurvey a year after the earthquake indicates that the fault is still active.—*M. C. R.*

12398. Oulianoff, Nicolas. Commentaires géologiques des resultats du nivellement dans la region Sierre-Montana-Sion effectué à la suite du seisme du 25 janvier 1946 [Commentary on the results obtained from the leveling of the region Sierre-Montana-Sion, made as a result of the earthquake of January 25, 1946]: Schweizer. naturf. Gesell, Verh., pp. 103–105, 1949.

The valley of the Rhône between Sierre and Sion, which was the epicentral region of the earthquake of January 25, 1946, was surveyed with high precision in 1916, 1924, 1927, and 1947. Repeat leveling included the determination of the altitude of 59 bench marks. In many places the bench marks were initially set in unfavorable locations, as on alluvial terrain, and consequently now show subsidence not related to seismic effects. For bench marks placed on solid rocks, settlement ranging from 20 to 50 mm. were found, attributable directly to seismic shocks.—*S. T. V.*

12399. Sato, Yasuo. Possibility of optical explanation of visible wave motion of ground: Tokyo Univ. Earthquake Research Inst. Bull., v. 25, pts. 1–4, pp. 37–41, 1947.

A possible explanation of reported visible wave motion of the ground may be a change in the density of air and consequent curvature of optical path by compressional waves in the air resulting from vertical movement of the ground. Numerical examples indicate the effect is too small to be detected by the naked eye.—*M. C. R.*

12400. Omote, Syun'itiro. Earthquake damages in Yokohama City due to the great Kwanto earthquake of September 1, 1923: Tokyo Univ. Earthquake Research Inst. Bull., v. 27, pts. 1–4, pp. 57–62, 1949.

The numbers of totally destroyed wooden houses were used to prepare a map showing the degree of earthquake damage. The area in which damage exceeded 90 percent occupies a large part of the city.—*M. C. R.*

12401. Omote, Syun'itiro. The relation between the earthquake damages and the structure of ground in Yokohama: Tokyo Univ. Earthquake Research Inst. Bull., v. 27, pts. 1–4, pp. 63–68, 1949.

From a study of the relation between the destruction of wooden houses (*see* Geophys. Abstract 12400) and geologic structure, it was found that, with certain exceptions, the thickness of the uppermost layer of reclaimed soil is closely related to the amount of damage; that places underlain by thick alluvium experience serious damages, the damage rate increasing conspicuously as the thickness of alluvium exceeds 30 meters; and that damage is slight on sand spits or compacted sandy shores.—*M. C. R.*

12402. Sato, Yasuo. Relation between seismic intensity and epicentral distance: Tokyo Univ. Earthquake Research Inst. Bull., v. 26, pts. 1–4, pp. 91–93, 1948.

From studies of the felt reports of several earthquakes, a straight line formula $I=a+b\Delta$ was determined for the relationship between intensity and distance. The value of $a$ ranges from 3.5 to 8.4, that of $b$ from $-0.71$ to $-1.40$.—*M. C. R.*

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12403. Ikegami, Ryohei. On the anomalous distribution of the maximum amplitude of earthquake motions: Tokyo Univ. Earthquake Research Inst. Bull., v. 26, pts. 1–4, pp. 83–89, 1948.

The distribution of maximum amplitudes of 91 earthquakes recorded at the principal stations in the Kwanto and Chubu [Chūbu-chihō] districts of Japan was investigated. In general the maximum amplitude decreases as the epicentral distances increase. Several anomalies, with too large or too small amplitudes regularly observed at certain stations, are attributed to the mechanism at the origin or to the geologic structure in the path of the waves.—*M. C. R.*

12404. Minakami, Takeshi and Sakuma, Shuzo. The earthquake motions on various formation of the earth's surface (I). Observation at Kōti City: Tokyo Univ. Earthquake Research Inst. Bull., v. 26, pts. 1–4, pp. 61–66, 1948.

Seismographs were set up at 14 stations on different formations in Kōti to record aftershocks from distances of more than 100 km. for a period of 26 days in March and April, 1947. Amplitudes were remarkably large on alluvial formations and motion lasted longer. Periods were longer on the alluvium and tended toward a fixed value. Amplitudes of nearby shocks, in which short periods predominate, were considerably reduced.—*M. C. R.*

12405. Sakuma, Shuzo. The earthquake motions on various formations of the earth's surface (II). Observations at Gobō and Kiribe: Tokyo Univ. Earthquake Research Inst. Bull., v. 26, pts. 1–4, pp. 67–73, 1948.

Observations of the aftershocks of the Nankai earthquake indicate that greater amplitude and longer periods are found on alluvium.—*M. C. R.*

12406. Valderrama Suárez, Mariano. Construcciones asísmicas [Earthquake-proof constructions]: Peru Soc. Ing., Inf. y Mem., v. 51, no. 6, pp. 339–341, 1950.

This is a brief discussion of the recommendations adopted by the Sixth Pan American Congress of Architects concerning structural precautions against damage caused by earthquakes.—*S. T. V.*

12407. Bernard, Pierre. Enregistrements microséismiques à Nantes [Microseimic recording at Nantes]: Annales Géophys., tome 6, no. 3, pp. 147–156, 1950.

The seismograms obtained at the new observatory of Petit-Port at Nantes during the first months of 1949 were analyzed and compared with those obtained at the old observatory of Saint-Maur. The Nantes observatory is erected on granite, that of Saint-Maur, on sedimentary rock. The periods of waves recorded on both seismograms were usually equal, but the amplitudes at Saint-Maur were regularly greater than those at Nantes, the ratio of the vertical amplitudes being 1.31 for waves of 5.3-second period, 1.13 for waves of 6.3-second period, 1.05 for waves of 6.9 second period, and 1.03 for longer waves of 7.5 second period. Ratios of the horizontal to vertical components, and of the north-south and east-west components at both stations in most of the observations agree with A. W. Lee's theoretical calculations. The maximum amplitudes of microseisms at Saint-Maur are associated with cyclones over Iceland and Faeroe Islands, but no such correlation was found at Nantes, perhaps because of the tectonic fea-

tures of this basaltic region that are also indicated by magnetic anomalies.—*S. T. V.*

12408. Caloi, Pietro. Due caratteristici tipi di microsismi [Two characteristic types of microseismic disturbances]: Annali Geofis., v. 3, no. 3, pp. 303–314, 1950.

In the opinion of the author both coastal surfs and microbaric oscillations near the center of a cyclone can cause microseisms. Examples observed in the Adriatic Sea are cited. When cyclonic minima move across the northern part of the Adriatic Sea toward the Gulf of Trieste with a velocity characteristic of the propagation of free sea waves, they produce violent changes of the level in the gulf followed by the appearance of seiches. Later, when the cyclone reaches the gulf, seismographs begin to register microseismic disturbances with periods ranging from two to three seconds. The amplitudes of these microseismic waves gradually grow and attain maxima at the time of the sharp rise of barometric pressure. These microseisms are obviously produced by a combination of two phenomena—appearance of short period microbaric oscillations during the rapid rise of atmospheric pressure, and a sea level substantially below normal. This however, takes place only in the immediate vicinity of the coast.

A typical example of microseismic waves caused by the action of violent surf hitting the seashore was observed during the storm of January 23–27, 1950, along the coast of Catania when horizontal amplitudes up to 60 microns and vertical amplitudes up to 40 microns were registered. At the same time no microseismic waves were registered at Messina, only 85 km. from Catania. This suggests the existence of a geologic discontinuity between the two locations that may be attributed to the volcanic action of Monte Etna.—*S. T. V.*

12409. d'Henry, G. Sulla natura fisica dei microsismi [The physical nature of microseisms]: Annali Geofis., v. 3, no. 1, pp. 87–94, 1950.

To investigate the possibility of determining the character of the microseisms from the analysis of three components of motion obtained at one station, disturbances originated from clearly localized cyclones with azimuths lying in the planes of the instrumental components were studied on the seismograms of the Rome and Trieste observatories. It is concluded that the behavior of the microseismic wave is completely irregular and does not show characteristic features of either Rayleigh or Love waves. This abnormality of the microseismic wave may be caused by successive reflections and refractions at discontinuities in the upper layer of the crust.—*S. T. V.*

12410. Giorgi, Maurizio, and Rosini, E. Sulla natura delle cause che generano i microsismi [The nature of the causes that generate microseisms]: Annali Geofis., v. 3, no. 2, pp. 173–213, 1950.

An investigation undertaken by the Istituto Nazionale di Geofisica in cooperation with the Servizio Meteorologico dell' Aeronautica Italiana of the relationship between microseismic phenomena and atmospheric disturbances is described.

The periods and amplitudes from hour to hour of about 50 microseism storms which occurred during the year 1949 were carefully determined and analyzed with relation to simultaneous cycles of meteorological changes, mostly in the Mediterranean, but often extending over the European continent. It is concluded that microseismic disturbances of periods varying from about two to six

or even ten seconds are causally related to the appearance over open bodies of water of atmospheric nuclei characterized by a positive barometric tendency. These nuclei of increasing barometric pressure may be either stationary or moving. The ultimate cause of microseisms must be periodic impulses of barometric pressure generated by turbulence in the upper layers of the atmosphere. (*See* Geophys. Abstract 11515.)—*S. T. V.*

12411. Morelli, Carlo. Studio comparativo dei microsismi registrati a Roma ed a Trieste [Comparison of the microseisms registered at Rome and at Trieste] : Annali Geofis., v. 3, no. 1, pp. 77–85, 1950.

Comparison of the period and amplitude of microseisms recorded simultaneously at Rome and Trieste shows that microseisms originating at a distance are always greater at Rome, the ratio being as high as 2 : 1. This is attributed to the effect of the alluvial layer on which the Rome seismological station is built. Microseisms of about 3.5-second period are greatly increased by resonance. Microseisms originated by disturbances over the Mediterranean also produce much greater amplitude at Rome Observatory.—*S. T. V.*

## ELECTRICITY

12412. Rikitake, Tsuneji. A method for studying the relations between the changes in geomagnetism and earth current: Tokyo Univ. Earthquake Research Inst. Bull., v. 25, pts. 1–4, pp. 9–13, 1947.

Anomalous changes in earth currents are known at times to precede earthquakes. However, the main changes in earth currents are due to variations in the magnetic field outside the earth, making it difficult to determine effects related to the earthquake itself. This paper presents a method of eliminating geomagnetic effects of external origin.

With the aid of the electromagnetic-field equations, an expression is derived for computing the electric field from values of electrical resistivity and the time rate of change of the magnetic field at the surface of the earth. The earth potential calculated by this method from magnetic data obtained during a solar eclipse was in good agreement with the observed potential. The method described should make it possible to obtain more information on the relation of changes in earth currents to earthquakes.—*R. G. H.*

12413. Norinder, Harald, and Salka, Oskars. The effect of geological discontinuities on artificial lightning discharges as studied in a model test arrangement: Arkiv för Geofysik, Band 1, Häfte 1, pp. 45–78, 1950.

In areas with varied geologic structure natural lightning strikes have been observed to concentrate in nests. This possible effect of geologic structure was confirmed by model experiments using electric sparks 75 and 170 cm. long striking a smooth, horizontal surface. Striking points were strongly concentrated at the edges of a vein of powdered iron ore embedded in sand; weaker concentrations were shown around clay veins, granite rocks, and horizontal strips of thin metal. Discharges from a negative electrode were much more poorly concentrated than those from a positive electrode. The paper includes charts of the striking-point distribution and of the electrical properties of the models, as well as high-speed photographs of the discharges and a brief explanation of the observed effects.—*D. F. B.*

12414. Tikhonov, A. N. Determination of electrical properties of deep strata of the earth's crust [in Russian]: Akad. Nauk SSSR Doklady, tom 73, no. 2, pp. 295–297, 1950.

A correlation between magnetic variations and telluric currents observed on the surface of the earth is derived on the basis of Maxwell's equations. In a simplified treatment, the earth's crust is assumed as a layer of finite electrical conductivity spread over a medium of perfect conductivity. The surface of the earth is assumed to be a plane and the vertical component of the electrical field very nearly vanishing on this plane. Two horizontal components of the electric field and the components of the magnetic field are known from observations. These conditions make it possible to write the basic Maxwell equations of the problem. The solution is a superposition of harmonic functions, from which it follows that for low frequencies the amplitude of the derivative of the magnetic variation is proportional to the intensity of the electrical field. For higher frequencies the amplitude of this derivative is a functon of the electrical intensity and its derivative. This relation produces a phase displacement determined by the electrical resistivity of the earth's crust. This equation makes it possible to draw conclusions about the electrical properties of deep layers of the crust from observed curves of variations of the magnetic and electrical field on the earth's surface.—*S. T. V.*

## RADIOACTIVITY

12415. Aler, Bo. The efficiency of a scintillation counter for gamma rays: Arkiv för Fysik, Band 2, Häfte 3, p. 225, 1950.

The general properties of a scintillation counter for gamma rays, consisting of a RCA 1P21 photomultiplier and an organic scintillator, were described and a comparison was made with the Geiger-Müller counter. Different methods to eliminate the dark current were discussed. With a reasonable background of 200 pulses per minute it is possible to count 50–60 percent of the Compton electrons from $Co^{60}$ gamma rays with a clear naphthalene crystal 2-centimeters thick. Using anthracene under the same conditions one can count about 90 percent of the Compton electrons.—*N. A. S.*

12416. Graf, T. Construction of a multiple gamma counter of high efficiency and short resolving time: Arkiv för Fysik, Band 2, Häfte 3, pp. 224–225, 1950.

By combining three different methods for increasing the efficiency of a Geiger-Müller counter for gamma rays, a new detector was constructed which has the the following advantages over a conventional brass counter: a higher efficiency, a shorter resolving time, a solid angle of nearly $4\pi$ for samples placed at the center of the multiple counter, and a distance function closely following the law of inverse squares.—*N. A. S.*

12417. Johansson, S. A. E. Some applications of scintillation counters: Arkiv för Fysik, Band 2, Häfte 3, p. 225, 1950.

Scintillation counters provide great counting speed, making it possible to use them for the determination of very intense radiation. The background of a counter, counting $10^7$ particles per second, has been eliminated by concidence coupling of two photomultipliers. The size of the impulses obtained from a

counter depends on the energy of the particles that penetrate into the crystal; this dependence can be used for determining the energy. Attempts have been made to measure the energy of alpha and gamma radiation from various sources in this way. Experiments have been conducted to find out the applicability of the scintillation counter in investigations of cosmic radiation.—*N. A. S.*

12418. Festa, C., and Santangelo, M. Sul decadimento del $K^{40}$ [On the disintegration of $K^{40}$]: Annali Geofis., v. 3, no. 1, pp. 95–101, 1950.

Methods for the measurement of the decay constant of $K^{40}$ and the results are critically analyzed with respect to their compatibility with basic geologic data. The most probable value of the decay constant $\lambda_\beta$ for disintegration with simultaneous production of beta rays is $(0.50\pm0.03)/10^9$ years. The constant $\lambda$ of the total decay is $(1.87\pm0.1)/10^9$ years. Recent experimental determinations of these constants by Graf, Ahrens and Evans, and Bleuler and Gabriel give an average value for $\lambda$ of $(1.89\pm0.2)/10^9$ years.—*S. T. V.*

12419. Tatel, H. E. Argon $^{40}$ and the age of the earth: Jour. Geophys. Research, v. 55, no. 3, pp. 329–336, 1950.

Potassium in the earth's crust cannot account for argon$^{40}$ in the atmosphere by a factor of perhaps ten, and it may thus be concluded that the argon$^{40}$, which appears to be of radiogenic origin and generated since the formation of the earth, originated from potassium within the earth's mantle. Estimates of the extent and time of this process are limited by a lack of knowledge of how much argon is entrapped within the earth. If there is none, then the argon, being in equilibrium with potassium, was produced in the last 1.5 billion years. If there has been entrapment, an age of 2.1 to 3.3 billion years would account for the atmospheric argon if only one-half to one-fourth respectively escaped. If it is assumed that the formation of the crust sealed off the interior and all argon generated subsequently has been entrapped, then the earth existed about 500 million years before the crust was formed.—*M. C. R.*

12420. Ippolito, Felice. Recenti dati sull età della terra [Recent data concerning the age of the earth]: Soc. Naturalisti Napoli Boll., v. 56, pp. 95–99, 1948.

A discussion of Holmes' and other recent methods of the determination of the age of the earth.—*S. T. V.*

12421. Coppens, René. Étude sur la radioactivité de quelques roches par la plaque photographique [Study of radioactivity of certain rocks by photographic method]: Soc. franç. minéralogie et cristallographie Bull., tome 73, no. 4–6, pp. 217–321, 1950.

Comparative tests of numerous specimens were made by photographic and other methods. The necessary experimental procedure is described in detail and several formulas are derived for determining the uranium and thorium content and the mixture of these elements.—*S. T. V.*

12422. Hée, Arlette. Recherches sur la radioactivité d'un granite des Vosges par la methode photographique [Investigation of the radioactivity of a granite from the Vosges by the photographic method]: Annales Géophys., tome 4, fasc. 3, pp. 242–252, 1948.

This is a detailed report of the experiments on a sample of granite to determine its radioactivity that were previously briefly described in the note to the

Academie des Sciences. (*See* Geophys. Abstract 11321.) The present article contains a detailed description of the procedure, reproductions of the photographs obtained, and analyses of the results. The examination of the traces of alpha particles on the photographs leads to the conclusion that the principal radioactive mass contained in the sample is uranium.—*S. T. V.*

12423. Hée, Arlette, Jarovoy, Michel, and Kleiber, Joseph. Etude des depôts actifs dus aux roches [Study of radioactive deposits present in rocks]: Annales Géophys., tome 6, fasc. 3, pp. 164–178, 1950.

In exploring the possibilities of the photographic method, experiments were made first with minerals containing only uranium, later with those containing thorium almost exclusively, and finally those containing uranium, actinium, and thorium. By using a more precise technique the numbers of disintegrated atoms of each of the active substances could be determined and certain quantitative results indicative of the radioactive contents obtained.—*S. T. V.*

## HEAT

12424. Benfield, A. E. Heat flow below the oceans: Nature, v. 165, no. 4194, p. 445, 1950.

Pettersson found the geothermal gradient in ocean-bottom sediments to be about 42° C./km., a value he considers unexpectedly high. (*See* Geophys. Abstract 11781.) However, if the low thermal conductivity of included water (0.0013 cal./cm. sec. deg. C.) appreciably influences the conductivity of the sediments, this high gradient may actually represent a lower heat flow than is usually found on the continents.—*D. F. B.*

12425. Rikitake, Tsuneji. A note on the temperature distribution within the earth: Tokyo Univ. Earthquake Research Inst. Bull., v. 27, pts. 1–4, pp. 17–20, 1949.

On the basis of previous study, it has been concluded that conductivity increases discontinuously below 400 km. to the order of $10^{-2}$ e.m.u., the outer layer being almost nonconducting with a conductivity of only $10^{-15}$ e.m.u. near the surface. From this conductivity distribution, a temperature distribution is inferred by a method similar to Coster's. (*See* Geophys. Abstract 10079.) The best fit is $T=273+\alpha x$ where $\alpha=3°$K./km. and $x=$the depth.—*M. C. R.*

## VOLCANOLOGY

12426. Jaggar, T. A. Steam-blast volcanic eruptions. (A study of Mount Pelée in Martinique as type volcano): Hawaiian Volcano Observatory, 4th Special Rept., 143 pp., 1949.

The report deals with the author's expedition to Martinique and St. Vincent in 1902 and comparison of the experiences of other investigators of "explosive" eruptions. The Hawaiian mechanism is reviewed with special reference to rifts, underground water, intrusion furnace, wedge rupture, and lowering of magma. These features of structure are applied to Martinique, St. Vincent, Kilauea, Tarawera Mountain, Sakura-jima, Katmai, Taal, and Tomboro to bring out the contrast in steam eruptions. For all volcanoes steam eruptions are believed to be resultant features of ground water and of collapse.

The Pelée disaster at St. Pierre May 8, 1902, which was followed by the extrusion of a dacite dome with spines and renewed activity in 1929, was observed for paroxysms of downblast. Structure sections are drawn to scale, and the structural reactions of intrusion, rifts, boiler, gas effervescence, heat, and timing are outlined; and their bearing on volcanism, in general, the zones of volcanism, and the reaction of magma is suggested. Steam blast is contended to be a climax of eruption in the water zone.

In the theoretical conclusions, the new approach (called Earth-core Volcanism) attempts to reconcile primitive moonlike earth volcanism to modern intrusive siliceous volcanism in contact with surface water. The author desires to stimulate experiment in earth exploration by physical testing and rock sampling under ocean basins. An extensive list of references is included.—*N. A. S.*

12427. Omer, G. C., Jr. Volcanic tremor (Pt. 2: The theory of volcanic tremor): Seismol. Soc. America Bull., v. 40, no. 3, pp. 175–194, 1950.

Volcanic tremor may originate in the vibration of laminae, composed of successive lava flows, ash beds, and magma intrusions, which are partly freed by differential tilting of the surface around a volcanic vent during an eruption. The force of magma ascending through a linear crack will buckle the laminae, freeing them near the surface, and the pulsation of the flowing magma then sets these partially free laminae into vibration. Approximate mechanical analyses have been made to determine the order of magnitude of the vibrational frequencies and relative amplitudes to be expected. In these analyses, the laminae were treated as vibrating bars, all damping terms were neglected, and the bars were regarded as rigidly clamped at one end, free at the end in contact with the magma column and perfectly free along the sides. This system of assumed bars may be set into longitudinal, flexural, or torsional nodes of vibration, but the weight of the evidence favors the longitudinal vibration as the best explanation of observed seismograms.—*M. C. R.*

12428. Coats, R. R. Volcanic activity in the Aleutian arc: U. S. Geol. Survey Bull. 974–B, pp. 35–47, 1950.

Of the 76 active or extinct major volcanoes recognized in the Aleutian arc, extending from Buldir Island on the west to Mount Spurr on the east, 36 have been active since 1760. When plotted against time, the activity of the arc shows some signs of periodicity, the intervals between maxima being multiples of 20 years. In this report the geographic positions and altitudes of all the known volcanoes are tabulated, together with all known eruptive activity between 1760 and 1948. The kind of activity that has characterized the arc is described briefly; a list of 17 calderas, 9 of them previously unmentioned in the literature, is given; and the relation of volcanism to the structure of the arc is reviewed.—*N. A. S.*

12429. Macdonald, G. A. and Orr, J. B. The 1949 summit eruption of Mauna Loa, Hawaii: U. S. Geol. Survey Bull. 974–A, pp. 1–31, 1950.

In beginning a new eruptive phase of Mauna Loa on January 6, 1949, lava broke out along a series of fissures extending part way across the summit caldera and a short distance down the southwest rift. Within 48 hours a flow that had advanced more than 6 miles down the western slope became inactive. Within 72 hours lava extrusion was entirely restricted to a short length of fissure at the foot of the southwest wall of the caldera where lava fountains as high as 800

feet built a large cone of pumice and fine cinder, with a small cone of coarse cinder and spatter in its crater. Quiet outflow continued until about the end of May. Except for the increase in the number of earthquakes during the month before the eruption, no definite premonitory pattern of earthquakes was recognized. For several days preceding the outbreak magnetic disturbances, possibly connected with magma movements, were observed near Honolulu, 190 miles away. The eruptive products, the bombing of lava flows, and the prediction of coming activity are discussed—*N. A. S.*

12430. Williams, Howel. Volcanoes of the Parícutin region, Mexico: U. S. Geol. Survey Bull. 965–B, pp. 165–274, 1950.

The oldest bedded rocks in the Parícutin region, the Zumpinito formation presumably of early Tertiary age, probably underlie Parícutin volcano at a shallow depth and are closely associated with coarse-grained gabbros of uncertain age. Following a long period of erosion, the post-Zumpinito volcanoes were built, presumably in late Pliocene or early Pleistocene time as they are considerably eroded. Since then different cones have discharged lavas of separate natures with no regular trend of differentiation as yet detected. Most of the young volcanoes are arranged without order, a few being parallel to the principal fissure zone at the new volcano, Parícutin. Parícutin's history, the petrography of the rocks of the region, and geologic maps of the area are presented.—*N. A. S.*

12431. Fries, Carl Jr., and Gutiérrez, Caledonio. Activity of Parícutin volcano from July 1 to December 31, 1949: Am. Geophys. Union Trans., v. 31, no. 5, pp. 732–740, 1950.

Eruptions from the crater continued to be extremely variable and activity seemed to be slightly less intense than during the preceding half year. The outward form of the cone did not change greatly. The elevation of the east peak remained unchanged at 2,774.2 meters above sea level, but the west peak rose nearly 17 meters through the accumulation of pyroclastic material. Lava continued to issue without interruption from the vent at the northeast base of the cone, and the old vent at the southwest base of the cone was active for a few days early in July. The flow from the northeast vent reached a maximum distance of 3,100 meters north and northwest at the end of December.—*M. C. R.*

12432. Petroeschevsky, W. A., and Klompé, Th. H. F. Het vulkanologisch onderzoek in Indonesië [Volcanological investigations in Indonesia]: Chronica Naturae, Deel 106, no. 5, pp. 187–206, 1950.

This is a brief review of the volcanological studies by the Koninklijke Natuurkundige Vereniging in Indonesië, prepared for its centenary celebration.

Numerous expeditions have been organized for topographic and morphologic studies, geophysical and chemical investigations, and purely volcanological observations of different volcanoes. Most of the craters have been precisely surveyed with photo-theodolites, maps were drawn, and detailed pictures of the craters were made from the air.

For seismological studies, the division now has 5 Wiechert seismographs, one Omori, one Milne, and several lighter instruments for field use. One recent acquisition is a tilt meter. Many magnetic measurements were made in the

craters. Gravity changes caused by the movements of the magma were also measured. Chemical analyses of volcanic gases are made regularly, and temperature measurements as high as 1,000° C. are made in boreholes. The Society publishes the Bulletins of the East Indian Volcanological Survey.

The article contains four photographs of craters and volcanoes, several tables with data on eruptions and a list of active volcanoes in the region with classification of their types.—*S. T. V.*

12433. Minakami, Takeshi. Recent activities of volcano Usu: Tokyo Univ. Earthquake Research Inst. Bull., v. 25, pp. 65–69, and 71–75, 1947.

Activity of Usu-dake started with a series of severe earthquakes in December 1943 and January 1944 at the northwestern foot of the mountain. This was followed by a great number of extremely shallow shocks at the eastern end and, simultaneously, a rapid rise of ground reaching a maximum of 50 meters at the center. The first explosion occurred June 23, 1944, near the center of the rising area. Explosive eruptions ceased in December 1944 but the upheaval and earthquakes continued until fall 1945 and viscous lava rose in the crater without overflowing. On the basis of geodetic and seismometric studies it is concluded that the activity was caused by viscous juvenile lava at a depth of 1–3 km. intruded into the upper crust near the eastern foot of Usu-dake and finally extruded.—*M. C. R.*

## TECTONOPHYSICS

12434. Andrée, Karl. Einige geologische Konsequenzen einer Erdentstehung auf kaltem Wege [Some geologic consequences of the formation of the earth by a cold process]: Forschungen u. Fortsch., Jahrg. 26, Heft 9–10, pp. 122–123, 1950.

A recent hypothesis proposes the formation of planets including the earth, as condensations of primeval cold nebula, thus denying any initial high heat content of the earth as a glowing, bright star. Stars are composed of light gases, those heavier than oxygen forming only one percent of the total mass of the sun, for example. The earth, however, is composed almost exclusively of substances heavier than oxygen. Almost the whole heat content of the earth is the result of radioactive disintegration and therefore, no shrinkage of the earth owing to cooling ever took place. This corollary of the hypothesis radically changes the old conceptions of orogeny and emphasizes the geotectonic consequences of primordial inhomogeneities of the earth's mass which resulted, in the extreme, in the separation of the moon.—*S. T. V.*

12435. Goguel, Jean. Les déplacements séculaires du pôle [The secular displacements of the pole]: Annales Géophys., tome 6, fasc. 3, pp. 139–146, 1950.

Many circulatory movements in the atmosphere, in the oceans, and in the earth's interior, have a total kinetic moment, which is not zero because of the unsymmetrical shape of continents. From analysis of these different phenomena, the conclusion is reached that a slow secular displacement of the pole may have occurred, of the order of 25 km. per million years. In about 400 million years since the beginning of the Paleozoic era, this displacement would amount to one-quarter of the meridian, if the forces always acted in the same direction.

In reality, changes in the direction of ocean currents as well as of atmospheric currents have certainly modified the direction of this displacement. Rapid displacements of the pole over important lengths are quite improbable.—*S. T. V.*

12436. Leiviskä, Iivari. Kallioperän murtumat maanjäristykset ja jääkautiset tapahtumat [Breaks, earthquakes and processes of the glacial age in their influence on the structure of rocks]: Terra, v. 59, no. 1, pp. 9–13, 1947.

The broken topography of the Finnish terrain, especially noticeable on the shore lines of inland lakes and on the southwestern coast of the country, which is cut by numerous inlets and bays, is caused by the faults that occurred at different times. According to Sederholm's theory, these faults are the results of earthquakes which occurred during and after the glacial period. Leiviskä believes the earthquakes of the present time are not related to the faults which occurred much earlier in the glacial period. At the present time earthquakes are noticeable in the central portion of the Fennoscandian uplift which extends in a northeasterly direction across the northern part of the Gulf of Bothnia. The earthquakes of recent times must be causally related to the continental uplift whose central portion trends in the same direction as the ancient fault.—*S. T. V.*

12437. Noetzlin, J. Bilans énergetiques en géophysique [Balances of energy in geophysics]: 62 pp., Actualitiés scientifiques et industrielles, no. 1038, Paris, 1948.

From detailed calculations of the amount of heat produced by different radioactive substances contained in the earth's crust, and critical analysis of relative data given by different scientists, it is concluded that these amounts were and are the dominating terms in total heat balance of the earth. Orogenic phenomena as well as volcanism are the results of slight local disturbances of thermal equilibrium, an excess of locally produced heat over that dissipated. As a result, a local rise of temperature takes place near the surface of the earth, or deeper in the crust, causing the folding of external layers or the local accumulation of fluid magma below the crust with subsequent possibility either of volcanic eruptions or rising of regional blocks.—*S. T. V.*

## INTERNAL CONSTITUTION

12438. Bonchkovskiĭ, V. F. Soviet science on the structure of the earth [in Russian]: Nauka i zhizn', no. 8, pp. 23–30, 1950.

This is a review of different hypotheses on the internal structure of the earth and a summary of the theory recently suggested by O. Ю. Schmidt. According to this theory the planetary system including the earth was torn from galactic masses by solar attraction. These masses, numerous in the Milky Way, are not luminous, and therefore the earth and other planets of the solar system never had the high temperature peculiar to the sun. Subsequent development of this idea leads to the conclusion that the temperature of the earth's interior increases only to a depth of about 100 km., chiefly from heat development by radioactive disintegration of elements in the earth's crust. At greater depths the temperature remains constant, but the pressure continuously increases. This combination of physical conditions brings about a decrease in the temperature of fusion

of different minerals precipitated at various depths and causes the stratification of the earth with formation of interlying liquid strata. Related seismologic evidence, especially the peculiar decreases of seismic velocity with depth, and the tidal effect of the sun and the moon on the solid and plastic masses of the earth are discussed and found to be in agreement with the theory.—*S. T. V.*

## EXPLORATION GEOPHYSICS

### GENERAL

12439. Fabiani, Ramiro. Problemi e metodi della ricerca petrolifera [Problems and methods of petroleum exploration]: La ricerca sci., v. 20, no. 8–9, pp. 1069–1094, 1950.

The origin of petroleum and the geologic conditions necessary for its preservation are discussed. In the second section the principles of the various geophysical methods, gravimetric, magnetic, electric, seismic, and radioactive, are analyzed, and practical applications of these methods are described, mostly by examples of American practices.—*S. T. V.*

12440. Taborda, B. A. A puntes sobre exploración geologica del petroleo [Remarks on geologic exploration for petroleum]: Dyna, no. 61, pp. 49–65, 1949.

The organization of a geological and geophysical survey for oil exploration including expenses, qualifications of personnel, organization of transport facilities, and selection of the instruments and equipment, are discussed.—*S. T. V.*

12441. Brasil Conselho nacional de petroleo. Relatorio de 1948 [Report for the year 1948], 154 pp., Rio de Janeiro, 1949.

Extensive geophysical exploration is being conducted chiefly in the states of Pará, Sergipe, and Bahia. Seismic refraction surveys of about 60,000 sq. km. were made along the Rio Corda, and the reflexion method was used in the Ilha de Marajó where 1,678 profiles were investigated. A gravimetric survey with 3,963 stations occupied was also made in the latter region. A magnetic survey was made in the Amazon valley. Other regions which were explored seismically were the central portion of the Estado de Sergipe and certain regions of the Estado da Bahia. Results of these surveys are presented as maps and profiles.—*S. T. V.*

12442. Dessau, G. Some results of geophysical prospecting conducted for the Geological Survey of India from 1945–1948: Geophysics, v. 15, no. 4, pp. 704–731, 1950.

Geophysical investigations conducted by the Geophysical Section of the Geological Survey of India are described. Included were magnetic surveys for iron-ore deposits near Daltonganj in Bihār Province, and for manganese deposits in the Central Provinces; spontaneous-polarization surveys for pyrite in the Son valley and for graphite at Dandatapa; electrical-resistivity and seismic-refraction surveys in connection with engineering problems; and electrical-resistivity investigations in coal-bearing areas. (*See also* Geophys. Abstract 12443.)—*M. C. R.*

12443. West, W. D. General report of the Geological Survey of India for the year 1948: India Geol. Survey, Records, v. 82, pt. 1, pp. 1–253, 1950.

Among the investigations of the geophysical section briefly described are the electrical-resistivity investigations in the Kamptee area, near the city of Nāgpur, to determine the boundary, which is everywhere covered by alluvium, between the possible coal-bearing formations and the surrounding Archean non-coal-bearing rocks. Determinations of depths to bedrock by both seismic and electrical-resistivity methods were made around the Manas railway bridge that has been dislocated by floods, and the results obtained by the two methods agreed fairly well. Similar surveys were also made in the Bombay Presidency to determine the depth to bedrock for bridge foundations. Investigations for manganese ore by the magnetic method were made in the Central Provinces. Horizonal magnetometer readings were made at more than 3,000 stations in an area of about ¾ sq. km. This survey was supplemented by electrical-resistivity and spontaneous-polarization measurements. The results indicate that although concordant results were obtained by the resistivity work, the magnetic method is the more suitable. A spontaneous-polarization survey for graphite deposits was made near Dandatapa, Athmallik, Orissa, with about 3,000 stations occupied over an area of about 0.6 sq. km. The results of prospecting for ground water by resistivity method in highly arid regions in west Rajputana indicated that the water-bearing zone is extremely thin and probably does not form a continuous water table. Salinity of ground water made the geophysical surveying most difficult.—*S. T. V.*

12444. Hallenbach, Franz. Physikalische Gesteinsdaten, Bestimmung und Verwendung [Physical properties of rocks, their determination and use]: Erdol u. Tektonik in Nordwestdeutschland, pp. 308–314, 1949.

Studies of the physical properties of rocks by the Amt für Bodenforschung in cooperation with other institutions, both in the laboratory and in the field, are described. Magnetic susceptibility, specific gravity, porosity, permeability, and elastic properties were studied. Some correlations of porosity with the depth of the formation and of seismic velocities and geologic age of a formation were noted. Investigations of the permeability of rocks suggested important deviations from d'Arcy's law. A negative correlation between the electrical resistivity of a formation and its radioactivity was established.—*S. T. V.*

## GRAVIMETRIC METHODS

12445. Olczak, Tadeusz. Pomiary wagą skrechén i problem wyznaczenia wyzszych pochodnych normalnych zewnętrznege potencjau siy ciężkosci [Measurements with the Eötvös torsion balance and the problem of determining the higher normal derivatives of the external gravity potential]: Poland Instyt. Geol. Biul., pp. 27–44, 1948.

A method of determining the first and second derivatives of the gravity force $g$ with respect to the vertical coordinate is presented. The procedure is based on the results from the measurements made with the torsion balance if the stations are dense enough, and on relations deduced from the Laplace equation. Both derivatives may be used with advantage in gravitational prospecting because both these values decrease rapidly with increasing distance from the disturbing mass.—*S. T. V.*

12446. Smith, N. J. The case for gravity data from boreholes: Geophysics, v. 15, no. 4, pp. 605–636, 1950.

Applications, instrumental requirements, and problems of interpretation of borehole measurements of gravity are considered, the analysis being hypothetical and qualitative.

A gravity meter in a borehole is subject to the free-air effect, the Bouguer effect, and the anomalous value. The free-air effect accounts for a linear increase in gravity for increasing depths; the Bouguer effect accounts for gravity effects of horizontal layering; and that portion of the gravity reading not accounted for by the free-air and Bouguer effects is the anomaly.

The body causing an observational anomaly may often be determined by indirect calculations of the effects of assumed idealized bodies. The vertical gradient is more sensitive to factors of depth and shape than the vertical acceleration of gravity, but its determination is more dependent on the initial free-air and Bouguer corrections. By combining borehole data with auxiliary information and acceptable corrections a density function of depth may be determined.

As the ability of an interface to reflect seismic waves depends on density, the density function may be used to determine interfaces at which seismic reflections may be expected and whether the reflected wave will be of the same or opposite phase. If density and velocity curves are determinable with sufficient accuracy, amplitude values could be used for correlation of wave patterns, if adjustment can be made for instrumental performance, but such use requires accuracy in velocity determinations several times as great as currently available. Data could also be used in identifying and evaluating elastic constants of the various layers.

Gravity values determined in boreholes could be used to identify or eliminate such geological conditions, as those that are due to mineral composition, porosity, fluid quantity and fluid type. These, in turn, could be used in predicting values for electrical resistivity, thermal capacity, thermal conductivity, induration and compaction. As density is likely to remain constant within formations, a density-depth function could be used to locate formations.

The determination of gravity values by gravimeters in current use is limited by the requirements of leveling and reading at rest. Acceleration changes that are due to motion can be greater than those that are due to geologic anomalies. If two gravity meter elements could be fastened together, the two effects could be opposed to produce a gravity-gradient meter, which would furnish data for immediate plotting and also make possible readings during motion, as both elements would undergo identical accelerations caused by motion. It could also furnish continuous profiles and detect thinner layers. Smaller spacing of the elements has greater powers of layer discrimination when adequate density contrast is present but that larger spacing is better for thick layering with less density contrast. Also, large spacing would be less sensitive to hole diameters. The size of the borehole must also be considered. For small ratios of hole radius to layer thickness, the effect of the hole dies off rapidly with distance from the layer, and is small even at the layer itself. For beds thick enough to be detectable, a hole diameter of eighteen inches is not likely to be critical. The presence of mud or casing represents a constant term in the gravity measurements except near ends of the hole or casing or near collars. End effects become negligible at the order of three times the hole diameter, and the effects of collars can be anticipated. Density logs in cased holes could be better than those in uncased holes.—*I. R.*

12447. Hammer, Sigmund. Density determinations by underground gravity measurements: Geophysics, v. 15, no. 4, pp. 637–652, 1950.

To determine the densities of subsurface strata, gravity observations were made in a vertical shaft at Barberton, Ohio. Measurements were made with a standard-type small-size Gulf gravimeter at approximately 200-foot intervals from the surface to the floor of a mine at 2,246.6 feet. Density measurements of hand and core samples made in the laboratory for comparison showed great differences and a systematic tendency toward lower density values. No significant sources of systematic error were found in the gravimeter results, so it is concluded that the discrepancy between density determinations is probably to be attributed to drying or other changes associated with core drilling. It appears that density determinations of finite intervals of underground rock strata can be better made by the gravimeter than by laboratory measurements of rock samples.—*M. C. R.*

12448. Sellien, K. Ein Diagramm zur Bestimmung der Wirkung gegebener unregelmässig geformter Massen auf die Schwereintensität [A diagram for the determination of the effect of given irregularly shaped masses on the intensity of gravity]: Gerlands Beitr. Geophysik, Band 61, Heft 2, pp. 61–65, 1950.

A procedure is developed for the calculation of the gravitational effect, at a given point on the earth's surface, of buried masses of irregular shape. This procedure consists in the division of the cross section of the buried body into a combination of narrow strips, each having broken lines as its boundary with a vertical or even inclined plane of fracture, similar to a geological formation with a break in its middle. The same procedure is also applicable when the area under investigation contains stratified formations of different density. The proposed procedure saves time, and results in greater accuracy because, with the aid of once-calculated tables, only addition and subtraction are used.—*S. T. V.*

## MAGNETIC METHODS

12449. Cook, K. L. Quantitative interpretation of vertical magnetic anomalies over veins: Geophysics, v. 15, no. 4, pp. 667–686, 1950.

From the formulas developed by Haalck, Heiland and others for special cases of the magnetic anomaly over tabular veins the general formula for the vertical-component magnetic anomaly over tabular veins has been derived as a function of the susceptibility, dimensions, shape, and disposition of the vein and of the strength and direction of the earth's field. Eight families of profiles of vertical magnetic intensity over veins have been plotted by varying one parameter while holding the others constant. These are: for vertical veins with infinite depth extent striking north, variation of depth to width ratio and of width; for vertical veins with finite depth extent striking north, variation of depth extent and of depth of cover; for infinite and finite veins striking north, variation in dip; for infinite and finite veins striking east, variation in dip.

The profiles are plotted in terms of a parametric unit so that those for vertical veins may be used repeatedly in different districts by choosing the proper factor as a multiplier for each curve.—*J. R. B.*

12450. Ingham, F. T. Iron: Federation of Malaya Geol. Survey Dept. Rept. for 1949, p. 25, 1950.

Anomalous behavior of compasses has been reported by pilots flying at 15,000 feet over the Gunong Benom, and the anomalies are stated to be somewhat more marked on the eastern side, near Tungku. It is possible the anomalies are due to the presence of iron-ore in a larger area and in larger deposits than is suggested by the scanty evidence noted on the ground.—*N. A. S.*

12451. Rayner, J. M. Preliminary geophysical report on the southern extension of the main line of lode, Broken Hill: New South Wales Geological Rept. 1939–1945, pp. 30–35, 1950.

An area of more than 1,400 acres containing several zinc ore bodies, some at a considerable depth, was surveyed in 1938–39 and later by magnetic and gravimetric methods. In the magnetic survey, two Askania field balances were used, and the probable error of a reading was ±4 gammas. The interval between traverses was 200 feet for the greater part of the survey, and the intervals between stations ranged from 25 to 50 feet. For the gravimetric survey, an Oertlings gradiometer with sensitivity of 2 Eötvös was used. Five traverses were made, the intervals between stations ranging from 200 to 500 feet. As a result of the geophysical surveys, a reversal in pitch of ore deposits was discovered, bringing them within readily mineable depths. Conclusions were checked and confirmed in many places by drilling.—*S. T. V.*

## SEISMIC METHODS

12452. Haarstick, Fritz. Die Weg-Zeitkurve in der Reflexionsseismik [The path-time curve in the seismic reflection]: Geol. Jahrb., Band 64, pp. 173–185, 1950.

Northwestern Germany is a very unfavorable place for seismic prospecting because formations are of insignificant and of varied thicknesses, and rapidly varying elastic characteristics. The velocity of seismic waves ranges from 1,800 m./sec. in Tertiary rocks to 3,500 m./sec. in Triassic rocks. This necessitates the use of complicated methods of analysis if gross errors in interpretation of the results are to be avoided. A new procedure based on the relation between the advance of the wave front from any point in a formation and the corresponding time interval is suggested. This relation is represented by the "path-time" curve. The graphic procedure suggested is applicable to formations of constant and of varying thickness. As the method is based on the knowledge of the velocity of seismic waves through different formations, the necessity for more experiments for measuring these velocities in drill holes is emphasized.—*S. T. V.*

12453. Langhammer, A. Bemerkungen zu L. Krouskij: Über die Bestimmung des wahren einfallens und der wahren Tiefe reflexions seismisch ermittelter Schichten [Comments on L. Krouskij's paper: The determination of the true inclination and depth of layers from seismic reflection data]: Erdol u. Kohle, Jahr. 31, Heft 5, pp. 217–218, 1950.

Krouskij determines the slope of the reflecting layer and its depth below the shot point by using its image and protracting the seismic ray beyond the point of intersection. This operation represents an extrapolation and cannot be always applied. Several examples are given when it would give an erroneous result, and a slightly different procedure proposed.—*S. T. V.*

12454. Slotnick, M. M., Brooks, J. A., Jr., and Redding, V. L. Note on well-shooting data and linear increase of velocity: Geophysics, v. 15, no. 4, pp. 663–666, 1950.

A determination of $v_0$ and $a$ in the equation for linear increase of velocity $v=v_0+ah$ may be made from three sets of well-shooting data, each set consisting of the horizontal distance from shot point to well head, depth, and travel time from shot point to that depth. For values of $a$ of 0.5, 0.6, 0.7, 0.8, and 0.9 which cover the range known from experience, the corresponding value of $v_0$ is computed from the expression for the travel time and the results plotted. The average of the intersections is used as the value for $v_0$ and $a$.—*M. C. R.*

12455. Campbell, F. F. The Fort Cobb anticline: Geophysics, v. 15, no. 4, pp. 585–604, 1950.

The Fort Cobb area is southwestern Oklahoma has been explored seismically by Amerada Petroleum Corp. and Superior Oil Co. Despite differences in seismic techniques, structural interpretations were similar. Three dry holes have tested the structure to a depth of 17,800 feet. The limited amount of data from wells tends to confirm the seismic data. Copies of seismic records, cross sections, and structure maps on three horizons are shown.—*M. C. R.*

12456. Rummerfield, B. F. Algunos problemas de la exploración sismologica en México [Certain problems in seismological exploration in Mexico]: Asociación Mexicana Geologos Petroleros Bol., v. 2, no. 5, pp. 305–311, 1950.

Seismologic methods of exploration have been applied to less than 25 percent of the total area of Mexico allocated for such prospecting and in many places the exploration has not yet been completed. As elsewhere, difficulties in seismic exploration are caused by insufficient knowledge of seismic velocities in different formations. To this must be added, as typically Mexican, difficulties produced by intrusive bodies, possible refractions of reflected rays, the effect of fractures and faults, and the possible pressure of reefs. The greatest difficulty, typical of the petroleum regions of northern Tampico, is the presence of many intrusions, creating a complicated subterranean structure and resulting in unusual paths of seismic rays. Similar conditions are found in the region of Poza Rica, Veracruz, where extrusive rocks reach the surface. Unusual conditions were also found in investigating salt domes on Tehuantepec Isthmus, where differences in the porosities in several Cretaceous strata complicated the seismograms by causing additional reflections.—*S. T. V.*

12457. Krey. Theodore. Einige Beispiele reflexions seismischer Ergebnisse Nordwestdeutschlands [Examples of the results of seismic investigations by the reflection method in northwestern Germany]: Erdöl u. Tektonik in Nordwestdeutschland, pp. 285–292, 1949.

The areas which have been explored by the seismic method include a series of Permian salt deposits in western Holstein, the deep salt domes of the northern part of Hanover province, shallow salt domes in Lüneburger Heide, anticlines near the Dutch-German frontier, and the basin of Münster. The seismic profiles and the suggested geologic cross sections of these structures are presented and their correlation discussed.—*S. T. V.*

12458. Hertwig, August. Das technische Experiment in der Bodenmechanik [The place of technical experiments in soil mechanics]: Bautechnik-Archiv, Heft 3, pp. 72–74, 1949.

The dynamic method of soil exploration consists of the production of mechanical waves by special vibrators set on the ground and observation of these waves by seismographs suitably distributed. By using vibrators in drill holes it is possible to increase the range of the method. The vibrators are run with a constant frequency, which can be varied, and thus the critical frequency of the surrounding terrain can be determined. Presence of disturbing bodies underground can be easily detected, if their mechanical properties are different from those of the surrounding medium, by changes in the velocity of the waves.—*S. T. V.*

## ELECTRICAL METHODS

12459. Huber, A. Zur theorie der geoelektrischen widerstandsmethoden [The theory of the geoelectric-resistivity methods]: Archiv für Meteorologie, Geophysik u. Bioklimatologie, Band 1, Heft 3–4, pp. 408–420, 1949.

A differential equation is derived for the potential field created by two electrodes placed on the earth's surface where the surface of the earth separates a medium of infinite electrical resistivity (air) from a nonhomogeneous one (ground) with its resistivity varying with the depth. An analysis is made of the boundaries of the region in which the nonhomogeneous field in the ground with assumed electrical properties can be replaced by a homogeneous one with an imposed limit of error which can be tolerated by such simplifying assumptions. In general, such regions will be found near the mid point between the two electrodes, where the lines of force run almost parallel. In other points of the medium the volume of the homogeneous field will be much reduced, but always available.

The method is also applied to a case of a buried cylinder, which produces an anomaly that serves as an indicator of its location. The treatment is purely theoretical.—*S. T. V.*

12460. Mukhina, G. V. The screening effect of conductive layers [in Russian]: Akad. Nauk SSSR Izv., Ser. geog. i geofiz., v. 14, no. 4, pp. 302–316, 1950.

Use of the electrical method of exploration is frequently impossible because of the presence of a conductive layer covering the soil. An approximate solution is derived for the electrical field at any point underground which is accurate for points lying deeper than three times the thickness of this upper layer. A more complicated case is treated when the underground is separated by a vertical plane into two domains with different electrical properties covered by a common conductive layer. The solution is given in the form of an integral equation, which can be solved by the method of successive approximations. This solution can also be extended to the case when the upper, conductive layer is also split into areas of different electrical resistivity.—*S. T. V.*

12461. Abelès, Florin. Recherches sur la propagation des ondes électromagnetiques sinusoïdales dans les milieux stratifiés [The propagation of sinusoidal electromagnetic waves in stratified media]: Annales physique, tome 5, pp. 596–640, 1950.

The study consists of two parts: development of the general theory of propagation of electromagnetic waves through stratified media, and special problems

of the propagation of waves through homogeneous thin strata. The treatment is general, but the conclusions can be applied to problems of mechanical vibrations, thermal waves, and acoustical phenomena.

The author starts from Maxwell's equations for the field in a stratified medium, discusses linearly polarized waves represented by exponential functions with complex exponents, and establishes a system of differential equations of the first order for these waves. Modifications caused by discontinuities in the physical properties of different strata are analyzed and the coefficients of reflection and transmission of waves are determined. These general results are applied to the special cases of the presence of absorbing layers, a medium with symmetrical properties, the presence of a very thin intermediate layer, and layers with periodical variations of physical properties.—*S. T. V.*

12462. Belluigi, Arnoldo. The electromagnetic field due to induced currents in a conductive slab of finite dimensions: Geophysics, v. 15, no. 4, pp. 687–703, 1950.

The theory of the electromagnetic field for a thin, plane, conducting slab oriented perpendicular to the ground is developed. Solutions are given in the form of integral equations for the case of a finite slab (dike) energized by an inducing alternating magetic field. The extension of these formulas to include the case of a semi-infinite slab, or mineralized vein, results in the derivation of the Peters-Bardeen integral-resolving formulas. Subsequent integration yields expressions for the horizontal and vertical components of the magnetic flux density along a direction normal to the slab. The results are presented in the form of graphs of the components in phase with the inducing field plotted against horizontal distances from the plate, for various depths and vertical thicknesses of the slab. These solutions may prove useful for the interpretation of electromagnetic field profiles.—*I. Z.*

12463. Belluigi, Arnoldo. "Bicaram"—Nuova apparecchiatura elettromagnetica ["Bicaram"—A new electromagnetic apparatus]: Ufficio Geol. d'Italia Boll., v. 70, pp. 227–241, 1950.

An instrument has been designed and constructed for use in geophysical prospecting by the electromagnetic method to permit a convenient comparison of the intensities and phase relations of two magnetic alternating fields. It consists of two identical coils, with adjustable ohmic resistances and capacities connected to the extremities of each coil, and a zero indicator, as in a Wheatstone bridge, in a middle plane. Ordinarily, an earphone with an amplifier will serve as a zero indicator. The theory of the apparatus is developed and the different elements described. Instructions are given for its use.—*S. T. V.*

12464. Belluigi, Arnoldo. Su alcuni orientamenti teorici per le misure elettromagnetiche in galleria di miniera [Some theoretical considerations on electromagnetic measurements in mining galleries]: Riv. Geofis. Appl., v. 11, no. 1, pp. 15–25, 1950.

Intensity, phase displacement and other properties of the secondary electromagnetic field in a homogeneous isotropic ground are computed as functions of the frequency and coefficient of induction of the primary electromagnetic field. The investigated electromagnetic fields are produced and measured by special instruments designed for use in underground galleries when mining metallic ores that show sufficient contrasts in electric properties with the surrounding

formations. The proposed measurements are to be applied when searching for electric anomalies in the underside walls or pillars of the galleries, assuming presence of buried ore bodies. Related formulas are given for the arrangements using electric dipoles or rectilinear emitters of finite length.—*S. T. V.*

12465. Whetton, J. T., and Myers, J. O. Application of electrical-resistivity measurements to the location of coal seams at shallow depth: Leeds Philos. Lit. Soc. Proc., v. 5, pt. 3, pp. 263–268, 1949.

An investigation was made to determine the value of electrical-resistivity methods in prospecting for coal seams at shallow depths. Suitable sites were selected where the topography was fairly level and where the seams had a shallow dip. Two sites were surveyed using an ordinary Megger earth tester and the single-electrode-probe method. The sensitivity of the instrument was such that a maximum depth penetration of 120 feet was secured.

The high resistivity of the coal seams may be considerably modified by the moisture content and by the mineralization of the underground water, reducing the contrast in resistivity between the various rocks.

Comparison of the resistivity results with the borehole logs shows that at one site a fair correlation exists between the depths of the coal seams indicated in the boreholes and the depths indicated in the probes, but in another area the method appears to have been more successful. Of 28 seams indicated in the boreholes, seventeen produce identifiable features on the curves.—*S. T. V.*

12466. Manfredini, Antonio. Studio geofisico della formazione gessososolfifera Siciliana con il metodo della resistivita elettrica [Geophysical investigation of gypso-sulfurous deposits in Sicily using electrical resistivity method]: Ufficio Geol. d'Italia, Boll., v. 70, pp. 243–246, 1950.

A survey for gypsum and sulfur was made of an area of about 8 sq. km. in Sicily during the summer of 1946 using the resistivity method with Wenner's configuration of electrodes and soundings to 200 meters depth. The satisfactory results of the investigations may be attributed to the great contrasts in resistivity ranging from 2.6 to 4.0 ohm-meters in sand; 11.0 to 16.0 ohm-meters in aluminites; and 41.0 to 70.0 ohm-meters in gypso-sulfurous layers.—*S. T. V.*

12467. Paver, G. L. The geophysical investigation of underground water supplies: a geological analysis of observed resistivity data: Jour. Inst. Water Eng., v. 4, no. 3, pp. 237–266, 1950.

Seventy-five electrical-resistivity surveys for water in Greece, Malta, Cyprus, Asia Minor, North Africa, Kenya, Somaliland, Tanganyika, and in South Africa are summarized. Direct current measurements with nonpolarizing porous-pot electrodes were mostly used, although commutated current measurements with a double commutator, producing a low frequency alternating current in the ground and direct current in the instrument circuit, were also used. This arrangement compensates for any earth currents and minimizes induction effects.

Typical examples of observed resistivity depth-probe curves, constant separation traverses, isoresistivity plans, and ratio-resistivity traverses form the basis for the discussion. All examples were verified by borehole data.

The geophysical data presented are divided into sections dealing with surveys over sedimentary, igneous, and metamorphic rocks, with further subdivisions

based upon geologic age. Interpretation of the observed data is discussed in the light of the geologic mode of occurence of underground water in each case, as controlled by the particular geologic, topographic, and hydrologic factors involved. From the very beginning of geophysical measurements to their final interpretation in terms of underground water potentialities, geologic factors are emphasized as being of primary importance.

A basic knowledge of the theoretical implications involved is necessary for a proper evaluation of observed resistivity data, the resultant interpretation being dependent entirely on an understanding of geologic probabilities.—*S. T. V.*

12468. Cooper, W. G. G. Electrical aids in water finding: Nyasaland Geol. Survey Bull. No. 7, 23 pp., atlas [no date].

This paper briefly reviews the theory and practice of electrical-resistivity surveys for ground water in Nyasaland. The effects of electrochemical action and electrosmosis as well as of terrain and geologic structure on migration and collection of ground water and on natural earth potentials are also discussed. Several examples are given to show the author's method of tabulating and interpreting resistivity data.—*H. R. J.*

12469. Walters, R. C. S. Some geophysical experiences in water supply: Jour. Inst. Water Eng., v. 3, pp. 436–441, 1949.

The results of resistivity surveys at three ground water and one dam site in England are briefly summarized.—*D. F. B.*

12470. Cummings, J. B., and Romslo, T. M. Investigation of Twin Buttes Copper mines, Pima County, Ariz.: U. S. Bur. Mines Rept. Inv. 4732, 12 pp., 1950.

As part of a program of mapping, test pitting, trenching, and sampling, detailed natural-potential surveys were made in six selected areas. A few centers of electrochemical activity were found near old mine workings. Horizontal resistivity profiles at four depths were made along one traverse across a fault of igneous and sedimentary rocks in contact. Natural-potential maps and resistivity profiles are included.—*G. D. B.*

12471. Lundberg, Hans. Airborne electrical surveys for regional studies in oil and ore prospecting: Canadian Inst. Min. Metallurgy Trans., v. 53, pp. 130–132, 1950.

An airborne method of making induction electrical surveys is described. A many-turn loop wound around the fuselage of a plane is energized with a few amperes alternating current of less than 1,000 c. p. s. This induces alternating current of the same frequency in conductors below the path of the aircraft, which in turn sets up a secondary field whose amplitude and phase are detected and recorded in the airplane. The conductors (ore bodies or low-resistive sedimentary horizon) can be identified by a study of their secondary induced effects, and because the secondary field can be calculated for different induction factors and depths, it is possible to determine from the phase and amplitude records the depth below the aircraft of flat-lying conductors. In oil prospecting the conductivity of groups of formations may be used to determine the amplitude and phase of the secondary field, but for interpretation purposes it is possible to idealize these effects as having been caused by only three or four formations. Information on sedimentary structure at a maximum depth of 2,500 feet can be

obtained from the records. The Quemont, a flat-lying highly conductive ore body, can be detected under 250 feet of overburden. Steep-dipping ore bodies and shear zones offering smaller target areas require extreme sensitivity of the equipment but can be located and identified by this method. Illustrations of test results are shown.—*W. J. D.*

## WELL LOGGING

12472. Cervera del Castillo, E. Registro radioactivo en el nordeste de Mexico [Radioactive logging in northeastern Mexico]: Assoc. Mexicana Geologos Petroleros Bol., v. 2, no. 5, pp. 313–322, 1950.

After a brief explanation of the physical principles of radioactive well logging, a lithological interpretation is presented of the results obtained in different oil wells in northeastern Mexico during surveys made in 1945–47.—*S. T. V.*

12473. Thomeer, J. H. M. A. Radioactiviteit van sedimentgesteenten als hulpmiddel bij het onderzoek van aardolieboringen [Radioactivity of sedimentary rocks as an aid in the investigation of bore-holes in petroleum exploration]: Geol. Mijn., 12 jaargang, no. 10, pp. 282–287, 1950.

Recording of the geologic and physical properties of formations penetrated by the borehole has become an indispensible operation in any oil field. Among the newer methods of investigation, the determination of the natural radioactivity of the formations deserves attention. A gamma-ray log is obtained by moving an ionization chamber or a Geiger-Müller counter along the section of borehole being surveyed and recording the reactions on the surface. This method of logging can be applied in cased-in wells and in holes filled with oil or brine mud where electrical methods are less applicable. A comparison of gamma-ray logs with electrical ones of natural potential is presented, and their similarities and differences interpreted in terms of geologic features. In certain points these two methods are complementary.—*S. T. V.*

12474. Biedendieck, C. H. Elektrische Sondendruckmessung [An electrical drill-hole pressure meter]: Erdöl u. Kohle, Jahrg. 3, Heft 8, pp. 383–384, 1950.

A new pressure gage for either separate measurements or continuous recording of pressure in a drill hole consists of two built-in oscillators in a strong container of small over-all dimensions which can be lowered into the well. One oscillator has constant frequency; the frequency of the other is influenced by the deflection of a membrane under the action of the fluid column in the hole. Interference of the two oscillator circuits, observed on the surface on an oscilloscope determines the pressure on the diaphragm of the instrument. The error of a reading is less than 0.2 percent. The gage can be built to measure pressures up to 2,500 meters.—*S. T. V.*

12475. Tobien, H. Über eine Fernkonnektierung von Schlumberger Diagrammen im Alttertiär Nordwestdeutschland [The correlation of Schlumberger logs in the lower Tertiary of northwestern Germany]: Erdöl u. Tektonik in Nordwestdeutschland, pp. 374–382, 1949.

In many oil fields in northwestern Germany an accurate correlation of strata may be made on the basis of Schlumberger resistivity and potential logs. Such correlation was feasible between fields as far as 120 km. apart along the profile stretching in a northeast direction from Hanover to Hamburg. The potential

curve was especially useful in this purpose. Accentuated peaks in the potential curve correspond to maxima of the resistivity curve, and were usually separated by sections of indefinite character, called interanomalies. The peaks usually indicate arenaceous layers, the interanomalies, argillaceous layers. Electrical logs obtained along the sea coast suggest epirogenic movements there, which are also indicated by paleontological evidence.—*S. T. V.*

12476. Schad, Albert. Stratigraphische Auswertung von elektrischen Bohrlochmessungen [Stratigraphic interpretation of electrical well logs]: Erdöl u. Tektonik in Nordwestdeutschland, pp. 364–374, 1949.

Experience has shown that the logs obtained by the Schlumberger method give a clear indication of the variations of the geologic and physical properties of the formations penetrated. In northwestern Germany the variations of facies in the horizontal direction are insignificant. Well logs, even though separated by great distances, are often very similar. This greatly facilitates the correlation of individual horizons and makes this correlation by the electrical method more accurate than can be done lithologically.

A detailed discussion of the geologic interpretation of the electrical logs and many practical examples are included.—*S. T. V.*

## TECHNICAL AIDS

12477. Pivovarov, C. P. An amplifier for very low frequencies [in Russian]: Zhurnal tekhnich. fiziki, v. 18, no. 6, pp. 799–804, 1948.

An amplifier operating with sufficient stability, even at frequencies as low as 5 c.p.s., is described. The pulses applied are of rectangular shape with the horizontal portion of the wave varying less than five percent at 5 c.p.s. Anodes of the vacuum tubes have in series an electronic stabilizer. In the author's experiments the amplification was about 150,000, but this can be made substantially higher. The instrument is provided for photographic recording. The amplifier can also operate from a storage battery.—*S. T. V.*

12478. Honnell, P. M. The absolute calibration of a Brush accelerometer and its response to square waves of displacement and velocity: Am. Geophys. Union Trans., v. 31, no. 5, pt. 1, pp. 691–695, 1950.

The response of accelerometers and seismographs relative to the output of a velocity monitor is easily obtained on an electromagnetic transducer or shaking table. This equipment can give an absolute calibration by matching the peak sinusoidal acceleration of the transducer to the vertical acceleration of gravity. In practice the transducer acceleration is reduced until the chattering of an auxiliary weight resting on the platform can no longer be detected. The technique appears to be accurate within 5 percent.

The resulting calibration of a Brush BL–301 accelerometer is given, and the response of this instrument to square waves of displacement and velocity, and to simple transient wave forms, is shown.—*D. F. B.*

12479. Allsop, G., and Guénault, E. M. Exploders for simultaneous firing of shots: Great Britain Safety in Mines Research Board, Research Paper 107, 14 pp., 1950.

This pamphlet is written primarily as instruction for use in mines or quarries, but it is also of interest to geophysicists, especially when employing the Poulter

seismic method of exploration. It gives an account of the electrical properties of low tension detonators which affect their firing when connected in series in a round of shots. Data are given from which it is possible to estimate the voltage and capacity needed to fire a given number of shots while taking the greatest precautions to avoid misfires which may cause accidents. The effect of leakage to the earth is also considered.—*S. T. V.*

## PATENTS

### MAGNETIC METHODS

12480. Fluxmeter. William R. Rathkamp, Oak Ridge, Tenn., assignor, by mesne assignments, to the United States of America as represented by the U. S. Atomic Energy Commission: U. S. patent 2,530,178, issued Nov. 14, 1950.

A device for determining magnetic field strength comprising a pulsating current conducting element forming an armature disposed in the magnetic field and being mounted to allow vibration of the element across the field so that the amplitude of the vibration is proportional to the strength of the magnetic field, and means responsive to vibration of the armature for giving an indication of the field strength comprising a member forming an armature positioned to be mechanically vibrated by the current conducting element so as to cause an e. m. f. to be generated in the member and means for measuring the magnitude of the induced e. m. f. Claims allowed, 2.

12481. Submarine-detecting device. Ellis A. Johnson, Chevy Chase, Md.: U. S. patent 2,535,068, issued Dec. 26, 1950.

In a system of the character disclosed for detecting and recording signals indicative of the presence of a submarine, a gradient device including a pair of opposedly connected nonrotating search coils adapted to generate said signals in response to variations in the intensity of the magnetic field within each of the coils, an electroresponsive device operatively connected to said coils and having an element adapted to be actuated to settings corresponding to the difference between the instant values of the flux through each of said coils, and means controlled by said element for recording said signals.

In a system of the character disclosed for attacking a submarine from an aircraft in flight, a pair of nonrotating opposedly connected search coils arranged in predetermined space relation on said aircraft and adapted to generate variable signal indications of opposite polarity in accordance with variations in the intensity of the earth's magnetic field within each of the coils, an explosive depth charge releasably supported by said aircraft, and means including a voltage integrating device operatively connected to said coils and responsive to the gradient of the magnetic field of the submarine detected by the coils for releasing the depth charge as the polarity of said signal indications is reversed during the passage of the aircraft over the submarine. Claims allowed, 20.

12482. Measuring and control method and apparatus. Thomas R. Harrison, Wyncote, and Lloyd B. Cherry, Philadelphia County, Pa., assignors, by mesne assignments, to Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., a corporation of Delaware: U. S. patent 2,535,412, issued Dec. 26, 1950.

The method of obtaining a measure of the strength of a magnetic field which consists of the steps of relatively moving a magnetic field and an exploring device to derive an electrical effect the direction of which corresponds to the direction of said magnetic field and the magnitude of which is a function of the strength of said magnetic field and also of the rate of relative movement of said magnetic field and said exploring device, applying said electrical effect to motor means to control the energization of said motor means for operation of the latter in a direction corresponding to that of said electrical effect for a period the duration of which corresponds to that of said electrical effect and at a speed which is in substantially linear accordance with the magnitude of said electrical effect, utilizing the operation of said motor means for moving an exhibiting member from a predetermined position in a direction corresponding to the direction of operation of said motor means for a period the duration of which corresponds to that of the operation of said motor means and at a rate which corresponds to the speed of operation of said motor means, utilizing the operation of said motor means for deriving a second electrical effect the magnitude of which is a function of the speed of operation of said motor means, opposing said second electrical effect and the first mentioned electrical effect in the control of the energization of said motor means to suppress the increase in the rate of motion of said exhibiting member tending to be effected by operation of said motor means as said first mentioned electrical effect increases in magnitude, thereby to expand the range of variation of said first mentioned electrical effect over which the rate of movement of said exhibiting member varies from zero to a maximum, and additionally controlling the energization of said motor means in accordance with the position of said exhibiting member as required to restore and maintain said exhibiting member in said predetermined position when the magnitude of said first mentioned electrical effect decreases below a predetermined value. Claims allowed, 26.

## SEISMIC METHODS

12483. Gain control system for seismographs. George B. Loper, Dallas, Tex., assignor, by mesne assignments, to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,526,608, issued Oct. 17, 1950.

The combination with an amplifier, of a gain-controlling system therefor comprising an electric valve having an input curcuit responsive to signals from said amplifier and an output circuit, means biasing said valve beyond plate current cut-off, said valve being conductive only on signal peaks, biasing means for said amplifier comprising in a series loop a rectifier and two resistors, a ground connection at the junction of said resistors, said output circuit including one of said resistors and a capacitor connected to the cathode side of said rectifier and

to one end of said last-mentioned resistor for flow of charging current through said capacitor, said rectifier having a polarity for flow therethrough of discharge current from said capacitor and through the other of said resistors continuously to develop across it a voltage of negative polarity with respect to said ground connection, and means for applying said negative voltage to said amplifier to control the gain thereof. Claims allowed, 7.

12484. Apparatus for separation of blasting-circuit leads. Josephus O. Parr, Jr., San Antonio, Tex., assignor to Olive S. Petty, San Antonio, Tex.: U. S. patent 2,527,148, issued Oct. 24, 1950.

A blasting machine for firing shots for seismic surveying including, in combination, a generator, a manually actuated plunger to rotate the generator shaft through a limited number of revolutions, conductors extending from said generator for connection to a blasting cap, a releasable connection in the circuit of each conductor located at said blasting machine, and lever means engaged and actuated by said plunger near the end of its stroke to release both said connections and thereby separate said conductors from said blasting machine. Claims allowed, 4.

12485. Drive for seismographic record strips. Robert L. Henson, Jr., and John W. Millington, Beaumont, Tex., assignors to Sun Oil Co., Philadelphia, Pa., a corporation of New Jersey: U. S. patent 2,532,911, issued Dec. 5, 1950.

In combination, means for advancing a record strip, a synchronous motor for driving said advancing means, a vibrating reed inverter for supplying alternating current for driving said synchronous motor, said inverter including an electromagnetic driving device for its reed and contact means engageable by said reed, a low voltage current supply, connections between the low voltage current supply, said driving device and said contact means through which said current supply would drive said reed at an approximately constant frequency, a tuning fork, driving means for the tuning fork, an amplifier supplying alternating current at relatively low power at the tuning fork frequency, means supplying said alternating current to said connections to maintain vibrations of said reed at the tuning fork frequency, thereby to control the frequency of the alternating current supplied by said inverter, and a synchronous motor for driving a timing device adapted to space timing markings on said record strip, said last mentioned synchronous motor being connected to said amplifier and enforcing precise uniform spacing of said timing markings. Claims allowed, 2.

12486. Seismic detector. Robert L. Henson, Jr., Beaumont, Tex., assignor to Sun Oil Co., Philadelphia, Pa., a corporation of New Jersey: U. S. patent 2,533,249, issued Dec. 12, 1950.

A seismic detector comprising means providing a rigid permanent magnet assembly having a pair of symmetrically arranged annular air gaps, a non-magnetic armature including a pair of coils and conductive elements mounting said coils located within said gaps, and spring means supporting said armature, said coils being astatically arranged so that stray magnetic fields cutting both coils induce therein bucking electromotive forces. while electromotive forces induced therein by relative movements of the coils and the magnet assembly are additive. Claims allowed, 9.

12487. Apparatus for solving seismic problems for location and dip of reflecting beds. Glenn M. McGuckin, Corpus Christi, Tex., assignor, by mesne assignments, to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,535,220, issued Dec. 26, 1950.

An instrument for contour plotting of subsurface strata comprising a pair of members having pivotal suports at points spaced in correspondence with the distance between seismic datum points and slidable in parallelism with each other, means interconnecting said members for maintaining them parallel, a scale on each of said members calibrated in terms related to seismic-reflection times, and a dip-bar extending at right angles to both of said members for all positions thereof. Claims allowed, 16.

12488. Optical recording apparatus for seismic waves. Albert J. Z. Caan, New York, N. Y., assignor to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,535,348, issued Dec. 26, 1950.

Apparatus for converting seismic recordings in terms of time to seismic recordings in terms of depth consisting of a lamp emitting light rays, a member attached thereto possessing a slit opening adjacent to said lamp, said lamp and said member being capable of reciprocation in a vertical direction to cause substantially parallel rays of energy to pass through said slit, a stationary seismic recording in terms of time aligned with said slit so as to receive said rays over its length during said reciprocation, a collimating lens for preventing the natural distortion of said rays passing through said seismic recording in terms of time, a distortion lens for distorting the rays thus corrected by said collimating lens from a time scale to a depth scale, said distortion lens having a shape determined by the time-depth curve of the area being surveyed, stationary detection means to receive the rays after they have passed through said distortion lens, said collimating lens and said distortion lens being positioned between said seismic recording in terms of time and said detection means. Claims allowed, 2.

## ELECTRICAL METHODS

12489. Method of geophysical exploration. Axel Rudolf Lindblad, deceased, late of Djursholm, Sweden, by Staffan Serrander, administrator, Stockholm, Sweden, Johan David Malmqvist, Boliden, and Gotthard Viktor Arnold Gustafsson, Akeshov, Sweden, assignors to Bolidens Gruvaktiebolag, Skelleftehamn, Sweden, a joint-stock company limited of Sweden: U. S. patent 2,527,559, issued Oct. 31, 1950.

A method of detecting the presence of subterranean ore bodies and the like that comprises introducing into a transmitter coil located near the earth's surface a current varying linearly with time and causing thereby the generation of a primary electromagnetic field of saw-tooth wave form, detecting in a detector coil located at some point distant from said transmitter coil the primary field so generated, simultaneously detecting a secondary electromagnetic field in said detector coil, said secondary field resulting from the impingement of said primary field on ore bodies below the earth's surface and recording time-spaced relation the two fields so detected. Claims allowed, 2.

12490. Electrical-prospecting method. Robert R. Thompson, Houston, Tex., assignor, by mesne assignments, to Standard Oil Devel. Co., Elizabeth, N. J., a corporation of Delaware: U. S. patent 2,531,088, issued November 21, 1950.

An apparatus for conducting continuous electrical prospecting surveys over an area beneath a body of water including a self-propelled vessel, a multi-conductor cable attached to said vessel and submerged in the water for towing behind the vessel, a pair of current electrodes and a plurality of potential electrodes positioned in spaced relation upon said cable and connected to respective conductors therein, and a plurality of submerged buoys attached at spaced positions along said cable intermediate between said electrodes, said buoys being of such shape and arrangement as to lift a substantial portion of said cable off the bottom of the body of water when said vessel and cable are in motion. Claims allowed, 3.

## RADIOACTIVE METHODS

12491. Wide range radiation intensity meter. Ted Fahrner, Whittier, Calif., assignor to Westinghouse Electric Corp., East Pittsburgh, Pa., a corporation of Pennsylvania: U. S. patent 2,524,901, issued Oct. 10, 1950.

A wide range radiation intensity meter comprising connections for applying a direct current potential, a Geiger-Müller counter tube and a grid controlled electron discharge tube connected in series across said connections, said counter tube being operated in the "proportional region," and means for measuring the voltage drop across said grid controlled electron discharge tube said voltage drop being a function of radiation intensity falling on said counter tube. Claims allowed, 5.

12492. Method of geophysical prospecting. John T. Callahan, La Feria, Tex., and John D. Lahmeyer, Tulsa, Okla., assignors to Industrial Nucleonic Devices, Tulsa, Okla., a corporation of Oklahoma: U. S. patent 2,526,326, issued Oct. 17, 1950.

The method of geophysical prospecting which comprises, at least partially shielding a radioactive energy detector from radioactive energy radiations from the earth, eliminating the shielding, and measuring the radio active energy reaching said detector both when shielded and unshielded to determine the relative magnitudes thereof. Claims allowed, 13.

12493. Coincidence proportional counter. John H. Manley, Urbana, Ill., assignor to the United States of America as represented by the U. S. Atomic Energy Commission: U. S. patent 2,531,144, issued Nov. 21, 1950.

A proportional counter for measuring the energy spectrum of a particle-emitting ionizing source comprising a chamber containing argon gas, a wire-like electrode suspended centrally of said chamber, a cross wire for maintaining said electrode in its central position, a source of positive high voltage connected to said electrode, a plurality of ring-shaped collecting electrodes surrounding and coaxially disposed with respect to said wire-like electrode, a coincidence amplifier circuit to which said ring-like electrodes are separately connected, said chamber having a bottom portion supporting an alpha particle emitting source below said wire-like electrode and said collecting electrodes and substantially axially thereof, conduit means for admitting gas into said chamber,

and a pressure gauge connected to said conduit means for indicating the gas pressure. Claims allowed, 7.

12494. Measurement of the intensity of penetrative radiations. Jack R. Carlin, Watertown, and Eric T. Clarke, Cambridge, Mass., assignors to Tracerlab, Inc., Boston, Mass., a corporation of Massachusetts: U. S. patent 2,531,804, issued Nov. 28, 1950.

In apparatus for measuring the intensity of penetrative radiations such as are emitted by radioactive substances, the combination comprising: an ion chamber, a pair of electrodes mounted in said chamber, a source of low voltage arranged to impress a collecting voltage on said electrodes such as to produce an ionization current well below saturation value, a connection from one of said charged electrodes to carry said ionization current, means for employing said ionization current to reduce the total ionization current developed, and means for measuring the ionization current so reduced. Claims allowed 14.

12495. Electronic counting circuits. Joseph W. Kennedy, Santa Fe, N. Mex., William R. Baker, Berkeley, Calif., and Clyde E. Wiegand, Sante Fe, N. Mex., assignors to the United States of America as represented by the U. S. Atomic Energy Commission: U. S. patent 2,532,503, issued Dec. 5, 1950.

A self-contained portable counter comprising an ionization chamber, a power supply for furnishing a high potential to said ionization chamber, a pulse amplifier, a scaling circuit the input thereto being the amplified pulses, a register, and switching means for impressing the output of the scaling circuit or the amplified pulses to said register. Claims allowed, 4.

12496. Prospecting. Gerhard Herzog, Houston, Tex., assignor to The Texas Co., New York, N. Y., a corporation of Delaware: U. S. patent 2,535,066, issued Dec. 26, 1950.

In prospecting, involving the detection of the intensity of gamma radiation from the earth with a first radiation detector in the presence of cosmic rays to which it is sensitive, the improvement which comprises interposing at least one additional detector sensitive to cosmic rays in the path of the cosmic rays passing to the first detector, and observing only those rays which are detected by the first detector alone. Claims allowed, 19.

## THERMAL METHODS

12497. Bolometer. Victor S. Rutherford, East Cleveland, and James F. English, Jr., Lakewood, Ohio, assignors to Bailey Meter Co., a corporation of Delaware: U. S. patent 2,524,478, issued Oct. 3, 1950.

In a bolometer of the electric resistance type, in combination, a highly evacuated sealed housing comprising a reflector portion of paraboloidal shape mirrored on the inner surface and a window portion joining the reflector portion in a plane beyond and substantially parallel to the latus rectum of the reflector; a target in said housing of extended area lying substantially in the plane of said latus rectum, spanning the focal center of the reflector and formed as a receptive grid of a relatively great length of coil-coil resistance wire having a diameter of the order of one mil and composed of a plurality of oppositely

directed, laterally spaced reaches; a pair of conducting posts passing through the wall of the reflector portion; means connecting the ends of said resistance wire to said posts; and insulated means supporting said reaches in the plane of said grid. Claims allowed, 3.

## WELL LOGGING

12498. Apparatus for logging wells. Jan J. Arps, Tulsa, Okla.: U. S. patent 2,524,031, issued Oct. 3, 1950.

In apparatus for logging a drill hole while drilling with a drill bit suspended in a drill hole upon a tubular drill stem and collar through which drilling fluid is circulated, the combination of: a turbine disposed within the drill stem and having its impeller means located in a drilling fluid circulating duct therein and thereby adapted to be driven by circulation of drilling fluid through said duct; a direct current generator in said drill stem; a mechanical drive connection between said turbine impeller and said direct current generator; a variable speed direct current motor; a pair of spaced electrode elements insulated from one another and positioned on and exteriorly of said drill stem to be in electrical communication with formation penetrated by the drill hole during drilling; and an electrical circuit connecting one of said electrodes to the other of said electrodes, said circuit including the output of said direct current generator connected in series with the input of said direct current motor; an alternating current generator mechanically connected to said direct current motor for generating an alternating current the frequency of which is a function of the speed of said motor; and an electromagnetic signal generator in communication with the drilling fluid duct in said drill stem, the actuating windings of which are connected to the output of said alternating current generator, for converting alternating output current from said alternating current generator into signal pulsations within said drill stem. Claims allowed, 3.

12499. Well-logging apparatus. Renic P. Vincent, Tulsa, Okla., assignor to Stanolind Oil and Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,524,150, issued Oct. 3, 1950.

In well logging apparatus including a chart and means to indicate on said chart variations in a well characteristic, an electric motor energized from an adjacent source, two oppositely rotating electrically actuated clutches driven by said motor, a single rotable shaft adapted on actuation of one of said clutches to drive the indicating means linearly, electrical means including at least one impedence responsive to a condition in said well for selectively actuating said clutches as said condition varies, and a cylindrical watertight case adapted to be lowered into a well enclosing all of said apparatus except said at least one impedence. Claims allowed, 4.

12500. Method and apparatus for well logging. William L. Russell, College Station, Tex.: U. S. patent 2,524,360, issued Oct. 3, 1950.

The method of logging wells which comprises the steps of measuring at a plurality of depths within a well the direction of the horizontal component of the earth's magnetism, said magnetism including flux due to both the induced and the remanent fields, measuring at a plurality of depths the dip of said magnetism, and recording separately the variations of said direction and of said dip as functions of depth.

Apparatus for logging wells comprising an instrument housing adapted for lowering into a well, a reference framework in said housing and movable relative thereto, means for maintaining said framework oriented in a fixed direction, means carried by said framework for producing a first electrical signal varying quantitatively with the direction of a directional magnetic property of well strata, means carried by said framework for producing a second electrical signal varying quantitatively with the strength of the magnetic field in the well strata, and means for recording the variations of each of said signals in correlation with depth in a well. Claims allowed, 17.

12501. Interface locator. Daniel Silverman, Tulsa, Okla., assignor to Stanolind Oil and Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,524,933, issued Oct. 10, 1950.

A method of indicating the position of an active interface between a conducting fluid and a nonconducting fluid in a well comprising introducing said conducting fluid into said well, introducing said nonconducting fluid into said well, said conducting and said non-conducting fluids being immiscible and of different densities, whereby an interface is formed in said well, locating a detector in the region of said interface, said detector being adapted to distinguish between said conducting and said nonconducting fluids, indicating at the surface in which fluid said detector is submerged, and cyclically submerging said detector alternately in said conducting and said nonconducting fluids, the frequency of said submersions being between about 1/10 and about 20 cycles per minute, whereby a positive qualitative signal will be repeatedly and intermittently produced at the surface when said detector is in the region of said interface and the ratio of signal-on to signal-off time indicates the mean level of said interface relative to said detector. Claims allowed, 12.

12502. Method for logging wells. Preston E. Chaney, Beaumont, Tex., assignor to Sun Oil Co., Philadelphia, Pa., a corporation of New Jersey: U. S. patent 2,526,857, issued Oct. 24, 1950.

In the logging of subterranean formations penetrated in well drilling operations by analyzing effluent drilling mud fluid for salt content, the method of continuously determining changes in the concentration in said drilling mud fluid of chloride ions, which comprises continuously circulating drilling mud fluid containing added phosphates, and having a pH of from 7 to 9.5, into and out of said well during the drilling operation, contacting the effluent drilling mud fluid with an electrode of reference potential and a silver electrode, and measuring the potential difference between said electrodes. Claims allowed, 3.

12503. Method of logging wells. John T. Hayward, Tulsa, Okla.: U. S. patent 2,528,882, issued Nov. 7, 1950.

The method of logging wells being drilled by the rotary method in which a drilling fluid circulated through the well is analyzed at the top of the well for the contents of the strata portions dispersed therein by the drill, comprising, modulating a drilling operation at a predetermined frequency adapted to correspondingly vary the rate of dispersal by said drill of said contents of said strata per unit volume of said drilling fluid, and analyzing said drilling fluid for said contents appearing therein in a concentration pattern corresponding to said frequency. Claims allowed, 19.

12504. Radio-activity logging of wells. John T. Hayward, Tulsa, Okla.: U. S. patent 2,528,955, issued Nov. 7, 1950.

In drilling of a well by the rotary method employing a circulating stream of drilling fluid, the method of logging the well, comprising, separating from the stream of returning drilling fluid the formation cuttings in the order in which they are deposited in said stream by the drill, and measuring the radioactivity of the so separated cuttings. Claims allowed, 10.

12505. Acoustic well-logging apparatus. Clare H. Kean, Houston, Tex., assignor by mesne assignments, to Standard Oil Devel. Co., Elizabeth, N. J., a corporation of Delaware: U. S. patent 2,530,971, issued Nov. 21, 1950.

An improved apparatus for acoustic impedance logging of formations along the liquid-filled portion of a borehole in the earth comprising, in combination, a transducer of acoustic wave energy of substantially a selected frequency having such a value that the wave length of said wave energy in the borehole liquid is longer than the diameter of the borehole, said transducer comprising an elongated element constituting a wave generating surface having a greater length than said wave length and electromagnetic means operatively associated with said element for causing the latter to vibrate in extensional mode at said frequency, a source of electric energy electrically connected to said electromagnetic means for exciting the latter at said frequency, means for moving said transducer along the formations in the borehole, and means for recording variations in electric energy supplied to said electromagnetic means as the transducer is moved along the formations. Claims allowed, 6.

12506. Well-logging recorder. Herschell R. Scivally, Shreveport, La.: U. S. patent 2,535,096, issued Dec. 26, 1950.

A well-logging machine for use in connection with rotary drilling equipment having a rotatable drill stem, which comprises, means holding and advancing a movable record receiving element, said means connecting with said rotary drilling equipment in a manner to advance said record receiving element at a rate of speed determined by the speed of the downward movement of said drill stem, a stylus movably positioned above and adapted to mark said record receiving element, a power driven screw shaft and gearing connecting the latter with said stylus, a movable clutch and gearing connecting said screw shaft with a driving means to rotate the latter at selected rates of speed, linkage and gearing connecting said clutch with said means for holding and advancing said record receiving element, said linkage and gearing operative with said advancing means to move said movable clutch and reverse the direction of rotation of said screw shaft and the direction of movement of said stylus, and providing thereby a marked record of the time consumed for a predetermined increment of downward movement of said drill stem. Claims allowed, 5.

12507. Electrical-logging system. Robert A. Broding, Dallas, Tex., assignor, by mesne assignments, to Socony-Vacuum Oil Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,535,666, issued Dec. 26, 1950.

A system for measuring changes in the electrical character of formations penetrated by a borehole which comprises an exploring unit movable along the borehole and including as a component part thereof an alternating current

bridge network having an elongated inductance forming one arm of said network and disposed lengthwise of said borehole for producing an electromagnetic field in the strata adjacent thereto, said bridge having circuit connections for application thereto of alternating current input signals and output connections, means for establishing balanced conditions in said bridge network with said exploring unit in a predetermined position, means for moving said exploring unit in said borehole past said formations to unbalance said bridge in accordance with variations in the electrical properties of said formations for production of signals, and measuring means including a detecting circuit having branches respectively connected to said circuit connections and to said output connections in which the signals applied thereto are opposed, said measuring means including an element movable in accordance with the algebraic difference between said signals to indicate an electrical characteristic of said formations. Claims allowed, 18.

## TECHNICAL AIDS

12508. Elevation-recording apparatus. Daniel Silverman, Tulsa, Okla., assignor to Stanolind Oil and Gas Co., Tulsa, Okla., a corporation of Delaware: U. S. patent 2,524,934, issued Oct. 10, 1950.

In elevation-surveying apparatus of the type including a gravity-responsive pendulum for supplying a reference direction for the measurement of grade angles, said pendulum being responsive also to accelerations of the transporting vehicle along the traversed path, means for correcting the elevation indications of said apparatus while said vehicle is in motion for the error introduced by said accelerations comprising: means for producing an electrical output proportional to the vehicle speed, means actuated by said electrical output for producing a motion proportional to the square of the vehicle speed, and means utilizing said motion for altering the elevation indications of said apparatus whereby substantially correct values thereof are given while said vehicle is in motion. Claims allowed, 8.

12509. Geophysical safety catch. Lloyd R. Deputy and Lena F. Deputy, Jennings, La.: U. S. patent 2,529,763, issued Nov. 14, 1950.

In combination with an explosive charge enclosing sleeve, a spring support mounted on the sleeve and adapted to support it in a vertical conduit, said spring support including a resilient strand and a sleeve encircling metal strap securing the strand to the sleeve, said strap having fastening means adjustably connecting the ends thereof and securing the strap around the sleeve, inwardly extending prongs struck from the strap and embedded in the sleeve, said strap having oppositely disposed outwardly offset portions, said strand having an arcuate intermediate portion engaging partially around the sleeve below the strap, said arcuate intermediate portion terminating in upwardly extending leg portions disposed between the sleeve and the outwardly offset portions of the strap, said strand having corresponding upwardly diverging end portions projecting from the upper ends of said upwardly extending leg portions each having an outturned conduit wall engaging terminal, said upwardly diverging end portions being biased outwardly by the resiliency of the strand for urging the outturned terminals into frictional engagement with the wall of the conduit to support the charge enclosing sleeve in the conduit. Claims allowed, 1.

12510. Detonation voltage measuring means. Deslonde R. de Boisblanc, Bartlesville, Okla., assignor to Phillips Petroleum Co., a corporation of Delaware: U. S. patent 2,534,004, issued Dec. 12, 1950.

The method of indicating the average amplitude of a sequence of voltage pulses comprising the steps of transmitting the pulses in a plurality of channels, integrating the pulses in a first channel which resulting integral is a function of the product of the average amplitude and average frequency of occurrence of said pulses, creating a voltage in a second channel proportional to the average frequency of occurrence of, but independent of the amplitude of, said pulses, applying said integral to move the indicator of an indicating device, and applying said voltage from said second channel to control said indicating device to vary the sensitivity thereof inversely as a function of the frequency of said pulses, whereby the average amplitude of said pulses is indicated. Claims allowed, 15.

12511. Detonation meter. Deslonde R. de Boisblanc, Bartlesville, Okla., assignor to Phillips Petroleum Co., a corporation of Delaware: U. S. patent 2,534,005, issued Dec. 12, 1950.

In a detonation meter the combination comprising means producing electrical voltages in response to pressure changes, a low pass filter tuned to pass selected frequency components of detonation, an amplifier, a threshold device comprising a vacuum tube having a grid, an adjustable negative grid bias resistor for said tube, said resistor being adjusted so that said threshold device amplifies only detonation generated voltages above a predetermined value, a rectifier, and integrating circuit and a vacuum tube voltmeter all connected in series in the exact order set forth in this claim.—Claims allowed, 5.

12512. Galvanometer. Carl A. Heiland, Denver, Colo., assignor to Heiland Research Corp., Denver, Colo., a corporation of Colorado: U. S. patent 2,535,065, issued Dec. 26, 1950.

An electrical galvanometer comprising, a field structure having pole pieces and a source of magnetic lines of force, a ribbon fixed at its ends with respect to said field structure, a coil mounted on said ribbon for oscillatory movement between said pole pieces, a concave cylindrical mirror mounted with its axis extending vertically and parallel to the axis of said ribbon for movement with said coil, and means for adjusting said galvanometer bodily about the center of said mirror. Claims allowed, 14.

12513. Projection-vibration indicator. Bernard William Smith, Winston-Salem, N. C., assignor to Western Electric Co., Inc., New York, N. Y., a corporation of New York: U. S. patent 2,535,326, issued Dec. 26, 1950.

In a vibration-testing apparatus, a light source, a viewing screen, a movable member having one end adapted to contact and vibrate with a unit to be tested, the other end of said member having an aperture adapted to be interposed and vibrate between the light source and the viewing screen, and means for projecting an image of said aperture upon said screen whereby a movement of the unit being tested will be transmitted through the vibrating aperture into a movement of an image of the aperture upon the viewing screen. Claims allowed, 12.

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