# Geophysical Abstracts 151 October-December 1952

(Numbers 14004–14183)

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GEOLOGICAL SURVEY BULLETIN 991-D

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

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# GEOPHYSICAL ABSTRACTS 151, OCTOBER-DECEMBER 1952

By Mary C. Rabbitt and S. T. Vesselowsky

## INTRODUCTION

Geophysical Abstracts are issued quarterly by the Geological Survey, U. S. Department of the Interior, to aid those engaged in geophysical research and exploration by providing informative abstracts of current literature dealing with geophysical exploration and the physics of the solid earth.

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

J. R. Balsley, D. F. Barnes, L. E. Birdsall, R. G. Henderson, H. R. Joesting, Elizabeth King, J. L. Meuschke, L. C. Pakiser, and Isidore Zietz have prepared the abstracts signed with their initials.

Geographic names used are those approved by the U. S. Board on Geographic Names. Where names in the original material differ from their official usage, both names are given, the latter in brackets.

The system of transliteration used for Russian names and titles is that of the Board on Geographic Names. A table showing this system was printed in Geophysical Abstracts 148 (Bulletin 991–A).

## EARTH PHYSICS

### GRAVITY

14004. Saxov, S. E. The variation of gravity within the earth: Tellus, v. 4, no. 2, pp. 138–140, 1952.

Following the hypothesis advanced by Olczak, the earth can be considered as a sphere built of concentric layers with gravity varying in accordance with the relation $g=g_0(r_0/r)^2-4/3\pi G\rho(r_0^3-r^3)/r^2$ where $\rho$ is the density in the concentric layer between the radii $r$ and $r_0$ and $G$ is the constant of gravitation. For the density Ramsey has given numerical values ranging from 2.72 g per cm$^3$ at the earth's surface to 18.5 g per cm$^3$ in the center with three discontinuities caused by phase transitions under increasing pressure. Corresponding gravity values range from 982 gal at the surface to 999 at the depth of 700 km, decrease to 986 gal at 1900 km, and rise again to absolute maximum of 1017 gal at 2898 km and then drop to zero at the center of the earth.—*S. T. V.*

14005. Schaffhauser, Edith. Influence de variations rapides de l'accélération de la pesanteur sur l'atmosphere terrestre [Influence of rapid variations of the acceleration of gravity on the earth's atmosphere]: Archives sci. phys. nat., v. 5, fasc. 2, pp. 97–101, 1952.

Possible correlations between microseismic disturbances of the periods of 10 sec to 1 min and barometric variations of the order of $g_0\times10^{-6}$ to $g_8\times10^{-7}$ are studied.

Such microseismic disturbances were discovered independently by Gutenberg and Benioff in St. Louis and Saxer in Fribourg, Switzerland. Variations of $g$ accompaning these microseisms produce impulses in the atmosphere. Assuming that the values of $g$ can be represented by a relation $g(t)=g_0+$ a $\sin\omega t$ and that the resulting compressions are adiabatic, the author derives for the barometric pressure an expression similar in form to that for $g$ $(t)$, but with a phase difference varying with the amplitudes of barometric oscillations. Thus both phenomena are synchronous and similar.—*S. T. V.*

14006. Hirvonen, R. A. Gravity anomalies and deflections of the vertical above sea level: Am. Geophys. Union Trans., v. 33, no. 6, pp. 801–809, 1952.

By the aid of Poisson's integral formula, the gravity anomalies, the potential of the disturbing masses, and the deflections of the vertical above sea level are known. This means a generalization of the well-known formulas of Stokes and Vening Meinesz. Some practical applications on the basis of presently available gravity observations are given.—*Author's Abstract*

14007. Monin, I. F. K voprosu issledovaniya figury geoida gravimetricheskim sposobom [On studying the shape of the geoid by the gravimetric method]: Akad. Nauk SSSR Izv. Ser. geofiz. no. 2, pp. 38–45, 1952.

Stokes formula is not very convenient for the determination of the geoid because in evaluating $\Delta g$, the gravitational anomaly, errors and arbitrariness are unavoidably involved. N. K. Migal derived another formula in which the gravitational anomaly does not enter.

Extensive calculations are presented to prove that with the latter formula an accuracy of 0.5–1.0 percent can be achieved, even admitting certain simplifications in the procedure.—*S. T. V.*

14008. García Siñeriz, José. La corrección topográfica en la investigación gravimétrica [The topographic correction in gravimetric investigations]: Rev. Geofís., v. 11, no. 41, pp. 1–17, 1952.

A method of computing the topographic correction of gravity determinations is discussed. The procedure consists of determining the gravitational effect of annular masses of increasing radii around the station divided into sectors of different angular openings, and summing up these effects. The attainable accuracy of the computations is influenced by the differences in elevation, and the precision and scale of available maps of the region.

Convenient forms and practical rules for necessary computations are worked out, and recommendations are given for the selection of appropriate station sites.—*S. T. V.*

14009. Morelli, Carlo. Primo contributo per una rete gravimetrica fondamentale in Italia [First contribution to fundamental gravimetric network of Italy]: Annali Geofis., v. 5, no. 1, pp. 97–123, 1952.

A regional gravitational survey of Italy, including the islands of Sardinia and Sicily was made using two Worden gravimeters. The astronomical observatory of Padova [$g$=980.658±0.37 gals in the Potsdam system] was used as the base station and 41 stations were occupied. The error in final determination of $g$ at individual stations was about ±0.01 mgal., and closing errors of individual loops were never greater than ±0.12 mgal.

Several tables and a map of the surveyed area are given.—*S. T. V.*

14010. Littlewood, C. A. Gravity measurements on the Barnes Icecap, Baffin Island: Arctic, v. 5, no. 2, pp. 118–124, 1952.

About 20 gravity-meter stations were occupied along seven traverses totaling 45 miles on the southeast lobe of the Barnes Icecap, to determine the thickness of the ice and the topography of the underlying rock. The greatest ice thickness was computed to be 1,533 feet using the values 0.91 and 2.67 for the densities of ice and underlying rock.—*H. R. J.*

14011. Hospers, J. Reinterpretation of a gravity survey in central northern Iceland: Geologie en Mijnb., jaarg. 14, no. 7, pp. 239–247, 1952.

In the summer of 1950, the author carried out geologic field work in part of the region in which Schleusener had made a gravity survey in 1943.

Numerous laboratory determinations of density of rock samples were made with the results substantially deviating from the assumptions made by Schleusener in interpreting the results of his survey. Bouguer anomalies were recalculated using the new data on density and some new tectonic properties obtained in recent geologic studies, and a quite different geologic profile was obtained. Isostatic compensation on the east-west profile was found to be far from complete. It was also found that the Bouguer anomalies decrease by 0.30 mgal for every kilometer in the southern direction, presumably as a result of the combined effect of the dipping of the basalt substratum and isostatic compensation of the higher topography in the south.—*S. T. V.*

14012. Gloden, Albert. Détermination des anomalies de la pesanteur au Grand-Duché de Luxembourg [Determination of gravity anomalies in the Grand Duchy of Luxembourg]: Soc. naturalistes Luxembourgeois Bull., 45 année, pp. 15–19, 1951.

From data obtained by the gravimetric survey of the Grand Duchy (see Geophys. abstracts 11012 and 11453) gravity anomalies were computed for 96 stations of the network using the Cassinis international formula for the determination of standard gravity.—*S. T. V.*

14013. Gloden, Albert. Une campagne altimétrique effectuée au Grand-Duché de Luxembourg en 1949 [An altimetric survey in the Grand Duchy of Luxembourg in 1949]: Soc. naturalistes Luxembourgeois Bull., 44 année, pp. 99–106, 1950.

As part of the gravimetric survey of the Grand Duchy of Luxembourg (see Geophys. abstracts 11012 and 11453) relative altitude determinations were made at about one hundred stations with a compensated Morin barometer. A description of the procedure used and the results obtained are given.—*S. T. V.*

14014. Glangeaud, Louis, and Lagrula, Jean. Corrélations entre les données gravimétriques et structurales dans le Nord de la province d'Alger [Correlations between gravimetric and structural data in the northern part of the province of Alger]: Acad. sci. Paris Comptes rendus, tome 235, no. 2, pp. 193–196, 1952.

Gravity anomalies here seem to vary with the thickness of the overburden which consists of secondary Tertiary and Quaternary formations. The density decreases with decreasing age, a fact which explains the negative anomalies found in several places. Positive anomalies are attributed to deep anticlines, whose presence and size have been previously established. A still better agreement between the gravitational pattern of the province and geologic details may be obtained if, instead of an average density of 2.67, values corresponding to individual formations are taken.—*S. T. V.*

## MAGNETISM AND ELECTRICITY

14015. Bullard, E. C. The origin of the earth's magnetic field: Géologie en Mijnb., jaarg. 14, no. 10, pp. 355–359, 1952.

This is a review of the theories of the origin of the geomagnetic field.—*S. T. V.*

14016. Luchak, George. A fundamental theory of the magnetism of massive rotating bodies: Canadian Jour. Physics, v. 29, no. 6, pp. 470–479, 1951.

A theory is developed to account for the empirical relation, $\vec{P}=-(\beta G/2c)\vec{U}$, between magnetic moment $\vec{P}$ and angular momentum $\vec{U}$ which Blackett found to be approximately valid for the earth, sun, and five stars. Maxwell's equations are extended in a relativistically covariant way to incorporate a gravitational field and a proper interaction between the electromagnetic and gravitational fields. For the earth and sun, the parameter appearing in the interaction term is approximately numerically equal to the density for materials at high temperatures and pressures. The equations indicate no magnetic field for mass bodies moving without rotation in their own gravitational fields. Also the nonrotational components of the earth's field due to interaction with the sun's gravitational field are negligibly small compared to the rotational component.—*R. G. H.*

14017. Stoyko, Nicolas. Sur le champ magnétique variable des étoiles [Variable magnetic field of stars] : Acad. sci. Paris Compte rendus, tome 235, no. 2, pp. 122–124, 1952.

In previous studies the author has established a relation between the variations of the geomagnetic field and variations of the rotational velocity of the earth. This relation can be put in the form $dHp = -0.3255\sqrt{M/R}\, dT/T^2 = 0.106 R\delta^{1/2} W$ (where $Hp$ is the intensity of magnetic field at the pole, $M$ = the mass of the earth, $R$ its radius, $T$ the period of revolution, $\delta$ the density, and $W$ the angular velocity). Similar equations are derived for several stars, with, of course, different constants in each.—*S. T. V.*

14018. Pramanik, S. K., and Narayanan, S. Y. Diurnal magnetic variation in equatorial regions: Indian Jour. Meteorology and Geophysics, v. 3, no. 3, pp. 212–216, 1952.

Observations of $H$ and $Z$ were made at Cape Comorin, Palamcottah, and Sankaranainarkoil [Sankaranāyinarkovil], all three stations approximately on the same meridian as Kodaikānal during March 1951 to supplement existing data. The diurnal range of $H$ in south India was found to be large in the region between the magnetic and geographic equators. Diurnal ranges of $H$ at Batavia [Djakarta] and Singapore are small, and those at Indian and Ceylon stations quite large, though all are far away from the crossing of the geographic and magnetic equators. The maximum range of $H$ in south India and Ceylon is not, as found by Martyn, between the magnetic and geomagnetic equators but to the south of both, as expected by Price and Wilkins. The magnetic equator in this region crosses longitude 77°30′ E. close to Palamcottah.—*M. C. R.*

14019. Walker, G. B., and O'Dea, P. L. Geomagnetic secular-change impulses: Am. Geophys. Union Trans., v. 33, no. 6, pp. 797–800, 1952.

Secular-change impulses in magnetic declination, dip, and horizontal intensity, derived from world-wide observatory data, tend to congregate around certain years (epochs). This tendency is examined statistically. As indications of the character of secular change, the impulses are well suited for use in the development of isoporic charts. Using a selected group of observatories, precise impulses were determined. These promise to be of value in investigations of the nature of secular change.—*Authors' Abstract*

14020. Lazarenko, G. P. Magnitnyye pulsatii v Kelese (Magnetic pulsations in Keles) : Tashkent Geofiz. Observatoriya, Trudy, vypusk 4(5), pp. 18–24, 1950.

Magnetic pulsations recorded at the Keles observatory for the 12 years from 1937 to 1948 were analyzed. Variations of the $H$-component were taken to be indicators of magnetic pulsations and the duration of the pulsation as the measure. The curves for winter and summer months thus obtained were found to be almost identical.

The magnetic pulsation curves were compared with similarly constructed curves for Pavlovsk (near Leningrad), Zi-Ka-Wei (China), and Uellen [Uelen] (near Bering Strait). Those of Keles and Zi-Ka-Wei were found to be similar; the Uelen and Pavlovsk curves were similar to each other, and mirror images of the first two.—*S. T. V.*

14021. Beagley, J. W. Geomagnetic sudden commencement analysis—Ambeley: New Zealand Jour. Sci. Technology, v. 33, sec. B, no. 6, pp. 460–470, 1952.

Detailed analysis of sudden commencements recorded on Amberley magnetograms from 1939 to 1949 shows that Amberley data do not support Parkinson and Ferraro's suggestion that the frequency of occurrence of their "type-II sudden commencements" depends on geomagnetic latitude. Diurnal distribution of sudden commencements shows a local-time postnoon maximum, in agreement with results obtained by Rodés, McNish, and Newton. The monthly frequency has a marked maximum in March and a lesser maximum in August. In the one cycle covered by this investigation, the decrease in sudden commencement occurrence with sunspot numbers is striking.—*M. C. R.*

14022. Grabovskiy, M. A. Magnitnyye svoistva ferritox i ikh znacheniye dlya geofiziki [Magnetic properties of ferrites and their significance in geophysics]: Akad. Nauk SSSR Izv., Ser. geofiz., no. 5, pp. 41–46, 1952.

Tectonic activity, both slow oscillations of the earth's crust and intrusive and volcanic activity, causes appreciable changes in subsurface temperature which in turn lead to local variations of the geomagnetic field. The causes of these geomagnetic disturbances are the extensive physicochemical changes in the mineral composition of rocks as a result of the temperature variation. Ferrites, combinations of $Fe_2O_3$ with an oxide of a bivalent metal, such as NiO, ZuO, or FeO are used to illustrate this. Such combinations as $NiOFe_2O_3$, or $MgOFe_2O_3$, or $FeOFe_2O_3$ (magnetite) are split into individual oxides with significant changes in magnetic properties, especially in the position of Curie point and in the magnetic permeability, and are finally magnetized, sometimes with same direction as the local geomagnetic field, and sometimes in the opposite direction. This phenomenon, in the opinion of the author, offers an explanation of many local positive or negatives anomalies.—*S. T. V.*

14023. Kondorskiy, Ye. I. K feorii magnitnykh svoistv gornykh porod i poroshkov [The theory of the magnetic properties of rocks and powdered substances]: Akad. Nauk SSSR Izv., Ser. geofiz., no. 5, pp. 47–54, 1952.

In a previous study (Geophys. abstract 12358) a formula was derived for magnetic susceptibility of conglomerates consisting of magnetic and nonmagnetic substances by assuming spherical magnetic particles.

Similar formulas for magnetic susceptibility and interior demagnetizing factor are now derived for conglomerates with magnetic particles of flattened or oblong to needle shape.—*S. T. V.*

14024. Kalashnikov, A. G., and Kapitsa, S. P. Magnitnaya vosprimchivost' gornykh porod pri uprugikh napryazheniyakh [Magnetic susceptibility of rocks under elastic stresses]: Akad. Nauk SSSR Doklady, tom 86, no. 3, pp. 521–523, 1952.

Tectonic processes cause changes in elastic stresses in rocks, thus producing variations in the geomagnetic field near the surface of the earth. The physical basis of this "tectonomagnetic" effect was studied in laboratory on samples of diabase, basalt, andesite, hornblendite, diorite porphyry, gabbro, porphyry, scarn, and diorite.

Samples 30 mm in diameter and 110 mm long were placed in the field of a magnetizing coil inside another induction coil. Both coils were connected in

series with a pair of compensating coils. Changes in the magnetic susceptibility of the sample, when compressed, produced changes in the mutual induction effect of the first two coils whose core was formed by the sample being investigated. Changes of the magnetic field induced an electromotive force in the exterior coil, and this was measured by the compensation method.

The frequency of the current feeding the coils was 130 cycles per second. The mechanical stress were as much as 1200 to 1600 kg per $cm^2$.

Results of these measurements are presented in curves. As a general rule, compression of specimens produced a decrease of the magnetic susceptibility measured parallel to stress, down to 50 percent (in basalt) of the initial value. Changes in susceptibility measured perpendicularly to stress were of less consistent character. The presence of magnetite in the specimen made the variation of susceptibility always negative. On the basis of the results obtained the authors conclude that seismotectonic phenomena are producing variations in geomagnetic field and that the magnetic susceptibility of a core sample obtained from a drill hole, when measured in laboratory, is not the same as that of the formation underground because of changes in mechanical conditions of the surrounding medium.—*S. T. V.*

14025. Hospers, J. Remanent magnetism of rocks and the history of the geomagnetic field: Nature, v. 168, no. 4287, pp. 1111–1112, 1951

Measurements of the remanent magnetization of 22 samples from two series of lava flows in northern Iceland were normal in the Quarternary and older Tertiary rocks but inverse in the middle Tertiary rocks. As an inversion resulting from tectonic activity is unlikely, it is concluded that an inverted geomagnetic field existed in Iceland for at least 25,000 years during the Tertiary. —*M. C. R.*

14026. Nagata, Takeshi. Reverse thermo-remanent magnetism: Nature, v. 169, no. 4304, pp. 704–705, 1952.

Experiments on hypersthene hornblende dacitic pumices containing magnetite grains are described. The thermoremanent magnetization induced by cooling in a low magnetic field was found to be opposite in direction to the field direction, as in some igneous rocks in the earth's field. The magnetic and thermal conditions for the effect were investigated but the reason for its occurrence is not clear.—*M. C. R.*

14027. Néel, Louis. Confirmation experimentale d'une mécanisme d'inversion de l'aimantation thermoremanent [Experimental confirmation of a mechanism of the reversal of thermoremanent magnetization]: Acad. Sci. Paris Comptes rendus, tome 234, no. 20, pp. 1991–1993, 1952.

The results obtained by Nagata (see preceding abstract) are discussed on the basis of Néel's previous work. It is easy to understand the process of reversal for a material containing two types of finely divided ferromagnetic constituents with different Curie points, the one with the higher temperature being capable of exerting a demagnetizing field on the one with the lower Curie point.—*M. C. R.*

14028. Nagata, Takeshi, Akimoto, Syun-iti, and Uyeda, Seiya. Reverse thermoremanent magnetism: Acad. Japan Proc., v. 27, no. 10, pp. 643–645, 1951.

A rock cooled from high temperature in a weak magnetic field has a residual permanent magnetization, called thermoremanent magnetization, the direction

of which coincides with that of the applied magnetic field. A hypersthene hornblende dacitic pumice from Volcano Haruna in Japan exhibits thermoremanent magnetization in the direction opposite to that of the applied field. This "reverse thermoremanent magnetization" is produced only when the magnetic field is applied during the period when the specimen is cooled from 45 C to 250 C but is of sufficient magnitude to mask the normal thermoremanent magnetization produced in cooling from 250 C to room temperature. The intensity of reverse thermoremanent magnetization depends upon the intensity of the applied magnetic field, ranging from zero at zero applied field through a maximum at an applied field of 2 oersteds to zero at an applied field of 7 oersteds. Above this value the thermoremanent magnetization is not reversed.—*J. R. B.*

14029. Turlygin, S. Ya., and Karelina, N. A. Vliyaniye sushi i morya na raspredeleniye prirodnykh elektricheskikh tokov po poverkhnosti zemli [The influence of dry land and sea on the distribution of telluric currents over the surface of the earth]: Akad. Nauk SSSR Izv., Ser. geofiz. no. 4, pp. 55–75, 1952.

The propagation of telluric current of cosmic origin over the surface of the earth is analyzed, and the reliability of the measurements of these currents as they are now made at several observatories is questioned. It is known that the electrical resistivity of rocks is always some thousands of even hundreds of thousands of times greater than that of the ocean. This certainly produces inequality in the distribution of telluric currents in maritime regions. Computations of the current density over the ocean and over adjoining part of the continent assuming a shore line of simple geometric shape, confirm this. Analytical determination of the distribution of current over the surface of the earth would be too complicated, so the solution of the problem was tried on a model. Telluric currents were imitated by a stream of glycerin flowing through narrow slots of different thickness, representing the ocean or continental masses. To make the stream visible the threads of glycerin were dyed with methylene blue injected through small openings distributed along the slot.

Current distributions in models of the Black Sea, Mediterranean Sea, and other water masses, were obtained, and always strongly deviated from homogeneous flow.

The authors conclude that telluric currents of cosmic origin can be measured either in open spaces of ocean or at points far removed from ocean in the middle of continents, but that otherwise the measurements are too much influenced by local inhomogeneities of the surface of the earth.—*S. T. V.*

14030. Beaufils, Yvonne, Gibault, Gaston, and Kunetz, Géza. Variations rapides dans les courants telluriques et le champ magnétique terrestre [Rapid variations of telluric currents and the geomagnetic field]: Acad. sci. Paris Comptes rendus, tome 235, no. 2, pp. 198–200, 1952.

In March 1952, during the period of the equinox, regular observations of telluric currents were made at a provisional station in the Champagne region of France. Simultaneously observations were made at the observatory of Chambon-la-Forêt of the horizontal component $H$ of geomagnetic vector as well as of its derivative $dH/dt$. At close correlation was established between the variation of the east-west component of telluric current and the variations in $H$. (*See also* Geophys. abstract 13831).—*S. T. V.*

## SEISMOLOGY

14031. Sretenskiy, L. N. Rasprotraneniye uprugikh voln. voznikagushchikh pri dvizhenii sistemy normalnykh napryazheniy po poverkhnosti polnprostranstva [Propagation of elastic waves produced by a system of normal stresses over the surface of semispace]: Trudy Moskovskogo Mat. Obshchestna, tom 1, pp. 167–186, 1952.

An analysis is made of vibrations generated in an elastic semispace by a system of stresses moving with constant velocity on a rectilinear trajectory over its boundary surface. The problem is of interest in the theory of the origin of microseisms.

The system of five differential equations for the generation of elastic waves in a homogeneous isotropic medium is derived and the particular solution is obtained, assuming the displacements of every point to be exponential functions of its coordinates and of time, multiplied by certain functions of the depth of the point below the free surface of the earth. These displacement functions are found in a general form and later evaluated for large $R$, so that the behavior of the crust is determined far enough from the source of disturbance.

In general, the points on the boundary surface describe plane curves, or surface waves; the planes of these curves make with the horizon a constant angle. At a sufficiently great distance from the source of the disturbance, points of the boundary plane describe ellipses.—*S. T. V.*

14032. Keylis-Borok, V. I. Ob uravnenii chastot mnogoslvinoy upreugoy sredy [Frequency equation of a multilayer elastic medium]: Akad. Nauk SSSR Doklady, tom 87, no. 1, pp. 25–28–, 1952.

The equation is analyzed to determine the frequencies of seismic waves possible in a semispace formed of $n$ plane-parallel layers bounded by a homogeneous isotropic medium. Normal stresses over the boundary surface are assumed everywhere equal to zero.

The wave equations can be expressed with the aid of Fourier-Bessel integrals. The system being axially symmetric, the equation for the frequency of waves can be represented in the form of a matrix.

For a sufficiently thin layer the frequency equation has one and only one real root; if Z=0, that is, the boundary at the surface, the problem reduces to that of Rayleigh waves.—*S. T. V.*

14033. Satō, Yasuo. Generation of Love and other *SH*-waves *in* Study on surface waves, pt. 6: Tokyo Univ. Earthquake Research Inst. Bull., v. 30, pt. 2, pp. 101–119, 1952.

It is shown that for *SH* waves the strength of a source at a point and the displacement at another point are connected by a reciprocal formula when both points are in a superficial layer or when one point is in the lower semi-infinite medium. When a periodic source is located in the superficial layer the refracted *SH* waves propagated in the lower medium ordinarily decrease in amplitude as the inverse 3/2 power of the horizontal distance from the source; however, predominant *SH* waves decrease in amplitude as the inverse 1/2 power of the distance. There are no reflected *SH* waves from a harmonic source. The amplitude function for Love waves is evaluated for certain elastic parameter values and plotted against velocity and period. It is concluded that large displacements belonging to the branch of Love waves with nodes in the layer cannot be expected.—*R. G. H.*

14034. Satō, Yasuo. Distribution of surface stress generating no Rayleigh waves: Tokyo Univ. Earthquake Research Inst. Bull., v. 29, pt. 3, pp. 445–453, 1951.

This paper demonstrates the manner in which surface stress can be applied to a semi-infinite elastic medium without generating Rayleigh waves. The problem is of practical importance in seismic prospecting where surface waves often obliterate later useful phases of the *P* group. The condition for nongeneration of Rayleigh waves is set up in terms of a function which depends upon the Poisson ratio. An example of a simple harmonic surface-stress distribution satisfying the condition is given. If the origin is of an aperiodic type, examples can be found in which the condition is only approximately satisfied.—*R. G. H.*

14035. Keylis-Borok, V. I. K voprosu ob issledovanii istochmikov ekvivalentnykh ochagam zemletryasenii [On the question of studying (seismic) sources equivalent to the foci of earthquakes]: Akad. Nauk. SSSR Geofiz. Inst. Trudy, no. 9 (136), pp. 20–42, 1950.

According to Japanese seismologists the foci of strong earthquakes can be divided on the basis of their dynamic characteristics into two groups: one in which the focus is a center of spherical dilation to which a simple force is added, and the other, a dipole with a moment. The first kind represents the foci of volcanic earthquakes; foci in the second group are typical of tectonic earthquakes.

In the present article, a study is made of the correlations of the dynamic parameters of this latter type of foci such as the length, direction, and lateral extension of the dislocation and resulting seismic effects observed on seismograms. The ground is assumed to be perfectly elastic and homogenous and the source of seismic shock to be a dipole with a moment. Assuming different values of the moment and the dipole acting in the focus and following the procedure suggested by A. E. H. Love, it is possible to compute resulting seismic waves and their effect at the arrival at the earth's surface. It is also possible to determine the form of isoseismal lines on the surface of the earth. Comparing the computed isoseismal lines with those observed, it is possible to evaluate the correctness of the assumptions made about dynamic characteristics of the focus and by varying these assumptions, to obtain satisfactory agreement.

In the computations the effect of dispersion, and influence of anisotropy and of incomplete elasticity of the ground are neglected, which is permissible for hypocentral distances exceeding 200 km. At these distances the focus can be assumed to be a point source when the linear dimensions of focus are small compared to the length of the waves.—*S. T. V.*

14036. Savarenskiy, Ye. G. Ob uglakh vykhoda seysmicheskoy radiatsii i nekotorykh smezhnykh voprosakh [On the angle of emergence of seismic rays and certain related questions]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 15 (142), 111 pp., 1952.

Seismic waves from the focus of an earthquake generate at every refraction new waves, both longitudinal and transverse, so that at the point of observation many different waves arrive, each of them bearing traces, not always understood but indelible, of the geologic structures through which they have passed. Travel times of these waves are used for the determination of hypocentral distances and for the interpretation of the structure of the earth.

A new seismological method which effectively complements the existing method based on an analysis of travel times is presented.

By applying the theory of elasticity and assuming the earth to be composed of homogeneous layers with discontinuities at known depths, it is possible to compute analytically the path of direct, refracted, and reflected waves, both longitudinal and transverse, from a distant earthquake. Differences between computed and observed angles of emergence of different waves may be caused by geologic irregularities near the point of observation or by different structures from those assumed in deep layers of the earth. In either case these differences are important indications of local geology and the internal constitution of the earth.

The study contains numerous examples illustrating the possibilities of this method of interpretation, first suggested by Galitzin. Methods of measuring the apparent and the true angles of emergence, the influence of stratification on this angle, and the methods of interpretation of the results obtained are also discussed.—*S. T. V.*

14037. Byerly, Perry. Theory of the hinged seismometer with support in general motion; Seismol. Soc. America Bull., v. 42, no. 3, pp. 251–261, 1952.

The purpose of this investigation was to ascertain the relative magnitude of terms normally neglected in writing the equation of the seismograph. These involve rotations of the support and accelerations at right angles to the principal forcing acceleration. The discussion is mathematical. Seven conditions under which these terms may be neglected are given.—*M. C. R.*

14038. Benioff, Hugo, and Gutenberg, Beno. The response of strain and pendulum seismographs to surface waves: Seismol. Soc. America Bull., v. 42, no. 3, pp. 229–237, 1952.

Investigations at Pasadena show certain advantages gained from the use of strain seismographs and vectorial recorders. The relationship between the response of strain and pendulum seismographs is well adapted to demonstrate the characteristic elliptical motion of the ground particles in Rayleigh waves. More detailed investigations of the effect of crustal inhomogeneities on surface waves are needed. It should be possible to use the vectorial recorder with vertical- and horizontal-pendulum seismometers or with vertical-pendulum and horizontal-strain seismometers to determine the actual shape of the Rayleigh-wave ellipses and the inclination of their major axes. Preliminary investigations suggest that the major axis may be inclined slightly to the vertical.—M. C. R.

14039. Mintrop, Lüdger. Die Gliederung der Erdrinde und des Erdmantels nach seismichen Beobachtungen [The stratification of the crust and mantle of the earth from seismic observations]: Akad. Wiss. Göttingen, Math-Phys. Kl., Nachr. Heft 2, pp. 46–48, 1947.

This paper is essentially the same as that abstracted in Geophys. abstract 11531.—*S. T. V.*

14040. Stechschulte, V. C. A method of obtaining *P* and *S* travel-time curves within a "stripped earth": Seismol. Soc. America Bull., v. 42, no. 4, pp. 313–314, 1952.

A simple method is outlined for obtaining from a time-distance curve of a deep-focus earthquake a table of travel times within an earth "stripped" to the depth $h$, the depth of focus. The method depends on the fact that such a curve for a deep-focus earthquake has a point of inflection and therefore has the same

slope at two different values of epicentral distance. The Herglotz-Wiechert method may then be applied to these travel times to obtain a velocity-depth distribution.—*Author's Abstract*

14041. Knopoff, L. On Rayleigh wave velocities: Seismol. Soc. America Bull., v. 42, no. 4, pp. 307–308, 1952.

The values of Rayleigh-wave velocities for materials which do not meet the condition $\sigma=1/4$ have been determined. Deviations from .9194 $V_s$, obtained when $\sigma=1/4$, are not great but are significant in the problem of the identification of seismic wave components at positions close to a source.—*M. C. R.*

14042. Ergin, Kazim. Observations on recorded ground motion due to *P*, *PcP*, *S*, and *ScS:* Seismol. Soc. America Bull., v. 42, no. 3, pp. 263–270, 1952.

The recorded motion of a point at the surface of the earth, in the vertical plane of propagation, upon the arrival of *PcP* and *ScS*, as well as of the direct *P* and *S* waves, is reproduced from the seismograms of the vertical, N–S and E–W component, long-period Benioff seismographs. It is found that *P* and *PcP* produce a back-and-forth vibration in the general direction of the incoming ray, and that *S* and *ScS* produce a motion the largest displacement of which is approximately perpendicular to the ray. *PcP* motion starts close to the vertical, but its horizontal component later increases. A minor *S* phase arriving close to and after *PcP* and a minor *P* phase arriving close to and before *ScS* are observed. The effect of these minor phases on the smaller component of the ground vibration caused by the waves reflected from the mantle-core boundary is discussed.—*Author's Abstract*

14043. Press, Frank, and Ewing, Maurice. Two slow surface waves across North America: Seismol. Soc. America Bull., v. 42, no. 3, pp. 219–228, 1952.

Surface shear wave (*Lg*) with initial period about ½ to 6 sec. with sharp commencements and amplitudes larger than any conventional phase have been recorded for continental paths at distances up to 6,000 km. These waves have a group velocity of 3.51±.07 km/sec. and for distances greater than 20° they have reverse dispersion. For distances less than about 10° the periods shorten and *Lg* merges into the recognized near-earthquake phase *Sg*.

An additional large amplitude phase in which the orbital motion of the particle is retrograde elliptical and the velocity is 3.05±.07 km/sec. has also been observed for continental paths.

It is believed that these phases are propagated through a wave guide formed by a superficial sialic layer. The problem of explaining the propagation of these surface waves is that of finding a crustal structure which is consistent with the other data of geology and geophysics and which will provide a suitable wave guide for the new phases. A possible nature of the wave guide is described.—*Author's Abstract*

14044. Ewing, Maurice, and Press, Frank. Crustal structure and surface-wave dispersion. Pt. 2: Solomon Islands earthquake of July 29, 1950: Seismol. Soc. America Bull., v. 42, no. 4, pp. 315–325, 1952.

Rayleigh waves from the Solomon Islands earthquake of July 29, 1950, recorded at Honolulu, Berkeley, Tucson, and Palisades are analyzed. Both the direct waves and those propagated through the Antipodes were observed for all stations except Honolulu. Application of a correction for land travel results in a

dispersion curve for the oceanic portion of the path. It is found that the observed dispersion could be accounted for by propagation through a layer of water 5.57 km. thick overlying simatic rocks having shear velocity 4.56 km/sec. and density 3.0 gm/cc. Basement structure in the Pacific, Indian, South Atlantic, and North Atlantic Oceans is identical within the limits of accuracy of the method.

The sinusoidal nature and duration of the coda is explained by the effect of the oceans on the propagation of Rayleigh waves.

The results are compatible with seismic refraction measurements in the Atlantic and Pacific Oceans.—*Authors' Abstract*

14045. Ergin, Kazim. Energy ratio of the seismic waves reflected and refracted at a rock-water boundary: Seismol. Soc. America Bull., v. 42, no. 4, pp. 349–372, 1952.

Energy ratios of seismic waves reflected and refracted at a rock-water boundary have been computed and are shown in graphs and tables. Poisson's ratios in the solid medium is a dominant factor in the behavior of reflected and refracted waves in the solid medium. Density has little effect. Peculiar effects are observed near the critical angles of incidence. At the critical angle all energy goes into the reflected wave of the same kind as the incident wave. In all cases, most energy goes into reflected *P* and *S* waves because of the contrast in densities and velocities in the two media.—*M. C. R.*

14046. Coulomb, Jean. Sur la nature des ondes *T* engendrées par les séisms sous-marins [On the nature of *T* waves produced by submarine earthquakes]: Acad. royale Belgique Bull., Cl. sci., 5th ser., tome 88, no. 13, pp. 393–395, 1952.

The author expresses the opinion that *T* waves cannot be Rayleigh waves spreading over the bottom of the ocean and modified by the pressure of the layer of water.—*S. I. V.*

14047. Gane, P. G., Seligman, P. and Stephen, J. H. Focal depths of Witwatersrand tremors: Seismol. Soc. America Bull., v. 42, no. 3, pp. 239–250, 1952.

Earth tremors originating at a single Witwatersrand mine were recorded by six vertical seismometer stations all within about 10,000 ft (3.0 km) of the foci. A triggered system of recording permitted the first arrivals to be timed to 5 milliseconds, giving a location accuracy of about 250 ft (75 m). All the 100 foci determined were in close proximity to the position of active mining, or slightly above it, and had a mean depth of 7,500 ft (2.3 km). Eighty per cent of the first movements observed were downward, that is, cataseismic.

Is may be concluded from the predominantly cataseismic nature of the first motion that the initial movements at the focus are into the mined-out cavities. However, failure in simple tension is not a common form of initial fracture. Two possible types of shear failure which could produce the cataseismic motions are: the hanging wall shears through its supporting pillars, moving down-dip; or the hanging wall shears, at a face being worked down dip, so as to tend to close the stope.—*M. C. R.*

14048. Hersey, J. B., Officer, C. B., Johnson, H. R., and Bergstrom, S. Seismic refraction observations north of the Brownson Deep: Seismol. Soc. America Bull., v. 42, no. 4, pp. 291–306, 1952.

Results of several refraction profiles made on the rise to the north of the Brownson Deep are presented. Good evidence for a high-speed layer with

travel-time curves showing a compressional velocity of 7.94 km/sec. and an intercept of 8.4 sec. is presented, and the presence of an overlying lower-speed layer (6.64 km/sec., intercept 8.1 sec.) is demonstrated on less complete evidence. Neither layer correlates with existing reflection data in the area. Two sets of secondary low-frequency arrivals are tentatively interpreted as a refracted shear wave and a wave that has taken a bottom and surface reflection and then a basement refraction. Evidence is presented for a newly observed forerunner of the refracted-surface reflected waves of the permanent sound channel (*RSR* waves) consisting of a train of nearly constant frequency waves which appear to travel between surface and bottom via the *RSR* path and along the bottom at the speed of sound in water at the bottom.—*Author's Abstract*

14049. Hill, M. N. Seismic refraction shooting in an area of the eastern Atlantic: Royal Soc. London Philos. Trans., ser. A., v. 244, no. 890, pp. 561–596, 1952.

For the experiments described in this paper a new method of seismic refraction shooting was developed. With this method hydrophones suspended at a depth of about 100 feet below the surface of the sea acted as receivers for compressional waves developed by depth charges exploding at a depth of approximately 900 feet.—*Physics Abstracts*

14050. Crary, A. P., and Cotell, R. D. Ice islands in Arctic research: Sci. Monthly, v. 75, no. 5, pp. 298–302, 1952.

Scientific investigations of floating ice islands in the Arctic included a seismic profile of 11,000 ft and observation of gravity. An increase of longitudinal velocity from 10,500 fps to 12,000 fps was observed at a depth of 50 ft. Long-distance shots produced flexural waves, from the frequency of which an ice depth of about 150 ft was computed. Gravimeter observations were made twice daily for a two-month period.—*M. C. R.*

14051. Imamura, Gakuro. Maximum gradients of crustal deformations at the time of a destructive earthquake: Seismol. Soc. America Bull., v. 42, no. 4, pp. 309–311, 1952.

By the destructive earthquake of July 10, 1804, the entire Kisagata area (Akita-ken) was uplifted. In October 1941 the present altitudes of former shore lines were measured and lines of equal upheaval determined. The maximum gradient is of the order of $10^{-3}$ and directed almost perpendicularly to the general trend, and it is concluded that the crust can deform itself without faulting when the gradient attains the order of $10^{-3}$.—*M. C. R.*

14052. Roberts, E. B., and Ulrich, F. P. Seismological activities of the U. S. Coast and Geodetic Survey in 1950: Seismol. Soc. America Bull., v. 42, no. 3, pp. 207–217, 1952.

Seismological activities of the U. S. Coast and Geodetic Survey, including geodetic work of seismological significance, are summarized. These reports include the teleseismic program, principal earthquakes in the United States during 1950, vibration work of the Seismological Field Survey, and instrumental development. Geodetic work includes triangulation in Riverside County,

Indio, and Long Beach, Calif. and leveling surveys at Lake Mead and between Galveston and Port Isabel, Tex.—*M. C. R.*

14053. Gubin, I. Ye. Seysmo-tectonicheskiy metod seysmicheskogo rayonirovaniya [Seismotectonic method of seismic zoning] : Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 13 (140), 62 pp., 1950.

Seismic zoning, defined as the evaluation of the danger from earthquakes in an area, is a factor of great importance in determining sites for dams, metallurgical works, and power houses. Up to now the seismicity of a region has been determined on the basis of statistical data of the approximate intensity and frequency of past earthquakes. As precise observations and recording of earthquakes were begun only very recently, and in sparsely populated regions of the U. S. S. R. even noninstrumental data on earthquakes are very scarce, the evaluation of seismicity is extremely uncertain. The author indicates several examples when such evaluations concerning regions of Turkistan were proved to be completely wrong, and he insists on the necessity of completing statistical data by thorough studies of geology, especially of tectonics.

The study contains a detailed discussion of the geology and seismology of Turkistan. (*See also* Geophys. abstract 13849).—*S. T. V.*

14054. Koning, L. P. G. Earthquakes in relation to their geographical distribution, depth and magnitude, pt. 4, South America : K. Nederland. Akad. Wetensch. Proc., Ser. B., v. 55, no. 3, pp. 263–279, 1952.

The isomagnitude line method (*see* Geophys. Abstract 13861) has been applied to earthquakes in South America. A single long seismic belt containing both shallow and intermediate shocks is found. Below this belt and separated from it by a gap are three areas of deep seismic disturbances. The geographical distribution of epicenters suggests that the foci can be arranged in a surface dipping toward the American continent, but this investigation indicates that the foci cannot be arranged on a single surface. There seems to be a more or less regular distribution, both horizontally and vertically, of relatively strong shocks.—*M. C. R.*

14055. Koning, L. P. G. Earthquakes in relation to their geographical distribution, depth, and magnitude, pt. 5, Central America and the Caribbean area, and pt. 6, The Southern Antilles : K. Nederland. Akad. Wetensch. Proc. v. 55, no. 3, pp. 272–279, 1952.

Isomagnitude studies of earthquakes in Central America and the Caribbean region indicate existence of two seismic belts. One zone along the Pacific coast of Central America is the northern continuation of the South American belt. In the surface layer this Central American belt is continued northward along the Pacific coast of North America and over the Aleutian arc. The Caribbean belt extends over the islands of Cuba, Haiti, Puerto Rico, and the Lesser Antilles to the coast of South America. The seismic areas in the Southern Antilles (islands in the south Atlantic Ocean off the coast of South America) do not form an uninterrupted belt. Only shallow and intermediate shocks occur, the maximum depth being 300 km in Central America and 200 in the Caribbean and south Atlantic areas. There is a more or less regular distribution of centers of relatively strong seismic intensity.—*M. C. R.*

14056. Koning, L. P. G. Earthquakes in relation to their geographical distribution, depth, and magnitude, pt. 7, The Pacific coast of North America and the Aleutian arc, and pt. 8, The Mediterranean region: K. Nederland. Akad. Wetensch. Proc., v. 55, no. 3, pp. 280–292, 1952.

Isomagnitude studies indicate that the seismic belt in the Pacific region of North American extends from Central America along the coast of the United States and Canada, curves into Alaska, and continues over the Aleutian arc to end east of Kamchatka. In Oregon and Washington the belt bifurcates into two branches surrounding an aseismic region. Shocks of intermediate depths to a maximum of 170 km occur only in the Aleutians. Large magnitude shocks occur chiefly in the Aleutian arc.

In southern Europe and Asia, one belt of shallow shocks extends from western Spain to southeastern Asia where it joins the East Indian belt. At greater depths seismicity seems to be restricted to several areas of different size. The deepest shocks (250–300 km) occur in southern Italy, and in the Hindu Kush there is a more or less regular horizontal and vertical distribution of the centers of relatively strong seismic intensity.—*M. C. R.*

14057. Gubin, I. Ye. Zemletryasemiya v Garmskoy oblasti [Earthquakes in the Garmskaya Oblast']: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 8 (135), 96 pp., 1949.

In further discussion of the "seismo-tectonic" method of seismic zoning (*see* Geophys. abstract 13849), the author emphasizes the necessity of studying not only the purely seismic characteristics of past earthquakes but also related tectonic features. Garmskaya Oblast' is a very fertile ground for such investigations.

A detailed geologic description of the province is given, including a tectonic history. All available statistical data on the seismicity of the region are also given. It is said that by application of this seismotectonic analysis, the author was able to predict earthquakes in several parts of the province.—*S. T. V.*

14058. Belousov, V. V., Kirillova, I. V., and Sorskiy, A. A. Kratkiy obsor seysmichnosti Kavkaza v sopostavlenii s ego tectonicheskim stroyeniyem [Brief review of the seismicity of the Caucasus in relation to its tectonics]: Akad. Nauk SSSR Izv., Ser. geofiz., no. 5, pp 3–9, 1952.

The Caucasus is a region of high seismicity. During only nine months of 1951, more than one hundred earthquakes were recorded. From statistical data a map has been constructed, indicating areas of maximum intensity and epicenters of earthquakes since 1933. The epicenters are concentrated along the ridge of extinct volcanoes across the Akhalkalaki plateau. Traces of Quaternary lava flows are found in the same area. Neither the seismicity of Caucasus nor its tectonics are yet sufficiently known.—*S. T. V.*

14059. Kirillova, I. V. Seysmichnost Akhalkalakskogo nagor'ya [Seismicity of the Akhalkalaki plateau]: Akad. Nauk SSSR Izv., Ser. geofiz., no. 5, pp. 10–24, 1952.

Akhalkalaki plateau has the average elevation above sea level of 1,500-2,000 m, with several ridges rising above this to a maximum of 3,400 m. Its most important tectonic feature is a line of volcanoes, inactive since the Tertiary or Quaternary, the so-called Abul-Samsar ridge [Samsarskiy Khrebet], which coincide with the principal line of epicenters.

The whole area is one of high seismicity. The city of Akhalkalaki has experienced more than 15 destructive earthquakes since 1868. The tectonic relations of the plateau are very complicated, but their relation to the seismicity has not yet been sufficiently investigated.—*S. T. V.*

14060. Mihailovič, Jelenko. Seizmološka karta Yugoslavije [Seismologic map of Yugoslavia]: Radovi seizmološkog zavoda F. N. R. J. u Beogradu., 110 pp., 1950.

Available data, mostly noninstrumental, on earthquakes in different parts of the present Yugoslavia between 360 and 1949 are summarized. For each earthquake the intensity, geographic position of the epicenter, and the data of occurrence are given. A map (scale 1:1,000,000) shows regions of different seismicity.—*S. T. V.*

14061. Due Rojo, Antonio. Notas sismologicas de 1951 [Seismological notes for 1951]: Rev. Geofís., v. 11, no. 41, pp. 105–108, 1952.

International collaboration was very much in evidence during 1951. After each earthquake which occurred anywhere in the world, pertinent information was directed to United States Coast and Geodetic Survey in Washington, using if necessary facilities of the U. S. State Department or of the Office of International Foreign Trade of the Department of Commerce. On the basis of this information, about 800 epicenters were located, and in addition about 200 hypocenters were determined. The geographic distribution of these earthquakes is shown on a special map of the world, and statistical data on the magnitudes of individual earthquakes are given.—*S. T. V.*

## RADIOACTIVITY

14062. Hess, V. F., Burns, W. F., and Parkinson, W. D. Gamma radiation from uranium $X_2$: Am. Geophys. Union. Trans., v. 33, no. 5, pp. 657–660, 1952.

The amount of ionization due to hard gamma rays from $UX_2$ ($Pa^{234}$) in equilibrium within a known amount of uranium was found, using a specimen of thorium-free Joachimstal ore, by substracting the calculated radiation due to RaC from the measured total hard-gamma radiation. Corrections for self-absorption, geometry, and differential absorption in the lead filter were applied. Ionization was measured in terms of Ra standards. It was found that 5.2 percent of the hard-gamma radiation is due to $UX_2$, the rest from RaC. Although the 5.2 is twice the figure given by Suddy and Russell, it nevertheless shows that the contribution of the gamma radiation of $UX_2$ to the total radiation of all radioactive products in rocks is insignificant.—*M. C. R.*

14063. Hurley, P. M., and Shorey, R. R. Discrimination of thoron alpha activity in presence of radon: Am. Geophys. Union Trans., v. 33, no. 5, pp. 722–724, 1952.

The short life of ThA is used as a means of discriminating between thoron and radon alpha activity. At low counting rate the count of double alpha pulses due to the rapid decay from Th to ThB indicates the ratio of radium to thorium X in the source solution.—*Authors' abstract*

14064. Vinogradov, A. P., Zadorozhnyy, I. K., and Zhukov, S. I. Izotopnyy sostav svintsov i vozrast zemli [Isotopic composition of lead and the age of the earth]: Akad. Nauk SSSR Doklady, tom, 85, no. 5, pp. 1107–1110, 1952.

Thirty-two samples of galena of different geologic ages were analyzed in a mass spectrograph, and on the basis of the relations among the different isotopes present the authors find that the age of the earth is between $2.1 \times 10^9$ years and $(5.0 \pm 0.5) \times 10^9$ years.—*S. T. V.*

14065. Kulp, J. L. The carbon 14 method of age determination: Sci. Monthly, v. 75, no. 5, pp. 259–267, 1952.

This is an account of the development of the carbon-14 method of age determination, the techniques of measurement and calculation, and the uses of the method for dating archeological and geological materials. Among the examples cited are the dating of the Mayan and other prehistoric cultures, and the use of the method in dating Wisconsin glaciation, volcanic eruptions in La Soufrière, hydrocarbons in recent marine sediments, and the circulation of the ocean.—*M. C. R.*

14066. Kulp, J. L., Volchok, H. L., Holland, H. D., and Ericson, D. B. Thick source alpha activity of some North Atlantic cores: Jour. Marine Research, v. 11, no. 1, pp. 19–28, 1952.

The alpha activity of samples from six representative deep-sea cores has been determined by the scintillation method. Relative alpha activity ranges from 2–3 counts per $cm^2$ per hr for sand, 2–4 for globigerina ooze, 4–6 for foraminiferal green clay, to 5-10 for fine white to red clay with low Foraminifera content. Actual alpha activity measured is determined to a large extent by percent of foraminiferal shells, the concentration and radioactivity of sand grains, and the composition of the clay. The greatest determinant seems to be the mineral composition of the particles. Some correlation between total alpha activity and $CaCo_3$ content or sand content is possible. Total thick-source alpha counting is apparently inadequate for age determinations by the ionium method.—*M. C. R.*

14067. Slack, H. A. Field measurement of the radioactivity of rocks *in* The application of recent counting techniques to geophysical research: Am. Geophys. Union Trans., v. 33, no. 6, pp. 897–901, 1952.

Further development of a field gamma-ray counter suitable for measuring the radioactivity of ordinary rocks in place (*see* Geophys. Abstract 12584) has resulted in greater sensitivity and portability. The instrument was calibrated against prepared standard radioactive concrete blocks and used to investigate the radioactivity of the Kirkland Lake area in northern Ontario. Additional observations over the Round Lake batholith do not alter previous results. An area of higher radioactivity to the north is believed to be a separate geologic structure.—*M. C. R.*

14068. Whitham, Kenneth. Laboratory scintillation counters applied to some geophysical problems, *in* The application of recent counting techniques to geophysical research: Am. Geophys. Union Trans., v. 33, no. 6, pp. 902–911, 1952.

The development and operation of a laboratory scintillation counter capable of analyzing the separate uranium and thorium contents of radioactive minerals

are described. A gamma-gamma analysis, that is, a method depending on two measurements giving the relative proportion of high- and low-energy gamma rays, was used. The advantages of this technique have been proved for the analysis of nonequilibrium samples, and some comparisons with the results given by conventional radiometric methods have been made for a number of samples. The counter finally developed is capable of analyzing samples with concentrations of only 0.05 per cent $U_3O_8$ equivalent and distinguishing between the two radioactive families when $r=U_3O_8/ThO_2$ is as low as 0.01.

An analysis of laboratory experimental data has shown that in measuring the distribution of radioactivity in geologic formations, and in estimating the radioactive heat production in rocks from field observations, scintillation counters using the gamma-gamma counting technique could be used to eliminate the uncertainties due to the presence of potassium, and that such a counter would be at least 20 times more sensitive that that described by Slack. (*See* preceding abstract)—*M. C. R.*

14069. Binggeli, Edmond, and Haenny, Charles. Mésure de la radioactivité des eaux de Lavey [Measurement of radioactivity of the water from Lavey spring]: Soc. vaudoise sci. nat. Bull., v. 65, no. 280, pp. 253–264, 1952.

The radioactive contents of samples of water from Lavey-les-Bains springs (Canton de Vaud, Switzerland) were determined using the method devised by Professor Lepape. A detailed description of apparatus and procedure is given. Corrections to be applied to these results are discussed, the most important among them being the reduction to the exact time when the sample was taken because of the rapid disintegration of some radioactive substances. Final precision of the determinations is estimated equal to 3 per mille. The average content was found to be 6.1 millimicrocuries per liter. Only one other spring in Switzerland is more radioactive than that investigated here.—*S. T. V.*

## HEAT

14070. Uffen, R. J. A method of estimating the melting-point gradient in the earth's mantle: Am. Geophys. Union Trans., v. 33, no. 6, pp. 893–896, 1952.

Using the Einstein-Debye theory of solids and Lindemann's theory of fusion, the ratio of the melting point at various depths in the mantle to that at depth 100 km is computed from seismic data. Using data for solid olivine, a value of 5,300° K is found for the melting point at the core boundary, which gives an upper limit for the actual temperature there.—*Author's Abstract*

14071. Kashpur, Ya. N. Geotermicheskiye usloviya kamennougol'nykh otlozheniy yugo-zapadnoy chasti Donetskogo basseyna [Geothermal features of the Carboniferous deposits of the southwestern part of the Donets Basin]: Akad. Nauk SSSR Doklady, tom 86, no. 4, pp. 809–812, 1952.

During the 1949–51 temperature measurements were made in 203 drill holes at different points of southwestern part of the Donets Basin [Donbass] at depths ranging from 400 to 1500 m. The geothermal gradient was found to vary from 14.2 C to 36.8 C per kilometer. The highest temperature at a depth of 1000 m was 52.5 C over the apex of the central part of the principal anticline. Over the limbs of the anticline this temperature was only 35 C.

On the basis of his measurements the author concludes that the temperature of formations increases from synclines to anticlines and that the temperature also increases from the upper Carboniferous formations toward those stratigraphically lower.—*S. T. V.*

## VOLCANOLOGY

14072. Kizawa, T. Geophysical phenomena accompanied by volcanic actions: Geophys. Mag., v. 23, no. 4, pp. 388–398, 1952.

Tremors and other types of geophysical activity accompanying eruptions of Mihara [Mihara-yama] in 1950 and 1951 and Aso in 1947 are described. No premonitory shocks were observed at Mihara-yama. There is a relationship, however, between the activity of the volcano and the direction of the maximum horizontal component of tremors. Studies of magnetic declination, deviation of radio waves and volcanic noise were also made.—*M. C. R.*

14073. Fries, Carl Jr., and Gutiérrez, Caledonio. Activity of Parícutin Valcano from July 1 to December 31, 1951: Am. Geophys. Union Trans., v. 33, no. 5, pp. 725–733, 1952.

The volume of pyroclastic material and new lava increased appreciably over that of the preceding 6-month period. The period was notable also for the great increase in frequency and intensity of violent explositions or detonations in the crater.—*M. C. R.*

## TECTONOPHYSICS

14074. Jeffreys, Harold. The earth (3rd ed.), 392 pp., Cambridge, England, the University Press, 1952.

The four chapters relating to the origin of the solar system have been omitted, and instead a general description of recent theories is given. The remaining chapters have been extended and almost completely rewritten to include recent developments. Discussions include those on the mechanical properties of rocks, the theory of elastic waves, observational seismology, the figures of the earth and the moon, stress-differences in the earth, the variation of latitude and the bodily tide, tidal friction, the age of the earth, the thermal history of the earth, the origin of the earth's surface features, and special problems.—*M. C. R.*

14075. Birch, Francis. Elasticity and constitution of the earth's interior: Jour. Geophys. Research, v. 57, no. 2, pp. 227–286, 1952.

The observed variation of the seismic velocities with depth, below the crust, is examined with reference to the variation to be expected in a homogeneous medium. A general equation is derived for the variation of the quantity, $\phi = V_P^2 - 4/3 V_S^2$, in a homogeneous gravitating layer with an arbitrary gradient of temperature. The parameters of this equation are then discussed in terms of the experimental and theoretical relations for solids. The principal parameter is $(\partial K_T / \partial P)_T$, the rate of change of isothermal incompressibility with pressure, which can be found for large compressions from Bridgeman's measurements. Comparison of observed and expected rates of variation of $\phi$ throughout the Earth's interior leads to conclusions regarding homogeneity and, with a larger uncertainty, to estimates of temperature.

A shadow zone at a depth of about 100 km, as suggested by Gutenberg, may be accounted for by a gradient of temperature of about 6°/km in a homogeneous layer of ultrabasic rock. Between depths of about 900 and 2,900 km, the mantle appears to be substantially uniform, and at a relatively uniform temperature of the order of several thousand degrees. Between about 200 and 900 km, the rate of rise of velocity is too great for a homogeneous layer, and indicates a gradual change of composition, or of phase, or both. New phases are required to account for the high elasticity of the deeper part of the mantle (below 900 km), and it is suggested that, beginning at about 200 to 300 km, there is a gradual shift toward high-pressure modifications of the ferro-magnesian silicates, probably close-packed oxides, with the transition complete at about 800 to 900 km. There may also be a concentration of alumina, lime, and alkalis toward the upper part of the mantle, in and above the transitional layer but below the crust, existing in minerals of high elasticity such as garnets and jadeites. The transitional layer appears to hold the key to a number of major geophysical problems.

The velocities in the core and inner core are also reviewed. The inner core is most simply interpreted as crystalline iron, the outer part as liquid iron, perhaps alloyed with a small fraction of lighter elements. The density and compressibility of iron at high pressures are estimated with the aid of the experimental compressions of the alkali metals; the central density is found to be about 15. Several other recent proposals regarding the crust are discussed.—*Author's Abstract.*

14076. Vening Meinesz, F. A. The origin of continents and oceans: Géologie Mijnb., jaarg. 14, no. 11, pp. 373–384, 1952.

The analysis of the earth's topography in terms of spherical harmonics leads to a hypothesis of a two-stage development of the continents by convection currents. The first current system causes the sial to form a single continent in the region where it converges, comprising one third of the earth's surface. In the second stage a new current system partially disrupts this mass into the present continents.—*E. K.*

14077. Scheidegger, A. E., and Wilson, J. Tuzo. An investigation into possible methods of failure of the earth: Geol. Assoc. Canada Proc., v. 3, pp. 167–190, 1950.

Many mountain and island chains have a shape which approximates a circular or spiral arc. Analyses of different mechanisms of yielding of the earth's crust lead the authors to conclude that the arc pattern can best be explained by a sliding fracture produced by the internal tension in an asthenosphere contracting around a nonshrinking core.—*J. R. B.*

14078. Scheidegger, A. E. Physical aspects of the contraction hypothesis of orogenesis: Canadian Jour. Physics, v. 30, no. 1, pp. 14–26, 1952.

If a cooling, contracting earth is assumed, the size of folds should become greater as the crust thickens. The equations for cooling of the earth as a function of movement or radioactive material are derived, and it is shown that the rate of cooling increases if such material is moved toward the surface. The equation relating stress and temperature in the earth is derived, and it is found that the position of the level of no strain is independent of the coefficients of heat conduction and is located at a place where the rate of change of thermal gradient is low. (*See* previous abstract)—*J. R. B.*

14079. Havemann, Hans. The earth's face determined by the core: Am. Geophys. Union Trans., v. 33, no. 5, pt. 1, pp. 749–754, 1952.

The author refers to the old theory of a periodic change in expansion and contraction of the Earth, caused by thermal conditions, especially by periodic accumulation and escape of radioactive heat. To this theory is joined: the hypothesis of rotational differences of core and mantle, the core not being warmed and cooled in the same way as the mantle; the hypothesis of a uniform crystalline (if solid) or semicrystalline (if nearly fluid) parallel structure of the core, which effects deformations of its spheroid boundary during tangential movements of the mantle. These deformations, in regionally accelerating or retarding the mantle's movement, also produce movements within the crust.

By means of this theory of the Earth's mechanism an explanation is attempted for a geological assemblage of facts, such as the origin of the Mediterranean or Alpide ring of structures, which in general is supposed to have been equatorial in the Tertiary; dislocations of the Earth's axis during Tertiary and other active phases of the Earth's history; and the origin of the Atlantic and Indian Oceans and of the crustal massif of central Asia.

In the second part of this paper, entitled An Actual Phase? there is an attempt to demonstrate that seismic observations of actual movements in the crust probably in the future will confirm or deny the probability of this theory.—*Author's Abstract*

14080. Oppenheim, Victor. The structure of Colombia: Am. Geophys. Union Trans., v. 33, no. 5, pp. 739–748, 1952.

The Colombian Andes consist of five distinct and physiographically independent ranges: the Coastal Range (also known as Cordillera de Baudo), Cordillera Occidental, Cordillera Central, Cordillera Oriental with its continuation, the Cordillera de Perija [Sierra de Perijá], and the Sierra Nevada de Santa Marta. Each of these shows marked structural characteristics and is of different age of uplift. The Guiana shield and its outliers in the eastern part of the country represent the old continental basement complex. The growth of the rest of Colombia took place north and west of this shield. The predominant tectonic pattern is one of block faulting rather than overthrusting. The rise of the Cordilleras seems to be due to vertical stresses or their components.

Despite the complex tectonic history, destructive earthquakes in modern times have not been numerous. About 50 percent of recorded shocks occurred in the Cordilleras Central and Occidental and 25 percent in the Cordillera Oriental. Almost all volcanoes are in the Cordillera Central. Only two are found in the Cordillera Occidental and none in the Cordillera Oriental.

Geologic and geophysical data suggest that the island arcs of the Antilles can be considered as continuations of the Colombian ranges.—*M. C. R.*

14081. Brodie, J. W. Features of the sea-floor west of New Zealand: New Zealand Jour. Sci. Technology, v. 33, sec. B, no. 5, pp. 373–384, 1952.

From data on Admiralty charts and additional soundings, submarine contours have been drawn at 500-fathom intervals of the Tasman sea floor between Australia and New Zealand between latitudes 27 and 47 S. To the west the major feature is the Tasman Basin [Southeast Australian Basin], the floor of which is generally deeper than 2500 fathoms. The basin is bounded on the west by the Australian coast and on the east by the Lord Howe Rise. The New Caledonia Trough [New Caledonia Basin], Norfolk Rise, Norfolk Basin, and

the Fiji Basin [North Fiji Basin and South Fiji Basin] follow successively to the east. All exhibit a slightly arcuate northwesterly trend, a trend which is similar to the pre-Tertiary fold axes in Australia and areas of older rocks in New Zealand.

Seismological evidence shows the Tasman Sea to be part of the Australian continental stable mass. The active circum-Pacific belt passes through southern and central New Zealand and broadens to the northwest along the margin of the Fiji basins.

The scale and dominance of north- to northwest-trending arcuate fold indicate that yielding to a west-southwesterly directed thrust has been the latest major movement in the area. The phase of compression which produced these folds was interrupted by the commencement of yielding along the Pacific margin. Under influence of the south-southwest component of the thrust, the eastern end of the old arc system has yielded to shearing and been displaced to the south a total of 300–400 miles.

This dislocation initiated a still continuing phase dominated by a component of compression directed to the west-northwest. According to E. I. Robertson the distribution of mass deficiencies revealed by the recent gravity surveys in the North Island, New Zealand, is not inconsistent with the effects of such compression.—*M. C. R.*

14082. Carnera, Luigi. Le variazioni della latitudine ed il movimento del polo di rotazione terrestre negli anni 1946–1948 [Variation of latitude and movement of the pole of the earth's rotation during 1946–1948]: Accad. sci. fis. e mat. Napoli Rend., Ser. 4, v. 16, pp. 126–133, 1949.

On the basis of data from the Misuzawa, Kitab, Carloforte, Gaithersburg, and Ukiah observatories, the extreme displacements of the earth's axis, in seconds of arc, were computed as follows: 1946, —0.193, +0.242 in the $x$ direction, —0.176, +0.276 in the $y$ direction; 1947, —0.194, +0.256 in the $x$ direction, —0.160, +0.218 in the $y$ direction; 1948, —0.104, +0.251 in the $x$ direction, —0.113, +0.252 in the $y$ direction.—*S. T. V.*

14083. Gerrard, J. A. F., Perutz, M. F., and Roch, A. Measurement of the velocity distribution along a vertical line through a glacier: Royal Soc. London Proc., Ser. A. v. 213, pp. 546–558, 1952.

Using an electric heating element, a vertical hole 137 m long was melted from the glacier surface to the rock bed. The hole was lined with a 3 inch steel tube which froze into the glacier and became tilted and bent according to the velocities prevailing at different depths. Using electrically recording pendulum instruments, the inclination of the tube at different depths was measured at the start of the experiment and again after one and two years. The rate of surface flow was found to be 35 m per year. Of this amount, roughly half seemed to be due to flow within the ice and the other half to sliding of the glacier over its bed. The velocity decreased regularly from the glacier surface downwards, and there was no indication of a yield stress below which ice was completely rigid. If the assumption is made that the deformation of the ice in the glacier is due to simple shear stress, a tentative relationship between this stress and the rate of shear strain can be derived from the results. This shows that flow is not Newtonian, but approximates to a relation where $\gamma=10^{-8}\ \tau^{1.5}$ ($\gamma$=rate of strain per second, $\tau$=shear stress in bars) over a range of $\tau$ between 0.1 and 0.75 bars. Comparison with laboratory compression tests by Glen (1952) indi-

cates that the exponent of $\tau$ increases at shear stresses above 1 bar.—*Physics Abstracts.*

## EXPLORATION GEOPHYSICS

### GENERAL

14084. Reich, Hermann. Über den Beitrag der Geophysik zur geologischen Forschung [Contribution of geophysics to geologic exploration] : Deutsche geol. Gesell. Zeitschr., Band 100, pp. 198–203, 1950.

This is a review of the application of geophysical methods to geologic investigations and in prospecting for minerals.—*S. T. V.*

14085. Rothé, Edmond, and Rothé, J. P. Prospection géophysique (Geophysical prospecting), tome 1, 438 pp, and tome 2, 714 pp., Paris, Gauthier Villars, 1950 and 1952.

The first volume of this two-volume treatise contains a discussion of the seismic and radioactivity methods of exploration. The second volume covers the gravimetric, electrical, magnetic, and geothermal methods. The physical bases of all methods, instruments, and practical applications are described.—*S. T. V.*

14086. Sharpe, J. A., and Fullerton, P. W. An application of punched card methods in geophysical interpretation: Geophysics, v. 17, no. 4, pp. 707–719, 1952.

The evaluation of a surface integral occurring often in geophysical interpretation is effected through the use of an I. B. M. punched card machine. This is made possible by replacing the integral by a double sum and by using a trigonal coordinate system. An illustration of the method is given by computing the second vertical derivative of a magnetic total-intensity field—*I. Z.*

14087. Clayton, Neal. Geophysical exploration in the San Juan Basin: Geophysics, v. 17, no. 4, pp. 900–906, 1952.

This is a review of some of the problems involved in the geophysical exploration of the San Juan basin in the so-called Four Corners area of Utah, Colorado, New Mexico, and Arizona.—*M. C. R.*

14088. Wantland, Dart. Geophysical measurements of the depth of the weathered rock mantle, *in* Symposium on surface and subsurface reconnaissance; Am. Soc. for Testing Materials, Special Tech. Pub. 122, 115–135, 1952.

Geophysical field studies are described which were made to ascertain the depth of weathered overburden mantle rock at the proposed site of a dam, on the American River in California. The applications of the electrical resistivity, the seismic refraction, and the magnetic methods in attacking this problem are discussed. The interpretation procedures employed are explained. Examples of results are presented which show that the geophysical and core drill determination of the depth to sound rock agreed within less than 4 ft. It is brought out that geophysics is a useful exploration tool at sites where the amount of rock that would have to be stripped is a factor.—*Author's Abstract*

14089. Bird, P. H. Experience with geophysics in New York State, *in* Symposium on surface and subsurface reconnaissance: Am. Soc. for Testing Materials, Special Tech. Pub. 122, pp. 151–155, 1952

This is a discussion of the use of the seismic and the electrical resistivity methods by the New York State Bureau of Soil Mechanics. The applications and limitations of each method are discussed. On the whole, the New York Bureau has emphasized use of the seismic method.—*M. C. R.*

14090. Nettleton, L. L. Sedimentary volumes in Gulf Coastal Plain of United States and Mexico, pt. 6, Geophysical aspects: Geol. Soc. American Bull., v. 63, no. 12, pt. 1, pp. 1221–1228, 1952.

At a session on "Sedimentary Volumes" at the annual meeting of the Geological Society in 1950, a series of papers were presented, the objective of which were studies of the distribution, thickness, volume, and general character of Mesozoic and Cenozoic sedimentary rocks of the Gulf Coastal Plain province rimming the western and northern shores of the Gulf of Mexico. On the basis of all geophysical data in an area which has probably been geophysically explored more intensively than any comparable large area in the world it is concluded that: the regional dip toward the Gulf of Mexico extends to the coast line without any indications of a synclinal axis at or immediately beyond the coast; that the thickness of sediments at the coast line is about 40,000 feet; and that Pre-salt sediments are thin, absent, or metamorphosed.—*M. C. R.*

## GRAVITY METHODS

14091. Grant, F. S. Three dimensional interpretation of gravitational anomalies, pt. 2: Geophysics, v. 17, no. 4, pp. 756–789, 1952.

This is the second of two papers describing a method of interpreting residual gravitational anomalies in terms of three-dimensional geological structures. This paper describes an analytical method for smoothing the data, and for constructing charts and templates for computing derivatives and other quantities required in the interpretation formulae already given in Part I. Tables of all quantities required for the practical utilization of this procedure are provided. Two examples of the application of these methods are given: the first, an artificial problem, and the second, an actual survey conducted over a sulphide body that has been outlined by extensive drilling.—*Author's Abstract*

14092. Gel'fand, I. S. Pryamye metody interpretatsii gravitatsionnykh i magnitnykh anomaliy ot trekhmernykh tel [Direct methods of interpretation of gravitational and magnetic anomalies produced by three dimensional bodies]: Akad. Nauk SSSR, Ural'skiy filial, Trudy Gorno-Geol. Inst., vyp. 19, Geofiz. sbornik 1, pp. 64–80, 1950.

The total mass and the center of gravity of a buried body can be found from observed gravity anomalies and gravity gradients; similar parameters of a magnetic mass can be determined from the observed components of magnetic vector. This, however, necessitates lengthy evaluation of double integrals in the formulas and is therefore seldom used.

In the present paper more convenient formulas for the computations of these integrals are derived, and the limits of errors which would effect the results if certain approximations are admitted were determined.—*S. T. V.*

14093. Steenland, N. C., and Woollard, G. P. Gravity and magnetic investigations of the structure of the Cortlandt Complex, New York: Geol. Soc. America Bull., v. 63, no. 11, pp. 1075–1104, 1952.

During 1946 and 1947, gravity and magnetic surveys were made to determine whether the complex represents one or more distinct lithologic units and what their shapes are beneath the surface. Both gravity and magnetic measurements were made at 185 stations, an average of 3 per sq. mi. Bulk density and magnetic susceptibility of samples of Cortlandt rock and surrounding country rock were also determined and contoured on separate maps.

The gravity data, in conjunction with known geology, suggest that the Cortlandt complex consists of a relatively thin sheet of igneous material derived largely from two vertical feeder pipes that extend to a depth of at least 5 miles. The main pipes lie near the eastern and southwestern margins of the main pluton. Two and possibly three subsidiary pipes lie at or near the western margin.

The magnetic map shows no general anomaly associated with the complex as a whole or with the gravity anomalies. A broad anomaly of 1,200 gammas in the center of the complex is attributed to an anomalous concentration of magnetite within the rock. Four local anomalies of about 1,000 gammas lie at or near the margin of the complex. Three of these can be correlated with bodies of magnetite-bearing emery.—*M. C. R.*

14094. Glenn, A. H., and James, R. W. Use of the wave height operational index in planning offshore gravity meter surveys: Geophysics, v. 17, No. 4, pp. 924–35, 1952.

The efficiency of offshore gravity-meter explorations (stations occupied per day) decreases from an average of 31.6 when waves are less than 2 ft high to 0.3 stations when waves are over 6 ft high. Statistical analysis of operating wave-height records provides a "wave-height operational index" which can be applied to both long-term and 48-hour wave forecasts to effect savings as large as 50 percent in the results of survey planning.—*D. F. B.*

## MAGNETIC METHODS

14095. Wait, J. R. The magnetic dipole over the horizontally stratified earth: Canadian Jour. Physics, v. 29, no. 6, pp. 577–592, 1951.

The behavior of a current-carrying loop of small radius located over a horizontally stratified earth is investigated. The medium is considered to have homogeneous and isotropic properties within each layer and only conductivity and dielectric contrasts between layers. Solutions to the wave equation are found in terms of a vector potential from which the electric and magnetic field vectors can be determined by appropriate differentiation. Expressions for mutual impedance between current loops and between loops and wire elements are given for various special forms of a two-layered earth. Both harmonic steady-state and step-function current sources are considered.—*R. G. H.*

14096. Mooney, H. M. Magnetic susceptibility measurements in Minnesota. Part I: Technique of measurement: Geophysics, v. 17, no. 3, pp. 531–543, 1952.

Susceptibility determinations have been made on 200 outcrops of 11 rock types, using a three-coil induction instrument. Measurement is effective over a hemisphere of 50 cm radius. Data are given to show that the instrument is much

less sensitive to rock surface irregularities than any previously described. Measuring circuits consist of 975 cycle oscillator, mutual inductance bridge, and two-stage amplifier. Investigation of errors shows that surface irregularities remain most important. Calibration by calculation is checked against ferric chloride standards through small samples taken at each outcrop. Data are given to show: 1) rock variability makes the check inconclusive, 2) variation of susceptibility within outcrops for gabbro and basalt is of the same order as variation between outcrops, 3) small-sample measurements show greater variation than large-sample measurements.—*Author's Abstract*

14097. Nodya, M. F. Novyy vid platform dlya izmeriniya vertikal'nogo gradienta anomal'nogo magnitnogo polya s pomoshchyu polevykh magnitnykh vesov [a new kind of platform for measuring the vertical gradient of anomalous magnetic fields with a magnetic field balance]: Akad. Nauk Gruzinsk. SSR Soobshcheniya, tom 12, no. 3, pp. 135–138, 1951.

The vertical gradient of the magnetic field is usually determined by measuring vertical magnetic component at different heights. In practice this height is seldom greater than 2 or 3 m and the measurements are made by using a special portable trestle. The author designed two easily portable trestles, one for the instrument, another for the observer. The latter can be made very light and not necessarily rigid. The use of two separate platforms greatly reduced the weight of the trestles, bringing them down to only 26 kg, a weight which can be easily transported even in the mountainous country.—*S. T. V.*

14098. Tucker, P. M. High magnetic effect of lateritic soil in Cuba: Geophysics, vol. 17, no. 4, pp. 753–755, 1952.

A susceptibility above average for soils, of $2{,}800 \times 10^{-6}$ cgs, was found in the lateritic soil of Cuba. A vertical-intensity magnetic survey showed that repeat readings of several stations gave erratic values that are attributed to local variations at the station.—*J. L. M.*

14099. Roze, T. N. Opredeleniye glubin istochnikov nekotorykh magnitnykh anomalii na territoriy evropeiskoy chasti SSSR [Determination of the depth of some sources of magnetic anomalies within the European part of the U. S. S. R.]: Akad. Nauk SSSR Izv., Ser. geofiz, no. 3, pp. 78–92, 1952.

For a given surface or volume distribution of underground magnetic masses there is a unique pattern of the potential field, but for every field pattern there is an infinity of different possible underground distribution of magnetic masses, all equivalent in their effect.

There are several methods of solving this "inverse problem of geophysics"; one of them here discussed consists of comparison of the given field pattern with patterns produced by disturbing bodies of known magnetic properties and given shape. For this purpose graphs of the vertical ($Za$) and horizontal ($H$) components are first constructed, the vertical maximum $Za_{max}$ is found, and new graphs of $Za/Za_{max}$ and $H/Z_{max}$ are constructed, taking for the unit on the axis of abscissae the length equal to the distance between the abscissae of $Za/Za_{max}$ and $Za/0.5\ Za_{max}$.

By trying several assumptions about the form, depth and magnetic properties, the very good agreement between the observed and computed graphs of several magnetic anomalies in European U. S. S. R. was obtained.

In several instances calculations were made not only for the horizontal position of the disturbing body, but also for different angles of inclination.

A total of 62 magnetic deposits, located in different part of European U. S. S. R., were interpreted in this manner. In several places, control drilling confirmed the conclusions of the author.—*S. T. V.*

14100. Canada Geological Survey. Aeromagnetic maps of the Province of Quebec: Dept. of Mines and Tech. Surveys, Geophysics Papers 88, 90, 92, 93, 94, and 98, 1952.

This is a continuation of the series listed in Geophysical Abstracts 13004, 13006, 13454, 13706, and 13930. The following quadrangles have been published as blue line aeromagnetic maps, which show by contour lines the total magnetic intensity at about 1,000 ft above ground level: G. P. 88, Doucet, Abitibi County; G. P. 90, Riviere Delestre, Abitibi County; G. P. 92, Villebon, Témiscaminque and Abitibi Counties; G. P. 93, Despinassy, Abitibi County; G. P. 94, Ducras, Abitibi County; and G. P. 98, Cuvillier, Abitibi County. The maps were prepared on a scale of 1 in=1 mile, and the contour interval of 10 to 500 gammas, depending on the intensity of the anomaly.—*L. E. B.*

140101. Canada Geological Survey. Aeromagnetic maps of Northwest Territories: Dept. of Mines and Tech. Surveys, Geophysics Papers 74, 75, 82, 83, and 87, 1952.

This is a continuation of the series listed in Geophysical Abstracts 13001, 13212, 13452, 13705, and 13929. The following quadrangles in the District of Mackenzie have been published as blue line aeromagnetic maps which show by contour lines the total magnetic intensity at about 1,000 ft above ground level: G. P. 74, Bear Creek; G. P. 75, Salt Lake; G. P. 82, Nyarling; G. P. 83, Sulphur Springs; and G. P. 87, Long Island. The maps were prepared on a scale of 1 in=1 mile, and the contour interval of 10 to 500 gammas, depending on the intensity of the anomaly.—*L. E. B.*

## SEISMIC METHODS

14102. Dix, C. H. Seismic prospecting for oil, 414 pp., New York, Harper and Brothers, 1952.

This is the first text devoted exclusively to seismic exploration for oil. Topics covered include summary of exploration methods, seismic crew operation, basic technical tools, velocity measurements, depth and dip computations, presentation of results, interpretations and the physical processes involved. An extensive bibliography is appended.—*M. C. R.*

14103. Johnson, A. M., and Wesley, R. H. Applications of seismic methods to foundation exploration, *in* Symposium on surface and subsurface reconnaissance: Am. Soc. for Testing Materials, Special Tech. Pub. 122, pp. 142–150, 1952.

The success of the use of geophysical exploration methods in oil and mining prospecting has logically led to the application of the techniques to other engineering fields. The increasing stress on careful foundation design and the consequent importance of thorough subsurface information, coupled with the necessity of accomplishing the subsurface exploration with the least possible expenditure of time and money, has opened a field in which geophysical explora-

tion can render a unique service. This paper discusses the development of one of the seismic techniques—seismic refraction—describes the methods of field operation and interpretation of results, and relates its use to several foundation or subsurface exploration problems.

Applications described include a carefully controlled trial profile study in the city of Detroit, the determination of depth to bedrock for piles under a high office building, a study of the foundation material at a plant site in South Carolina, and others. In all instances it was found that the geophysical technique supplied the required information about subsurface conditions in a comparatively short period of time and with an accuracy as shown by several drilling checks. The paper concludes that seismic work has proved itself in highway and foundation work as a supplement to other proven methods.—*Authors' Abstract*

14104. Towles, H. C. Jr. A study in integration of geology and geophysics: Geophysics, v. 17, no. 4, pp. 876–899, 1952.

The need for cooperation between the integration of geology and geophysics in the search for petroleum is illustrated by application and analysis in the Kilgore Area, Gregg and Rusk Counties, Texas. Independent interpretations of geologic structure from regional geology and reflection seismograph survey are presented and evaluated. The geologic interpretation is revealed to be based on accurate data of insufficient density and distribution to reveal even sizable structural features. The reflection seismograph interpretation of structure reveals both small and large features which are of doubtful validity due to questionable time-depth relationships over the area. An integrated interpretation utilizing the geological data to define velocity limitations for the seismic time-depth relationship is attempted and a theoretical corrected structural interpretation is presented. The following conclusions are reached: (1) Standard methods of exploration for petroleum often produce incorrect results; the limitations of geologic and reflection seismograph methods do not overlap; therefore, is is possible to utilize the maximum interpretation of geological data as a guide to the velocity variations which affect the seismic interpretation. (2) Lack of sufficient velocity information can be a serious handicap to utilization of the reflection seismograph method; therefore, every opportunity to obtain additional velocity information should be utilized. (3) The Kilgore Area illustrates that existing seismic interpretations of structure that are in disagreement with known geologic data may often be recomputed for a correct interpretation at a small extra cost.—*Author's abstract*

14105. Pasechnik, I. P. Resultaty eksperimental'nogo izucheniya rezonansnykh yavleniy v kolebatel'noy sisteme pochva-seysmograf [Results of experimental investigations of resonance phenomena in the vibrating system ground-seismograph]: Akad. Nauk SSSR Izv., Ser. geofiz., no. 3, pp. 34–57, 1952.

In a continuation of previous studies (*see* Geophys. abstract 13934) the effect of the placing of the seismograph on the ground has been investigated. Field tests were made consisting of the determination of natural frequency and damping coefficient of vibrating ground-seismograph system as influenced by the properties of the ground, and by the placement of the instrument (as on the ground, or in a hole), and details of instrument construction, such as the shape

of the bottom, ratio between immovable and movable masses, and similar factors. Results are presented in graphical form.—*S. T. V.*

14106. Pasechnik, I. P. Sravnenic rezul-tatov teoreticheskogo i eksperimental-'nogo issledovaniya resonansnykh yavlenii v sisteme pochva-seysmograph [Comparison of the results of a theoretical study of resonance phenomena in the system ground seismograph with experimental data]: Akad. Nauk SSSR Izv., Ser. geofiz., no. 5, pp. 25–40, 1952.

A theoretical study is presented of resonant properties inherent in the elastic system ground seismograph. This is done first using the precise method, the ground being treated as elastic continum with continuously distributed elastic properties, then an approximate solution of the same problem is given, as done by Wolf (*see* Geophys. abstract 7558). Comparison of these solutions shows that over the range of frequencies of interest in exploration geophysics the approximate solution differs very little from the accurate one and is much more convenient to use.

For this approximate solution an alignment chart is constructed giving the frequency of natural oscillations of the ground-seismograph system as a function of the seismic velocity of the ground, its density, the mass of the instrument, and the dimensions of its bottom area. In starting seismic measurements in an area it is important to adjust the mass of the instrument and its bottom area so that the resulting natural frequency becomes sufficiently different from the frequencies of observed waves. (*See also* Geophys. abstracts 13934 and 14105).—*S. T. V.*

14107. Hayakawa, Masami. Some problems of seismic exploration [In Japanese with English summary]: Geol. Survey of Japan Report 137, 68 pp., 1951.

The value of seismic prospecting techniques can be increased by considering the amplitude and frequency of the recorded waves in addition to their arrival times. After considering the frequency, damping, and sensitivity characteristics of the Haeno seismograph, the author uses this instrument in demonstrating the following facts: Transverse waves occur on refraction records when the media around the shot point is very hard, the shot point is not far from the surface, and the shape of the charge is not spherical; and the depth of the surface layer may be determined by calculations based on the period of "stationary" waves received at that point. Discontinuities in the graph of distance versus amplitude of the initial peak seem to correspond to inflection points in the time-distance curve, and can also be correlated with geologic structures such as faults.

Theoretical considerations are used to show that the amplitude of reflected waves increases when the velocity contrast increases but is greater for a water bottom surface than for a land surface; and that the reflected wave is in phase with the incident wave for a soft-to-hard interface but is 180° out of phase for a hard-to-soft interface.

In addition the author proposes an improved "contour method" of plotting the results of fan shooting. He also considers briefly the concentration of explosive energy in certain directions, the effect of low velocity layers, the anisotropy of rock formations, and the possible detection of very thin layers.—*D. F. B.*

14108. Yepinat'yeva, A. M. Sposob opredeleniya ranosti koeffitsiyentov pogloshcheniya seysmicheskikh voln [A method of determining the difference between the coefficients of absorption of seismic waves]: Akad. Nauk SSSR Izv., Ser. geofiz., no. 3, pp. 70–77, 1952.

The coefficient of absorption of seismic waves propagating through a formation can be an indicative characteristic of the formation, but its determination is not always possible. In this article the use of differences between these coefficients as an indicative property of adjacent formations is discussed. The procedure is as follows: One of the waves registered on seismograms is selected as the fundamental one and the ratio of the amplitudes of other waves to this one are determined and traced on semi-logarithmic paper. A variation of these ratios is a reliable indicator in identifying and tracing different waves, and at the same time an additional characteristic of the formation. It is especially useful when the velocity contrasts is small but the absorption coefficients in adjoining media are very different.—*S. T. V.*

14109. Cantos Figuerola, José. Una modalidad de aplicación e interpretación del método sismico [A procedure of application and interpretation of the seismic method]: Rev. Geofís., v. 11, no. 42, pp. 129–145, 1952.

This article is similar to that abstracted in Geophys. Abstract 13713.—*S. T. V.*

14110. Berson, I. S. O seysmicheskikh volnakh, vosnikanyushchykh v vertical'no-slostoy srede [Seismic waves in vertically stratified medium]: Akad. Nauk SSSR Izv., Ser. geofiz., no. 3, pp. 3–33, 1952.

An analysis is made of kinematic conditions which control seismic waves produced in a vertically stratified medium, both overlain by a horizontal layer or extending to the surface of the earth. Travel time curves are constructed for a number of waves corresponding to profiles in different directions. The computed travel time curves are compared with those actually observed over areas of known geology, and good agreement is found between them. In a vertically stratified area, additional types of waves can be generated, for instance, laterally refracted waves.

Instrumental arrangements necessary for obtaining clear structural details are described. It is always important to have a network of profiles parallel and perpendicular to the plane of stratification. In preliminary reconnaissance it is desirable to have at least the system of profiles perpendicular to stratification.

When the distance from the shot point to the line of geophones is short and the distance from the vertical boundary is much greater, no lateral refracted waves can be observed. Then the analysis of dynamic characteristics of seismograms, especially those of refracted waves, can be very useful in interpreting the results. It is important to have the sensitivity of different seismographs adjusted to the same degree, thus making possible direct comparison of amplitudes and their changes.

The article contains numerous graphs and three plates with facsimiles of observed seismograms.—*S. T. V.*

14111. Bugaylo, V. A. Uraveniye (n–1) oy vetvi godografa prelomlennykh voln [Equation of the (n–1) segment of the travel-time curve of refracted waves]: Akad. Nauk SSSR, Ural'skiy filial, Trudy Gorno-Geol. Inst., no 19, Geofiz. sbornik no. 1, pp. 14–21, 1950.

In a stratified medium with different velocities in each layer, the travel-time curve becomes a sequence of segments, differently inclined to the $x$-axis. Follow-

ing the method of G. A. Gamburtsev, the author derives equations first for the fourth and fifth segments, and then presents a generalization of formulas for the $n$th segment. The assumption is that seismic velocity increases monotonically with depth and that boundaries between layers are plane, though differently inclined to the horizontal and with the angle of inclination increasing with depth.—*S. T. V.*

14112. Berson, I. S., and Yepinat'yeva, A. M. O mnogokhatnykh prelomlennykh volnakh [On multiple refracted waves]: Akad. Nauk SSSR Izv., Ser. geofiz., no. 4, pp. 9–32, 1952.

One difficulty in the interpretation of seismic exploration records is the presence of waves which have undergone multiple refractions and reflections. A theoretical study has been made of various kinds of multiple reflection and refraction on the basis of kinematic and dynamic relations determined by the angle of incidence, the ratios of velocities, and similar factors. Two criteria are established which can aid in the recognition of multiple refracted waves when the refracting and reflecting surfaces are planes parallel to the surface: the travel time curves are parallel to the simple refracted waves, and the form of the simple and multiple refracted waves are similar, though sometimes of opposite phase. Comparison of amplitudes does not give reliable information.—*S. T. V.*

14113. Bugaylo, V. A. Uskorennyy raschet svodnykh godografov otrazhenii dlya gorizontalnykh struktur [Rapid determination of total travel time for waves reflected from horizontal structures]: Akad. Nauk SSSR, Ural'skiy filial, Trudy Gorno-Geol. Inst., vyp. 19, Geofiz. sbornik 1, pp. 22–25, 1950.

Construction of a master chart is proposed to be used in the determination of the total travel time of multiple reflected waves where the medium is horizontally stratified. The travel time $T$ of reflected wave is given by the relation $T=1\sqrt{x^2+4h^2}$ where $v$ is the velocity of propagation, $x$ the distance from shot point to seismograph, and $h$ the depth of reflecting boundary. This equation can be transformed into $(T/2h)^2-(x/2h)^2=1$ which is the equation of hyperbola. It can be proved that the angular coefficient $-dT/dx$ which determines the trajectory is independent of $h$. Thus two families of theoretical travel time curves can be constructed, one being functions of the two variables $x$ and $h$, the other characterized by constancy of angular coefficient. The same master chart can be transformed to bilogarithmic coordinates, which is sometimes more convenient.—*S. T. V.*

14114. Contini, Camillo. Il calcolo delle superfici riflettenti nei rilievi sismici a riflessione [The calculations of reflecting surfaces in reflection seismic surveying]: Annali Geofis., v. 5, no. 1, pp. 77–95, 1952.

On the basis of seismic exploration and geological data, formulas for the variation of the velocity of longitudinal waves with depth are analyzed, and it is concluded that the best agreement with seismic evidence is given by the formula $V=V_0\sqrt{1+nZ}$, where $V_0$ is the velocity near the surface of the earth (1,500 m per sec), $Z$ is the depth in meters, and the coefficient $n$ equals 0.0016.

The influence on seismic velocity of heterogeneity and anisotropy of formations, especially noticeable in areas of folding or steep dips, is also discussed, and the problem of determining the reflecting boundary from seismic data is analyzed.—*S. T. V.*

14115. Krouskij, L. Eine Anwendung der "regula Falsi" in der praktischen Seismik [An application of the method of approximations in seismic prospecting]: Erdöl u. Kohle, Jahrg. 5, Heft 10, pp. 623–624, 1952.

An iteration procedure which can be applied graphically, is suggested for improving the assumed value of seismic velocity constructions. It can be applied when shooting from one point in two diametrically opposite directions. In the proposed geometric figure three points lie on a straight line only with the correct value of seismic velocity. By making intentionally this value too high or too low, deviations from this line are obtained, making it possible by interpolation to obtain more accurate value of seismic velocity.—*S. T. V.*

14116. Jakosky, J. Jay, and Jakosky, John J., Jr. Frequency analysis of seismic waves: Geophysics, v. 17, no. 4, pp. 721–738, 1952.

A single broad-band recording of seismic waves is made in the field on motion picture films in a method developed by International Geophysics, Inc. The film is developed in the office and cut into sections for each shot. Each section is spliced into a closed loop and analyzed by photocell, with the photocell output amplified and passed through a heterodyne-type wave analyzer. Different filter settings are used and observed visually on a cathode-ray tube. When the desired result is obtained a conventional photographic reflection seismogram is taken and interpreted by standard methods.

This method of seismic-reflection surveying has its chief application in marginal or difficult areas where interference is a serious problem. It reduces the need for multiple shots at different filter settings.—*L. C. P.*

14117. Hughes, D. S., and Kelly, J. L. Variation of elastic wave velocity with saturation in sandstone: Geophysics, v. 17, no. 4, pp. 739–752, 1952.

The velocity of dilational waves in four sandstones has been measured as a function of pressure in the range 50 to 1,000 bars at room temperature and at 100° C. At least two cores from each sample were run, one dry and one saturated with water. In addition two cores from one sample were run at several partial saturations. The porosities of the samples varied from about 8 to 20 percent. The effect of water content is dependent on pressure. At low pressures (50 bars) the velocity rises sharply at small saturations (0–10 percent), remains constant with saturation 10 to 90 percent and then decreases as the saturation approaches 100 percent. At 50 bars the velocity at 100 percent saturation is generally higher than at 00 percent saturation. Even for the one exception an extrapolation would indicate this to be true at atmospheric pressure. As the pressure is increased the rise at low saturations decreases; at 500 bars it disappears. The velocity is almost constant with saturation until about 90 percent saturation is reached. It then decreases rapidly as 100 percent saturation is approached.

A qualitative explanation of these results is given.—*Authors' abstract.*

14118. Evison, F. F. The inadequacy of the standard seismic techniques for shallow surveying: Geophysics, v. 17, no. 4, pp. 867–875, 1952.

Seismic methods in geophysics are not well adapted to shallow exploration because of certain practical and fundamental limitations. The most important of these limitations is that "the explosive impulse is inherently unsuitable for detailed shallow surveying" because of its frequency characteristics and duration. A typical shallow seismic-refraction survey illustrates the limitations of the

standard field and interpretation techniques. Use of an electromechanical rather than an explosive source of energy offers some promise in overcoming this difficulty.—*L. C. P.*

14119. Allen, C. F., Lombardi, L. V., and Wells, W. M. The application of the reflection seismograph to near-surface exploration: Geophysics, v. 17, no. 4, pp. 859–866, 1952.

Thickness of glacial drift in a large area of western Minnesota was determined during the fall of 1951 by the Stanford Research Institute using a special shallow-reflection seismograph technique. Air shots were used, offset 350 ft in each direction from a spread of five seismometers placed at intervals of 25 ft. The A .V. C. system was removed and a filter peaked at 100 cycles per second was used, along with a high speed camera and high frequency galvanometers. Bedrock depths from a few hundred to several hundred feet were accurately determined. This method should be useful in a number of shallow-mining, engineering, and ground-water problems.—*L. C. P.*

14120. Krey, Theodor. The significance of diffraction in the investigation of faults: Geophysics, v. 17, no. 4, pp. 843–858, 1952.

Overlapping of reflections on a record taken across a fault is to be expected for thrust faults, or for normal faults if there are differences of dip on both sides of the fault. However, this overlapping is observed much more frequently than is accountable for by these reasons and is demonstrated to be caused by diffraction of seismic waves. Overlapping caused by diffraction is increased if the profile crosses the fault at an acute angle. Diffraction also causes apparent changes in dip near the fault trace. Several practical examples illustrate the effect of diffraction and point out the inherent approximations involved in locating faults by the reflection seismograph. Diffraction will also occur at any sudden termination of a reflecting horizon.—*L. C. P.*

14121. Romberg, Frederick. Limitations of the seismic method of mapping faults: Geophysics, v. 17, no. 4, pp. 827–842, 1952.

The seismic-reflection method of mapping faults and other complex structural features is seriously hampered by certain limitations, such as lateral-velocity variations, curved reflecting surfaces, inaccuracy of seismic data, shot-hole filtering, broken reflecting surfaces, instrumental and spread configuration limitations. Improved interpretation, instrumental and field techniques may overcome some of these difficulties; others cannot be eliminated but merely recognized in order to avoid false interpretations.—*L. C. P.*

14122. Schriever, William. Sound ranging in a medium having an unknown constant phase velocity: Geophysics, v. 17, no. 4, pp. 915–923, 1952.

The differences in arrival times at four sound detectors arranged on the corners of a square can easily be used to determine the direction of an explosion without knowing the velocity in the medium. Calculations show that an array having a 2,000 ft diagonal can determine the direction of an explosion 10,000 ft distant within 5 minutes of one and that if the wave front is essentially plane the result is independent of the motion of the medium. The use of two such arrays for locating practice bomb drops is proposed.—*D. F. B.*

14123. Reich, Hermann. Ergebnisse seismischer Untersuchungen in Kohlenbergwerk Peissenberg [Results of seismic investigations in the Peissenberg coal mine]: Erdöl u, Kohle, Jahrg. 4, Heft 9, pp. 538–542, 1951.

In the winter of 1951 the Institut für angewandte Geophysik at München made investigations of the elastic properties of Molasse sedimentary rocks in the Peissenberg coal mine. Velocities of propagation of seismic waves were determined at a depth of 650 m below ground, using electric microphones and mechanical seismographs.

The velocity of longitudinal waves in variegated Molasse was found to be 3,200 m per sec, in adjoining sandstone formations 3,600 m per sec. The velocities of transverse waves were found to be 1,800 and 2,150 m per sec respectively. Clearly observable phenomena of refraction of seismic waves were observed along an inclined folded formation of rock having high seismic velocity, about 4,600-5,200 m per sec.—*S. T. V.*

14124. Tateishi, Tetsuo. Seismic prospecting at Toyosuto Coalfield, Hokkaido [In Japanese with English resume]: Geol. Survey Japan Bull., v. 2, no. 9, pp. 29–34, 1951.

A seismic refraction survey in 1950 indicated presence of layers with velocities of 1.5, 1.8, 2.1, 2.4, 2.8, and 3.5 kmps. Geologic data suggest these are the Quaternary (1.5), Takikawa (1.8–2.1), and Ishikari (2.4–3.5) formations.—*M. C. R.*

14125. Iida, Kumizi, and Kurihara, Shigetoshi. Offshore seismic exploration in Ube coal field [In Japanese with English summary]: Geol. Survey Japan, Report no. 146, 61 pp., 1952.

Offshore refraction surveys of the coal field were made between 1947 and 1950. Sled-mounted detectors dragged across the fairly flat sea bottom proved more efficient than detectors suspended from floats, which though handled very rapidly were disturbed by water motion. Thicknesses of Quaternary sediments, Tertiary sediments, and basement rock were mapped to depths of 300 meters.—*D. F. B.*

## ELECTRICAL AND ELECTROMAGNETIC METHODS

14126. Abercrombie, W. F. The practical value of an earth resistivity method in making subsurface explorations, *in* Symposium on surface and subsurface reconnaissance: Am. Soc. for Testing Materials, Special Tech. Pub. 122, pp. 136–141, 1952.

This is a discussion of the resistivity method as used by the Georgia Highway Department. Ten examples are given of tests made in the state.—*M. C. R.*

14127. Moore, R. W. Earth-resistivity tests applied to subsurface reconnaissance surveys, *in* Symposium on surface and subsurface reconnaissance: Am. Soc. for Testing Materials, Special Tech. Pub. 122, pp. 89–103, 1952.

This is a review of the use of the resistivity surveys as a reconnaissance method in problems of highway engineering, location of construction materials, bridge- and tunnel-construction sites, and similar engineering problems. Examples are quoted largely from the work done by the Bureau of Public Roads.—*M. C. R.*

14128. Scharon, H. L. Electrical resistivity geophysical method as applied to engineering problems, *in* Symposium on surface and subsurface reconnaissance: Am. Soc. for Testing Materials, Special Tech. Pub. 122, pp. 104–114, 1952.

The electrical-resistivity geophysical method has been used with success in solving problems of the location of subsurface waters, thickness of unconsolidated sediments or overburden, buried channels, and other geological conditions directly related to construction-engineering problems. This paper presents a brief account of the electrical-resistivity method and gives several examples to demonstrate its application.—*Author's Abstract*

14129. Seigel, H. O. Ore body size determination in electrical prospecting: Geophysics, v. 17, no. 4, pp. 907–914, 1952.

Metallic sulfide-bearing rock has a much higher electrical conductivity than the usual country rock. This contrast may be used to gain an estimate of the size of the body associated with a mineralized intersection in a drill hole. The method depends on the primary voltage disturbance created by the body and the variation of the disturbance with electrode spacing. Theoretical curves for the effect of an oblate spheroid are given for use in interpretation.—*M. C. R.*

14130. Yost, W. J., Caldwell, R. L., Beard, C. I.. McClure, C. D., and Skomal, E. N. The interpretation of electromagnetic reflection data in geophysical exploration. Pt. 2: Metallic model experiments: Geophysics, v. 17, no. 4, pp. 806–826, 1952.

A metallic model of a horizontally stratified section of the earth's crust has been constructed to provide information of considerable value in the interpretation of geophysical data. Modeling considerations and experimental arrangements are discussed in detail for a system employing loops of wire as transmitter and receiver for the study of propagation of electromagnetic energy in and on a semi-infinite conductor. An experimental check of the theory given in Part I (Yost, 1952) has been made for the case of a semi-infinite conducting medium underlying a semi-infinite insulator. Discontinuities in electrical conductivity within such a medium have been shown to reflect electromagnetic pulses back to the surface. A detailed study of the shape of these pulses from single reflectors has been made showing that certain characteristics of the pulse shape can be correlated with the depth and nature of the reflecting horizon. The reflected signals can be approximately described by considering the discontinuities as reflectors which, in turn, can be replaced by virtual "image" oscillators in a homogeneous structure. The extent to which this approximation holds is discussed in the light of experiments with the model. An example is given of the use of a nonconcentric loop arrangement for geophysical profiling of a limited reflector, such as a salt dome. Finally, data are given to show the agreement between model signals and field results obtained from a known resistivity contrast in the earth.—*Authors' Abstract*

14131. Clark, A. R., and Mungal, A. G. Scale model experiments in electomagnetic methods of geophysical exploration: Canadian Jour. Physics., v. 29, no. 4, pp. 285–295, 1951.

Model experiments employing electromagnetic-inductive methods are described. A plane circular horizontal loop 10 feet in diameter was used as the energizer, and brass conductors of various shapes and dimensions were placed at prescribed

depths below the loop. An exciting frequency of 50,000 cycles was utilized corresponding to a scale factor of 100 to 1 on the basis of 500-cycle field work. Phase and amplitude measurements were made by using a vertical search coil of 1-cm radius which was placed at any point on a diameter of the loop.

Cylinders, discs, rings, plates, boxes, and solid bars were used as models. Profiles of amplitude and phase are plotted as a function of horizontal distance. Characteristic features of the curves are noted for various type models as an aid to geophysical interpretation. Boundaries of a steep-dipping conductor occur at maximum amplitude response. As the ratio of the maxima on either side of a conductor of short depth extent is not altered by its position relative to the loop, short conductors may be differentiated from those with considerable depth extent. When the horizontal length of the conductor is large compared to its width, the current near the long edges may be considered as an infinite line current. The half width of the amplitude-response curve at the half maximum value is equal to the depth to the line current. This also holds approximately for conductors whose horizontal length and breadth are the same. For conductors of large depth extent, the dip may be estimated from the ratio of the two maxima.—*I. Z.*

14132. Gel'fand, I. S. Priblizhennyy uchet granitsy zazdela v methode zaryazhennogo tela [Approximate method of determining the boundary effect due to the buried charged body]: Akad. Nauk SSSR Ural'skiy filial, Trudy Gorno-Geol. Inst., vyp. 19, Geofiz. sbornik 1, pp. 43–50, 1950.

The influence of the earth's surface on the potential produced at a point on it by a buried charged body is ordinarily accounted for by simply doubling the computed value. This is admissible when the depth of the body is sufficiently great, but can otherwise result in error. Formulas are derived which give better approximation if the charged body is a sphere, a vertical or horizontal disk, or a horizontal circular cylinder of finite dimensions. The accuracy of the derived formulas is determined by the depth of the buried body, but is much greater than the usual doubling of the value of potential.—*S. T. V.*

14133. Bulashevich, Iu. P. Sviaz' mezhdu elektricheskimi i gravitatsionnymi anomaliiami [Relations between electrical and gravity anomalies]: Akad. Nauk SSSR, Ural'skiy filial, Trudy Gorno-Geol. Inst., vyp, 19, Geofiz, sbornik no. 1, pp. 3–13, 1950.

Certain relations between gravity and magnetic anomalies have been long established. In the present study approximate correlations are established between electrical anomalies in a homogeneous field and corresponding magnetic anomalies and through them with gravity anomalies. This correlation is valid, however, only under certain conditions as to the shape and density of distributing body and the constancy of magnetizing field. The derivation is made by replacement in the potential equation of magnetic susceptibility by dielectric constant and of the intensity of magnetic field by that of electrostatic field. The effect of the boundary surface ground air on data characterizing the electric field and the necessary corrections are also discussed.—*S. T. V.*

14134. Spicer, H. C. Electrical resistivity studies of subsurface conditions near Antigo, Wis.: U. S. Geol. Survey Circ. 181, 19 pp., 152.

Resistivity measurements were made in a glaciated area near Antigo to locate buried sand and gravel deposits which might be developed as aquifers and to

determine depth of bedrock. Results are presented as cross section and contour maps. It was found possible to differentiate glacial deposits by means of these resistivity measurements and to determine the depths to and thicknesses of materials, as well as depth to the pre-Cambrian bedrock. It was also possible to evaluate the character of the glacial material from their electrical resistivities and to recommend the most suitable sites for drilling water-supply wells.—*M. C. R.*

14135. Kaneko, Jun. Electrical and magnetic prospecting on the Sankyo iron mine, Niigata Prefecture [In Japanese with English resumé]: Geol. Survey Japan Bull., v. 2, no. 7, pp. 38–43, 1951.

On the basis of negative self-potential and magnetic anomalies, sites for drilling are recommended.—*M. C. R.*

14136. Murozumi, Masayoshi. Contribution to the electrical prospecting in Shōjingawa sulphur mine and Amemasugawa sulphur mine, Hokkaido. [In Japanese with English résumé]: Geol. Survey Japan Bull., v. 2, no. 7, pp. 21–29, 1951.

Resistivity and self-potential surveys to determine the size of deposits and locate new deposits are described. Recommendations for further prospecting and drilling are made.—*M. C. R.*

14137. Schneider, Hans, Truelsen, Christian, and Thiele, Heinrich. Die Wassererschliessung [Procurement of water], 420 pp., Vulkan Verlag, Essen (Germany), 1952.

This book, the collective work of several authors, deals with all phases of finding and recovering underground water. The second part, of about 90 pages by Thiele, has the subtitle—Die Geolektrik in der Wassererschliessung (Electric methods in finding water). The physical foundations of geoelectric measurements, the more commonly used instruments, and different procedures for measurements of resistivity methods are discussed. This is followed by a discussion of electric specific resistivity, a basic property determined primarily by the structure, water content, and chemical composition of underground material.

About 170 references are included.—*S. T. V.*

## RADIOACTIVITY METHODS

14138. Cook, J. C. An analysis of airborne surveying for surface radioactivity: Geophysics, v. 17, no. 4, pp. 687–706, 1952.

Quantitative estimates for the gamma radiation field intensities expected to be encountered in flight over various geologic bodies are presented. Scattering effects are included in the calculations, but several simplifying assumptions were necessary, such as assigning equal energies to all photons. Results are compared with geiger counter measurements of three kinds: near a small natural carnotite deposit, near a tenth-curie of radium, and soundings made over normal terrain at various times. It appears that anomalies from most outcrops of radioactive ores will exceed the normal fluctuations of background radiation due to topography, variations of composition of the surface, etc., only at flying altitudes of less than about 35 feet. However, such anomalies can probably be detected

under favorable conditions by their characteristically pointed shape, allowing flight at higher elevations. Requirements on flight plan and instrumentation are discussed.—*Author's Abstract*

## WELL LOGGING

14139. Wyllie, M. R. J. Procedures for the direct employment of neutron log data in electric log interpretation: Geophysics, v. 17, no. 4, pp. 790–805, 1952.

It is well-known that under suitable borehole conditions there is a relationship between porosity and the deflection of a neutron log curve. This relationship finds practical use, calibration of the neutron deflections being made by reference to porosities measured on cores. It is shown that theoretically core analysis is not mandatory for neutron log calibration and that the calibration may be achieved by direct plotting of suitable neutron and electric log data. For this purpose the concept of the neutron deflection corresponding to a formation factor of unity is introduced. It is shown that this concept makes it possible to use a combination of electrical and radioactivity log data to locate zones of oil saturation in carbonate rock formations and even to estimate the oil saturation. Application of the method to sandstones is also considered. In oil-base mud logging, neutron-log data may be conveniently combined with resistivities read off induction logs to give information bearing on the location of saturated zones and the estimation of connate water salinities. Finally a combination of electrical and radioactivity log data is theoretically capable of contributing to the quantitative elucidation of the "dirty sand" problem.—*Author's Abstract*

14140. Burtin, Jean. Die neue Schlumberger-Technik und ihre Anwendung in Aufschlussbohrungen für Braunkohle, Steinkohle und Wasser [The new Schlumberger procedure and its use in exploratory drill holes for lignite, coal, and water]: Braunkohle, Wärme und Energie, Band 4, Heft 13/14, pp. 260–265, 1952.

Recent improvements in drill hole logging in exploring for oil, coal or lignite are reviewed with special attention to determinations of the resistivity of the formation beyond the infiltration depth, using the microlog. Another improvement discussed is gamma-ray logging. Electrode arrangements for measuring dip and strike in wells are briefly described.

Examples of the interpretation of the curves obtained by different methods are given. The great value of using several methods of logging simultaneously is emphasized.—*S. T. V.*

14141. Hée, Arlette, and Lecolazet, René. Utilization de trous forés dans les roches pour l'étude de leur rayonnement pénétrant [Use of drill holes in rocks for the study of penetrating radiation]: Acad. sci. Paris Comptes rendus, tome 235, no. 2, pp. 201–203, 1952.

The importance is emphasized of certain corrections to be applied when measuring gamma-ray radiation in a drill hole or on the surface of the earth. These corrections are: topographic correction, correction for cosmic radiation, and for the emanation from the mountain if the point of observation is at its foot. Examples of the evaluation of these corrections are given (*See also* Geophys. Abstract 13886).—*S. T. V.*

## PATENTS

### GRAVITY METHODS

14142. Jakosky, J. J. Gravity meter, U. S. patent 2,613,536, granted Oct. 14, 1952. 9 claims.

14143. Cloud, R. T. Gravity meter, U. S. patent 2,614,432, granted Oct. 21, 1952. 21 claims. Assigned to North American Geophysical Co.

14144. Boucher, F. G. Gravity and density gradiometer for boreholes, U. S. patent 2,618,156, granted Nov. 18, 1952. 10 claims. Assigned to Standard Oil Development Co.

### MAGNETIC METHODS

14145. Lee, F. W. Temperature compensation magnetometer indicator, U. S. patent 2,615,957, granted Oct. 28, 1952. 8 claims.

14146. Means, W. J. Magnetic testing system, U. S. patent 2,615,961, granted Oct. 28, 1952. 9 claims. Assigned to Bell Telephone Laboratories, Inc.

An electromagnetic system for indicating magnetic field strength.

14147. Mayes, F. M. and Tickner, A. J. Magnetometer gradiometer apparatus and method, U. S. patent 2,620,381, granted Dec. 2, 1952. 25 claims.

### SEISMIC METHODS

14148. Doolittle, W. W. Marine seismic surveying, U. S. patent 2,614,165, granted Oct. 14, 1952. 4 claims. Assigned to Stanolind Oil and Gas Co.

A detector spread for marine seismic surveying.

14149. Piety, R. G. Method for determining the direction of arrival of waves, U. S. patent 2,614,166, granted Oct. 14, 1952. 12 claims. Assigned to Phillips Petroleum Co.

14150. Volk, J. A. System of seismographic visual recording, U. S. patent 2,614,228, granted Oct. 14, 1952. 1 claim.

14151. Poulter, T. C. Apparatus for seismic exploration, U. S. patent 2,615,521, granted Oct. 28, 1952. 2 claims. Assigned to Institute of Inventive Research.

Multiple flat explosive plates for firing in air.

14152. Poulter, T. C. Seismic exploration employing elevated charges, U. S. patent 2,615,522, granted Oct. 28, 1952. 8 claims. Assigned to Institute of Inventive Research.

Employs 7 equispaced air shots.

14153. Poulter, T. C. Seismic exploration, U. S. patent 2,615,523, granted Oct. 28, 1952. 20 claims. Assigned to Institute of Inventive Research.

A system of firing in air two successive seismic impulses separated by three-fourths of the natural period of earth vibration in the region under study.

14154. Poulter, T. C. Seismic exploration employing elevated charges, U. S. patent 2,615,524, granted Oct. 28, 1952. 12 claims. Assigned to Institute of Inventive Research.

Employs 13 equispaced air shots.

14155. Carlisle, C. H. Seismic exporation method, U. S. patent 2,619,186, granted Nov. 25, 1952. 3 claims. Assigned to Standard Oil Development Co.

A method of seismic prospecting employing multiple shots fired below the surface of a body of water.

14156. Seavey, G. C. Generation and transmission of sound pulses, U. S. patent 2,620,766, granted Dec. 9, 1952. 11 claims. Assigned to Sonic Research Corp.

Apparatus for transmitting a train of sound waves of controlled frequency into the earth.

14157. Lee, B. D., and Herzog, Gerhard. Seismic prospecting, U. S. patent 2,620,890, granted Dec. 9, 1952. 6 claims. Assigned to The Texas Co.

A method of recording modulated seismic waves on a magnetic tape and demodulated waves of selected frequency on a conventional oscillograph.

14158. Ording, J. R. Seismic exploration method, U. S. patent 2,622,691, granted Dec. 23, 1952. 3 claims. Assigned to Standard Oil Development Co.

A method of seismic exploration of water-covered areas.

14159. Bayhi, J. F., and Baker, J. T. Seismic prospecting with optimum geophone coverage, U. S. patent 2,623,113, granted Dec. 23, 1952. 3 claims. Assigned to Standard Oil Development Co.

A system of mixing seismic impulses of adjacent detectors.

14160. Thomas, M. E. Seismometer, U. S. patent 2,623,938, granted Dec. 30, 1952. 4 claims. Assigned to Phillips Petroleum Co.

## ELECTRICAL METHODS

14161. Lee, F. W. Method of geophysical prospecting, U. S. patent 2,613,247, granted Oct. 7, 1952. 8 claims.

A modification of the Lee-partitioning resistivity method.

14162. Bilhartz, H. L. Method for measuring resistivity of earth samples, U. S. patent 2,613,250, granted Oct. 7, 1952. 7 claims. Assigned to The Atlantic Refining Co.

14163. Nichols, C. R. Electrical prospecting, U. S. patent 2,619,520, granted Nov. 25, 1952. 15 claims.

An electrical prospecting method for determining physical characteristics of a subsurface portion of the earth by measuring and integrating the potential difference between a base potential and the potential of a moving point.

14164. Kunetz, Géza. Method for the electric prospection of the subsoil, U. S. patent 2,623,097, granted Dec. 23, 1952. 6 claims. Assigned to Compagnie Générale de Géophysique.

A method of measuring time variations of potential differences associated with telluric currents.

14165. Cartier, W. O., McLaughlin, G. H., and Robinson, W. A. System of airborne conductor measurements, U. S. patent 2,623,924, granted Dec. 30, 1952. 11 claims. Assigned to The International Nickel Co. of Canada, Ltd.

An airborne electromagnetic device for mapping ore bodies.

## RADIOACTIVITY METHODS

14166. Lord, A. H., Jr. Prospecting using gamma ray detection, U. S. patent 2,617,945, granted Nov. 11, 1952. 3 claims. Assigned to The Texas Co.

14167. Weller, B. L. Radiation detector circuit, U. S. patent 2,617,946, granted Nov. 11, 1952. 7 claims. Assigned to the United States of America as represented by the U. S. Atomic Energy Commission.

14168. Zollers, S. M. Radioactivity survey apparatus, U. S. patent 2,619,601, granted Nov. 25, 1952. 7 claims. Assigned to the United States of America as represented by the U. S. Atomic Energy Commission.

14169. LeVine, H. D., and Di Giovanni, H. J. Radiation detection and measuring means, U. S. patent 2,620,446, granted Dec. 2, 1952. 1 claim. Assigned to United States of America as represented by the U. S. Atomic Energy Commission.

14170. Bernstein, William, and Ballentine, Robert. Radioactive particle counting, U. S. patent 2,622,208, granted Dec. 16, 1952. 6 claims. Assigned to the United States of America as represented by the U. S. Atomic Energy Commission.

14171. Beckman, A. O., Herd, H. H., and Robinson, A. D. Dosimeter, U. S. patent 2,613,327, granted Oct. 7, 1952. 10 claims. Assigned to the United States of America as represented by the U. S. Atomic Energy Commission.

A radiation dosimeter.

## WELL LOGGING

14172. Ring, Roland. Well surveying instrument, U. S. patent 2,613,448, granted Oct. 14, 1952. 2 claims. Assigned to Sperry-Sun Well Surveying Co.

An instrument for recording positions in a well.

14173. West, T. S. Well tester, U. S. patent 2,613,747, granted Oct. 14, 1952. 7 claims.

An apparatus for obtaining samples of the fluid content of the earth formations traversed by a well bore.

14174. Hildebrandt, A. B. Inclinometer for boreholes, U. S. patent 2,614,334, granted Oct. 21, 1952. 12 claims. Assigned to Standard Oil Development Co.

14175. Mathews, H. A., Riordan, M. B., and Scott, L. B. Sound indicator and fluid level indicator for wells, U. S. patent 2,615,080, granted Oct. 21, 1952. 3 claims. Assigned to Byron Jackson Co.

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