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January-December

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*Abstracts of current literature
pertaining to the physics of
the solid earth and to
geophysical exploration*

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FRED A. SEATON, *Secretary*

GEOLOGICAL SURVEY

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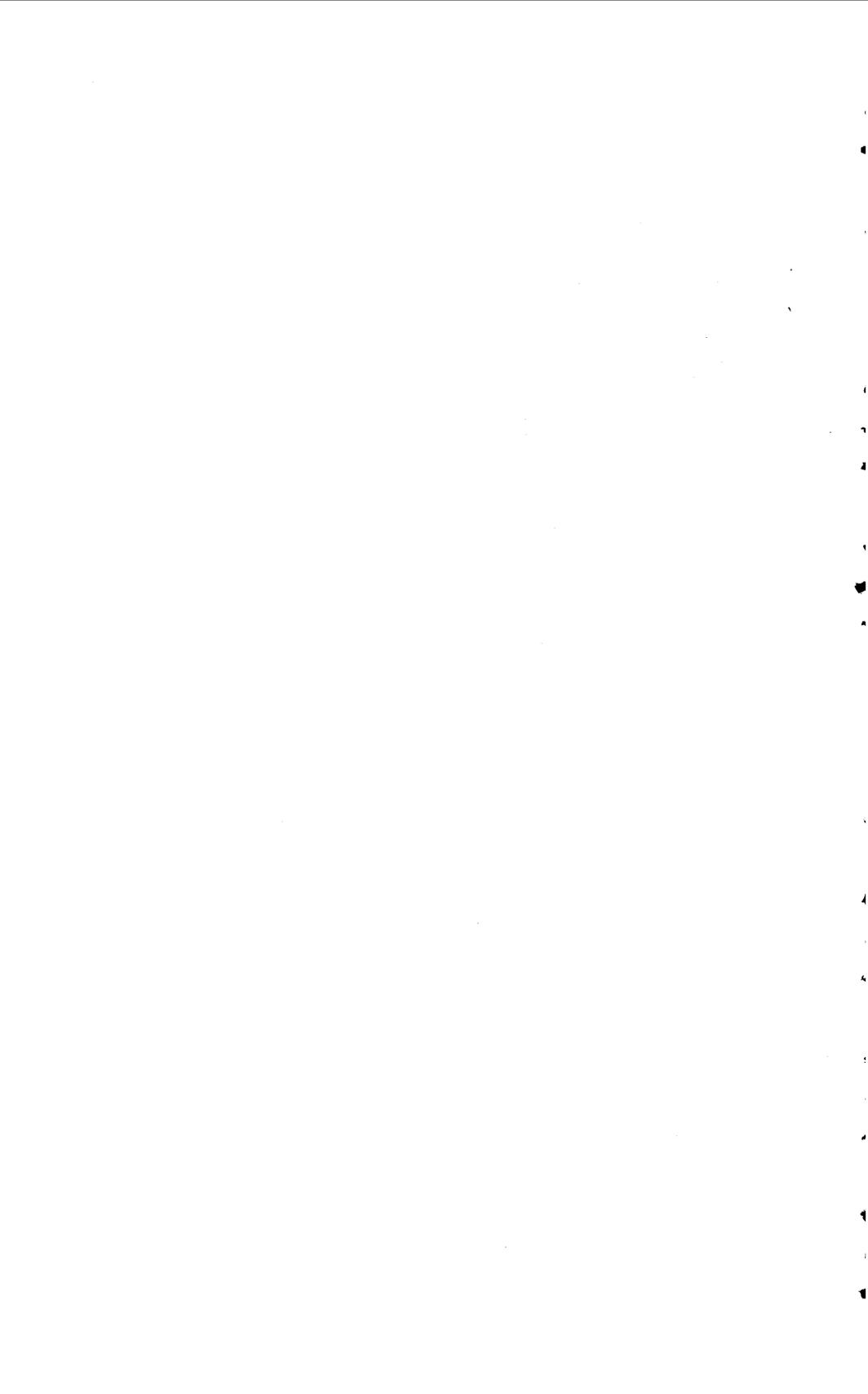148–151, January–December 1952, Geological Survey Bulletin 991.

152–155, January–December 1953, Geological Survey Bulletin 1002.

156–159, January–December 1954, Geological Survey Bulletin 1022.

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Geophysical

Abstracts 172

January-March

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By MARY C. RABBITT, DOROTHY B. VITALIANO, S. T. VESSELOWSKY *and others*

GEOLOGICAL SURVEY BULLETIN 1086-A

*Abstracts of current literature pertain-
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GEOPHYSICAL ABSTRACTS 172, JANUARY–MARCH 1958

By MARY C. RABBITT, DOROTHY B. VITALIANO, S. T. VESSELOWSKY, and others

INTRODUCTION

EXTENT OF COVERAGE

Geophysical Abstracts includes abstracts of technical papers and books on the physics of the solid earth, the application of physical methods and techniques to geologic problems, and geophysical exploration. The table of contents, which is alphabetically arranged, shows the material covered.

Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memoranda) or of other papers presented orally at meetings unless summaries of substantial length are published. Abstracts of papers in Japanese and Chinese are based on abstracts or summaries in a western language accompanying the paper.

LIST OF JOURNALS

Full titles and abbreviations of journals cited for the first time in this issue (with the sponsoring organization and its address where these do not form part of the title) are given below. This list supplements the List of Journals published in Geophysical Abstracts 160 (January–March 1955, Bulletin 1033–A) and the supplements published in Geophysical Abstracts 161–171.

Acta Geophys. Sinica—Academia Sinica. Institute of Geophysical Meteorology. China.
Akad. Nauk Ukraynskoy RSR Geol. Zhur.—Geologichniy Zhurnal. Akademiya Nauk Ukrayns'koy RSR. Kiev.
Indian Mining Jour.—Indian Mining Journal. Calcutta.

FORM OF CITATION

The abbreviations of journal titles used are those adopted by the U. S. Geological Survey and used in many geological journals. For

papers in most languages other than English, the title is given in the original language as well as in translation. Slavic names and titles have been transliterated by the system used by the United States Board on Geographic Names. This system of transliteration for Russian was given in Geophysical Abstracts 148 (January–March 1952, Bulletin 991–A). Titles of papers in Japanese and Chinese are given in translation only.

ABSTRACTORS

Abstracts in this issue have been prepared by W. J. Dempsey, F. Frischknecht, R. G. Henderson, W. H. Jackson, M. F. Kane, R. M. Moxham, Virginia S. Neuschel, L. C. Pakiser, I. Zietz, and R. E. Warrick, as well as by the principal authors. The notation "Author's abstract" followed by the initials of an abstractor indicates a translation of the author's abstract.

AGE DETERMINATIONS

172–1. Pierucci, M. Sull'eta dell'Universo [On the age of the universe] : Nuovo Cimento, v. 5, no. 3, p. 572–578, 1957.

In order to resolve the discrepancy between the age of the universe as first deduced from its expansion and the age of the earth as calculated from radioactive transformations (the former was smaller), new calculations are made in which the quotient between actual mean densities of two successive orders (stars, star-clusters, galaxies, and galaxy-clusters each have a characteristic gas, expanding at about the same rate) is used as a quotient between original density and present density. In this way an age of about 1.1×10^{10} yrs is obtained, which is about twice that of the earth and thus agrees quite well with radioactive evidence.—*D. B. V.*

172–2. Herdmenger, Johannes. C^{14}-Alterbestimmung keine Allheilmethode [C^{15} age determination no wonder-method] Forschungen u. Fortschr., v. 31, no. 8, p. 235, 1957.

Serious sources of error in radiocarbon dating are the higher carbonic acid content of soil, which precludes any control over C^{14} exchange, and variations in C^{14}-content of the atmosphere. Decrease in strength of the geomagnetic field results in increased intensity of cosmic radiation and thus increased C^{14} in the upper atmosphere; in 4,000-year old objects the error from this source could be as much as 1,000 years.—*D. B. V.*

172–3. Pittioni, Richard. Der Beitrag der Radiokarbon-Methode zur absoluten Datierung urzeitlicher Quellen [The contribution of the radiocarbon method to the absolute dating of primitive sites] : Forschungen u. Fortschr., v. 31, no. 12, p. 357–364, 1957.

Radiocarbon data for Europe and North America are summarized in several tables: geologic dates, archeologic dates, a bibliography of radiocarbon dates, and an alphabetic listing by localities.—*D. B. V.*

172–4. Münnich, K. O. Ist die Alterbestimmung nach der C^{14}-Methode zuverlassig? [Is age determination by the C^{14} method reliable?] : Umschau, v. 58, no. 4, p. 109–111, 1958.

A discussion of the sources of error in radiocarbon dating. It is concluded that in almost all cases the uncertainty is still at least ± 100 years for individual datings.—*D. B. V.*

172–5. Spaulding, Albert C. The significance of differences between radiocarbon dates: Am. Antiquity, v. 23, no. 3, p. 309–311, 1958.

The meaning of the differences between two or more radiocarbon dates is analyzed on the basis of statistical information on counting rates. In the simplest case two dates are compared, using the principle that the standard error of the difference of two independent quantities is the square root of the sum of squared standard errors of the separate quantities. The reasoning is then extended to a case involving four datings (of the same tree burned in the Mt. Mazama eruption) which then becomes an example of the analysis of variance.—*D. B. V.*

172–6. Ruhe, R[obert] V., Rubin, Meyer, and Scholtes, W. H. Late Pleistocene chronology in Iowa: Am. Jour. Sci. v. 255, no. 10, p. 671–689, 1957.

Iowan till yields wood with dates beyond the present range of radiocarbon dating and places the Iowan substage as more than 29,000 years ago and as older rather than younger than the Farmdale. Farmdale in Iowa is dated at 24,500 years before the present. Tazewell loess was being deposited from before 17,000 to approximately 15,000 years ago. The maximum southern advance of the Cary stage of the Des Moines lobe was approximately 14,000 years ago and Cary glacial activity in the southern extremity continued from 11,900 to 14,000 years ago. Part of the Des Moines lobe associated with the Altamont moraine, dated at 11,600 to 11,800 years ago, antedates Two Creeks dated at 11,400 years ago. Postglacial major vegetational and climatic changes in Iowa are recorded at 8,200 to 6,600 and 6,600 to 6,500 years ago. A gully cycle may be related to the latter.—*V. S. N.*

172–7. de Vries, H., Barendsen, G. W., and Waterbolk, H. T. Groningen radiocarbon dates II: Science, v. 127, no. 3290, p. 129–137, 1958.

This list covers measurements made from August 1954 to March 1956. The samples included groups pertaining to the problem of the lowering of the Dutch coast relative to sea-level and to geological problems of the Gulf of Paria; individual samples related to special geologic problems; a series of samples from northwestern Europe including some standard sections and pollen zones; and archeological samples.—*M. C. R.*

172–8. Roubault, Marcel, and Coppens, René. Étude de la répartition de la radioactivité et du plomb dans un cristal de zircon [Study of the distribution of radioactivity and of lead in a zircon crystal]: Acad. Sci. Paris Comptes Rendus, v. 246, no. 1, p. 137–140, 1958.

The distribution of radioactivity in a large zircon crystal from a pegmatite at Betroka, Madagascar, was determined in two ways: by exposing a nuclear emulsion plate to a polished face, and by spectrographic analysis of the powder of seven samples (approximately $1\times1\times.5$ cm each) from different parts of the crystal. Both methods show considerable variations in uranium and lead within the crystal. Age calculations by the Larsen formula range from 403 to 605×10^6 yrs, which, with a possible error of ±20 percent, gives a spread of 373 to 725×10^6 yrs. A similar range of ages was found by the "total lead" method: 373 to 597×10^6 yrs. This variation of 50 to 100 percent in the same crystal suggests that determination of age from zircons should be considered very approximate, but it is not rejected as a routine method.—*D. B. V.*

172–9. Sprintsson, V. D., and Chernova, N. N. Sdvoyennaya argonovaya ustanovka [A binary argon installation]: Vses. nauchno-issled. geol. inst. Informatsionnyy Sbornik, no. 3, p. 107–109, 1956.

By addition of a second line of gas-absorbers it is possible to double the efficiency of the apparatus for argon age determinations.—*S. T. V.*

172–10. Polevaya, N. I., Murina, G. A., and Sprintsson, V. D. O vozmozhnykh oshibkakh pri opredelenii absolyutnogo vozrasta gornykh porod argonovym sposobom [Possible errors in determining the absolute age of rocks by the argon method]: Vses. nauchno-issled. geol. inst. Informatsionnyy Sbornik, no. 3, p. 109–114, 1956.

Of the three sources of errors in determining the absolute age of rocks by the argon method: accidental errors in experimentation; systematic errors,

caused by inaccuracy of the disintegration constants of potassium; and errors caused by the migration of argon and potassium, the last is the most important and should be the object of special study by geophysicists.—*S. T. V.*

172–11. Evernden, J[ack] F., Curtis, G[arniss] H., and Lipson, J[oseph]. Potassium-argon dating of igneous rocks: Am. Assoc. Petroleum Geologists Bull., v. 41, no. 9, p. 2120–2127, 1957.

Potassium-argon dating of a sequence of intrusive igneous rocks from Yosemite National Park, California, is in excellent agreement with age relations determined in the field. An elapsed time of 18 million years between youngest and oldest intrusions is indicated and the average interval time between intrusions is approximately 2 million years. Crystallization apparently required somewhat less than 2 million years in these masses, a figure which is in good agreement with Larsen's estimate of 1 million years for crystallization of the southern California batholith. Ages were also determined of rhyolite and andesite from Sutter Buttes which geologic evidence indicates as probably close to 1 but not more than 5 million years old. The ages determined are in the range suggested by the field evidence.—*M. C. R.*

172–12. Amirkhanov, Kh. I., Brandt, S. B., Bartnitskiy, Ye. N., Gurvich, V. S., and Gasanov, S. A. K voprosu o sokhrannosti radiogennogo argona v glaukonitakh [On the question of retention of radiogenic argon in glauconites]: Akad. Nauk SSSR Doklady, v. 118, no. 2, p. 328–330, 1958.

Samples of two different glauconites were heated to various temperatures in order to determine the degree of retention of radiogenic argon. Whereas in microcline the argon begins to be driven off at 400°C and in muscovite at over 600°, in glauconite approximately 20 percent is lost at 100° and all of it at 500°. Differential thermal analysis curves show endothermic effects at similar temperatures, with one peak between 100 and 200° (loss of adsorbed water) and a second between 500 and 600° (loss of water of constitution). Radiogenic argon and probably potassium also is evidently held as loosely as the water in the glauconite lattice. For absolute age determinations on glauconite therefore, it is necessary to know the geologic history of each sample as fully as possible. Possibly glauconite might be used in paleotemperature investigations.—*D. B. V.*

172–13. Amirkhanov, Kh. I., Magataev, K. S., and Brandt, S. B. Opredeleniye absulyutnogo vozrasta osadochnykh mineralov radioaktivnymi metodami [Determination of the absolute age of sedimentary minerals by radioactive methods]: Akad. Nauk SSSR Doklady, v. 117, no. 4, p. 675–677, 1957.

The age of 45 glauconites from various parts of the Dagestan Autonomous Republic, ranging in age from lower Cretaceous through Tertiary, was investigated by the argon method. Of these, 26 agreed remarkably well with the geologic data (these are tabulated); in 11 samples no radiogenic argon was found, and in 8 samples the radiogenic argon content and, hence, the ages were too low. Argon seems to be lost from glauconite more easily than from mica or feldspar; at 100–150° it is partly lost, at 500–600° completely. Evidently paleotemperatures, metamorphism, local heating, and weathering affect glauconite more easily than they affect igneous rocks. At present glauconite is useful in argon dating of particular geologic formations; in the future, together with other potassium-bearing authigenic minerals, it may provide the basis for a new

geologic time scale. In the meantime detailed study of the geological, geo-chemical, and physical factors determining argon retention in glauconite is necessary.—*D. B. V.*

172–14. Lipson, Joseph. Potassium-argon dating of sedimentary rocks: Geol. Soc. America Bull., v. 69, no. 2, p. 137–150, 1958.

Authigenic sedimentary rocks of well-established geologic age, ranging from Miocene to Givetian, have been analyzed at the Berkeley potassium-argon dating laboratory using equipment designed to date materials of low radiogenic argon content. The ages of seven glauconites from the Oligocene (30×10^6 yrs), Eocene (45×10^6 yrs), and Paleocene (55×10^6 yrs) of New Zealand are consistent with the stratigraphy and correspond to the few previous uranium-lead and potassium-argon dates for that segment of the geologic time scale. The ages of three Miocene glauconites from New Zealand are too high compared to the Oligocene, which may be too low. An Albian glauconite from the MacMurray district of Canada is too high (142 ± 10^6) compared to other dated samples. Ages of a Cenomanian feldspar from Alberta ($94.9 \pm 4.7 \times 10^6$) and a Givetian sylvite from Saskatchewan ($285 \pm 14 \times 10^6$) are consistent with the Holmes B time scale. The anomalous ages might be due to contamination from older material embedded in the glauconite or by atmospheric argon; they also seem to show a correlation with low potassium content. One such sample is a core, which might have retained more argon than exposed samples.—*D. B. V.*

172–15. Curtis, G[arniss] H., and Reynolds, J[ohn] H. Notes on the potassium-argon dating of sedimentary rocks: Geol. Soc. America Bull., v. 69, no. 2, p. 151–160, 1958.

A companion paper to Lipson's (see Geophys. Abs. 172–14). The physical dates found for plutonic rocks, contact metamorphic aureoles around plutons, and regionally metamorphosed rocks represent the last heating of the rock, not necessarily the age of formation; in ancient plutonic masses the difference between true and apparent ages is of little consequence as both probably fall within the limits of error. For late geologic history (Cretaceous to Recent) minerals from extrusive igneous (or shallow intrusive) and sedimentary environments are most reliable for potassium-argon dating. The ultimate geologic time chart will probably be based for the most part on physical dates for such igneous minerals. In sedimentary rocks the unaltered detrital minerals of volcanic origin, presumably formed shortly before deposition, are ideal for dating purposes. Authigenic feldspar, sylvite, and particularly glauconite are also suitable. Separation of glauconite is described briefly. The sources of error—contamination, argon inheritance, and diffusion—are discussed, the last at some length.—*D. B. V.*

172–16. Damon, Paul E., and Kulp, J. Laurence. Argon in mica and the age of the Beryl Mt., N. H., pegmatite: Am. Jour. Sci., v. 255, no. 10, p. 697–704, 1957.

A^{40} and K^{40} measurements on specimens of margarite (calcium mica) from two Appalachian localities and potassium micas associated with the Beryl Mountain, New Hampshire, pegmatite and associated country rocks are used to show the probable absence of appreciable primary argon in these minerals. The age of the Beryl Mountain pegmatite and associated regional metamorphism appears to be 323 ± 10 million years.—*Authors' abstract*

172–17. Ovchinnikov, L. N., Shur, A. S., and Panova, M. V. On absolyutonom vozraste nekotorykh izverzhennykh, metamorficheskikh i osadochnykh obrazovaniy Urala [On the absolute age of some igneous, metamorphic, and sedimentary formations of the Urals] : Akad. Nauk SSSR Izv. Ser. geol., no. 10, p. 3–14, 1957.

The results of more than 60 argon age determinations on igneous, metamorphic and sedimentary rocks and minerals from the Urals are presented. The data attest to the feasibility of applying the argon method to rocks of all origins.—*D. B. V.*

172–18. Polevaya, N. I., Murina, G. A., and Chernova, N. N. O vozmozhnogti opredeleniya absolyutnogo vozrasta effuzivnykh porod [On the possibility of the determination of the absolute age of effusive rocks] : Akad. Nauk SSSR Doklady, v. 105, no. 3, p. 523–525, 1955.

Ages of minerals from felsic igneous rocks from different parts of the U. S. S. R., for which there are reliable geologic ages ranging from Precambrian to Eocene, were determined by the argon method. Results of 21 of 24 tested specimens were in good agreement with geological indications. The experiments show that the specimens did not lose any noticeable amounts of argon and that there was no occlusion.—*S. T. V.*

172–19. Romanova, M. A. O vozraste magmaticheskikh porod okrestnostey g. Krasnovodska [On the age of the magmatic rocks in the vicinity of Krasnovodsk] : Akad. Nauk SSSR Doklady, v. 117, no. 5, p. 870–873, 1957.

At the end of this short petrographic paper the absolute age of 250×10^6 yrs is given for the Krasnovodsk granites, determined on mica by the potassium-argon method at the Laboratory of Precambrian Geology of the Russian Academy of Sciences.—*D. B. V.*

172–20. Harpum, J. R. The age relationships of the rocks around Hombolo, Dodoma District: Tanganyika Geol. Survey Recs., v. 3, p. 32–33, 1953 [1956].

The Hombolo series, north-northeast of Dodoma Township, is best correlated with the Dodoma series, south of Dodoma, on the basis of petrology and structure. Both series are probably pre-Nyanzian in age and among the oldest rocks in this part of Africa as indicated by age determinations of between 2,500 and 4,000 million years on lepidolite from the lithium-bearing pegmatite in the Hombolo series. The inaccuray of the strontium method used, however, does not permit exact correlation of the Hombolo series.—*V. S. N.*

Komarov, A. G. Remanent magnetization of rocks and their age (Paleomagnetism and wandering of the poles). See Geophys. Abs. 172–173.

EARTHQUAKES AND EARTHQUAKE WAVES

172–21. Savarenskiy, Ye F. Seysmologiya i seysmicheskaya slyzhba v. SSSR za sorok let [Seismology and seismic service in U. S. S. R. for forty years] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 11, p. 1332–1340, 1957.

A review of the development of seismology and seismic exploration methods in the U. S. S. R. since 1917.—*S. T. V.*

172–22.   Savarenskiy, Ye. F.   O rabotakh po seysmologii v Yaponii [Seismologi-
cal research in Japan] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 12,
p. 1453–1468, 1957.

A report of a visit to seismological research centers in Japan in connection with
the International Geophysical Year.—*S. T. V.*

172–23.   Wartnaby, J.   Seismology : London Science Museum Geophysics Hand-
book, no. 1, 47 p., 1957.

A brief survey of earthquakes, their causes, detection, interpretation, and ap-
plication to seismic prospecting introduces this catalog of exhibits in the Seismo-
logical Section of the London Science Museum.—*V. S. N.*

172–24.   Gryglewicz, Zofia.   Aktywność sejsmiczna w 1956 r. [Seismic activity
in 1956] : Acta Geophys. Polonica, v. 5, no. 4, p. 310–318, 1957.

A summary of the strong earthquakes of 1956 based chiefly on data from
Polish and other seismological bulletins.   Two maps show epicenters of the
principal earthquakes in Europe and in the world.—*M. C. R.*

172–25.   Lotze, Franz.   Aktuo-geologische Charakteristik des Jahres 1956
[Actuo-geological characteristics of the year 1956] : Neues Jahrb.
Geologie u. Paläontologie Monatsh., no. 12, p. 527–537, 1957.

In 1956 a total of 713 definite and 29 questionable earthquakes were recorded
in central Europe (Münster and Strassburg stations), a frequency of 1.95 per
day as compared to 2.16 in 1955.   Monthly distribution was more regular than
in 1955, with a minimum in April (1.6 per day) and maximum in July (2.61
per day).   Foci were determined for 248 of the 713; of these 116 occurred in the
Mediterranean area, 10 in the Atlantic and Arctic, 24 on the continent of Asia,
4 in the Indies, 87 in the Pacific (exclusive of the American coast), 2 in Australia,
and 21 in America including the Pacific coast.   Foci of 37 were over 50 km deep;
magnitudes of 42 were 6 or more.   The most destructive were those in Afghanistan
on June 9, in Lebanon on March 16, in the Aegean Sea near the Cyclades on
July 9, in western India on July 21, in Anatolia on February 20, in central Burma
on July 16, near Granada, Spain (date not mentioned), in central Hungary on
January 12, at Acapulco, Mexico (date not mentioned) in Ecuador on January 16,
and in southern Iran on November 4.   A total of about 1,000 were killed, 1,700
injured, 70,000 left homeless by these disasters, with damage calculated at
250 million German marks.

Volcanic activity in 1956 included increased activity of Etna in February-
March and in April; in February a lava flow at Stromboli reached the sea; in
January Merapi in Java deposited heavy ash falls on 15 villages; in May
Sakurajima in Japan erupted; on May 23 a submarine eruption occurred be-
tween Oahu and Kauai in the Hawaiian Islands; and in late November Llaima
in southern Chile resumed activity after a quiet year.   Altogether there were no
deaths resulting from volcanism in 1956; damage is difficult to estimate.—*D. B. V.*

172–26.   Tokarov, V. A.   O seysmichnosti Arktiki [The seismicity of Arctic
regions] : Akad. Nauk SSSR Doklady, v. 106, no. 5, p. 904–906, 1956.

Arctic earthquakes are for the most part shallow; deep shocks are known to
have occurred only in Kamchatka and southern Alaska.   The seismicity of the
Arctic region has remained almost unchanged during the last 50 years.   Two
periods are observed—one of 24–36 months, another of 12–19 months.   The most

seismically active zones are the Greenland Sea, and southern Alaska and Kamchatka. Activity in southern Alaska is characterized by many epicenters, at which quakes are seldom repeated. Greenland is characterized by a small number of epicenters, at which shocks occur more frequently.

The entire Caledonian zone extending from the Scandinavian Peninsula to Spitzbergen is characterized by frequent feeble shallow earthquakes. The Hercynian folding along the shore of Siberia shows insignificant seismic activity. On Polar Ural, Pay-Khoye, and the Canadian Arctic Archipelago earthquakes are unknown. The idea that the entire Arctic region is a single seismic zone does not hold. The earthquakes are predominantly tectonic, and the seismicity is different in structures of different age.—*S. T. V.*

172–27. Murphy, Leonard M., and Cloud, William K. United States earthquakes 1955: U. S. Coast and Geod. Survey, 83 p., 1957.

This is a summary of earthquake activity in the United States and regions under its jurisdiction for 1955; a listing of the non-instrumental results for all recorded earthquakes; and (in tabular form) a summary of seismological observatory and strong-motion seismograph results.—*V. S. N.*

172–28. Solov'ev, P. A. Zemletryaseniye v Tscentral'noy Yakutii [The earthquake in the central Yakutsk A. S. S. R.]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 12, p. 1507–1509, 1957.

Little information is available on earthquakes in the central part of the Yakutsk Republic, one of the least populated parts of Siberia. Two earthquakes are known, one in 1776 and the other in 1849. An earthquake of intensity 4 to 5 occurred January 29, 1956 about 60–80 km southwest of the city of Yakutsk. Inhabitants of the area reported a feeble trembling of the ground, displacements of furniture, opening of doors, and similar phenomena.—*S. T. V.*

172–29. Tamrazyan, G. P. Razrushitel'nyye zemletryaseniya Zakavkaz'ya i fazy luny [Destructive earthquakes of Transcaucasia and the phases of the moon]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 12, p. 1510–1511, 1957.

A statistical study was made of the occurrence of strong earthquakes in Transcaucasia and the phases of the moon for the period 1088 to 1950. During that time 111 earthquakes of intensity greater than 6 occurred, 66 during the new and full moon, and 45 during the first and the last phases of the moon. The ratio is 146:100. Strong earthquakes (intensity greater than 8) do not follow this rule. During the last 60 years 8 of the 11 strongest earthquakes occurred during the period of the new and the full moon and only 3 during the first and the last phases. In establishing a casual relation between the occurrence of earthquakes—that is, strong underground deformations—and the phases of the moon, the positions of the earth, the moon, and the sun must be taken into account.—*S. T. V.*

172–30. Antunes, M. T. Aspectos geofisicos do terramonto de Benavente de 23 Abril de 1909 [Geophysical aspects of the Benavente earthquake of April 23, 1909]: Lisboa Faculdade Ciencias Rev., ser. 2, B, v. 6, no. 1, p. 5–28, 1956.

The macroseismic and instrumental records of the Benavente (Portugal) earthquake of April 23, 1909 are analyzed in order to throw light on the problem

of earthquakes in Portugal and its vicinity. The epicentral coordinates and focal time are determined from P-wave arrival times at 23 stations in various parts of Europe and elsewhere as $\phi=38°56'\pm36.4'$ N, $\lambda=08°44'\pm65.7'$ W, H=17h39m36.8s$\pm$8s G. c. t. Further calculations show that depth of focus is be-. tween 15 to 31 km; magnitude=7$\frac{1}{3}$ (Gutenberg-Richter); acceleration=681 gals; energy liberated=10^{25} ergs.—$D. B. V.$

172–31. Kuo Tseng-chien. On the Shensi earthquake of January 23, 1956 [in Chinese with English abstract]: Acta Geophys. Sinica, v. 6, no. 1, p. 59–68, 1957.

The earthquake, felt over an area of more than a million square miles, is reported to have caused the loss of more than 800,000 lives and to have had an intensity at the epicenter of about 12. The depth of focus is estimated as 38 to 45 km from the radius of the felt area and intensity of the epicenter. Isoseismal lines indicate the source to be a fault dipping east-northeast and dipping toward the Wei-ho Valley. Seismicity in the area is apparently cyclical with a period of 6 or 7 hundred years; the most active period was during the 10th century. Seismicity is greater east of 108.8° east longitude.—$M. C. R.$

172–32. Morimoto, Ryōhei, Ossaka, Joyo, and Fukuda, Tomoko. Geology of Imaichi district with special reference to the earthquake of Dec. 26, 1949 (III): Tokyo Univ. Earthquake Research Inst. Bull, v, 35, pt. 2, p. 359–375, 1957.

Among the most conspicuous topographic changes in the vicinity of Imaichi, Japan, caused by the earthquake of December 26, 1949 were earthfalls and landslips in the area covered by a thick Pleistocene formation of volcanic origin; a bed of greasy white clay provided a slipping plane.—$D. B. V.$

172–33. Schwarzbach, Martin. Einige griechische Beispiele zum Kapitel: Bauweise und Erdbebenschäden [Some Greek examples of the topic: Construction and earthquake damages]: Neues Jahrb. Geologie u. Paläontologie Abh., v. 106, no. 1, p. 45–51, 1958.

Examples are cited from the Greek earthquakes of June 9, 1956 in the Aegean Sea (Santorin) and March 8, 1957 in Thessaly (Volos and vicinity) showing how unsuitable construction considerably increased the damage to buildings.— $D. B. V.$

172–34. Hsieh Yü-show. A new scale of seismic intensity adapted to the conditions in Chinese territories [in Chinese with English abstract]: Acta Geophys. Sinica, v. 6, no. 1, p. 35–48, 1957.

A new 12-degree seismic intensity scale adapted to conditions in China has been developed on the basis of field observations and historical material. Owing to lack of instrumental data, quantitative expressions such as displacements or accelerations, are not included in the scale.—$M. C. R.$

172–35. Kirillova, I. V. O periodichnosti razrushitel'nykh zemletryaseniy Kavkaza i Turtsii [On the periodicity of destructive earthquakes in the Caucasus and Turkey]: Akad. Nauk SSSR Doklady, v. 115, no. 4, p. 771–773, 1957.

A graph is constructed, from data in the literature, in which the numbers of destructive earthquakes in Turkey, the Caucasus, and China are plotted against

time. An eccentric periodicity is shown which is correlated, in another graph, with vertical crustal movements reflected in fluctuations of the level of the Caspian Sea.—*D. B. V.*

172–36. Gutenberg, B[eno]. Earthquake energy released at various depths: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 165–175, 1957.

Most energy of earthquakes is released in crustal layers above the Mohorovičić discontinuity. In the circumpacific and Alpine belts, the only zones where foci below 60±km are known, the average annual energy released in earthquakes decreases downward to a minimum near 300 km depth. Except for secondary maxima near 350 km in the Japanese area and near 400 km (from a single large shock) in the Tonga-Kermadec belt, the energy release in belts with very deep foci remains relatively small down to 500±km and increases to a secondary maximum between 550 and 650 km. Below 650 km the energy release decreases rapidly to zero below 720±km.—*Author's summary*

172–37. Scheidegger, Adrian E. Distribution of seismic faulting in the world; Geofisica Pura e Appl., v. 38, p. 1–9, 1957.

Fault plane solutions have recently been made on a sufficient number of earthquakes to allow local effects to become recognized. If a statistical analysis of 225 earthquakes whose focal mechanism is now known is made, the main conclusion obtained implies that in most regions of the world, earthquakes represent transcurrent faulting. There are exceptions to this rule in rather small areas of the world where the faulting in earthquake foci is normal-reversed rather than transcurrent. One such area is the Pamir Knot, the other Indonesia and Micronesia. No evidence can be obtained for the existence of a level of no strain. Needless to say, the generally observed transcurrency in earthquake faulting constitutes a severe difficulty in most theories of mountain building.—*Author's summary*

172–38. Gotsadze, O. D., Keylis-Borok, V. I., Kirillova, I. V., Kogan, S. D., Kukhtikova, T. I., Malinovskaya, L. N., and Sorskiy, A. A. Issledo-vaniye mekhanisma zemletryaseniy [An investigation of the mechanism of earthquakes]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 40(166), p. 1–148, 1957.

A comprehensive review of studies by the Geophysical Institute of the Akademiya Nauk since 1948 on the dislocations of the foci of earthquakes and the relation between different mechanical types of dislocations and changes in the form of seismic waves propagating through the earth—and of similar studies in other parts of the world. Two chapters cover the physical bases of the methods and applications to earthquakes in the U. S. S. R.—*S. T. V.*

172–39. Keylis-Borok, V. I. Methods and results of the investigation of earthquake mechanism (a brief information): Bur. central séismol. internat. Pubs. sér. A, Travaux sci., v. 19, no. 170, p. 383–394, 1956.

A method of determining dislocation (fault plane and motion direction) in the source of earthquakes has been worked out in the Geophysical Institute of the Academy of Sciences of the U.S.S.R., and an unambiguous solution has been obtained for about 250 sources. The method is based on the theory of elasticity as developed by V. J. Smirnov and S. L. Sobolev and involves reduction to a

homogeneous medium eliminating influence of interfaces and curvature of the ray and then solution of the simpler inverse problem for a homogeneous medium. Most of the computations can be carried out graphically with the help of special nomograms. The application of the method to deep-focus shocks in the Pacific Ocean and central Asia and to shallow-focus earthquakes in Pamir and Kopet-Dagh is discussed.—*M. C. R.*

172–40.   Usami, T[atsuo]. Effects of the shape of earthquake origin upon the displacement distribution of the initial motion: Quart. Jour. Seismology, v. 21, no. 4, p. 1–6, 1957.

Calculation of radial and tangential components of displacements of both dilatational and distortional waves in an infinite medium around a spheroidal cavity whose wall is subjected to hydrostatic pressure or normal pressure of the harmonic type indicates that: there is a possibility of observing an initial rarefaction from an explosive source; the shape of an earthquake origin so affects the displacement distribution of the initial motion that the state of the origin (shape and stress condition) cannot be uniquely determined from the displacement distribution of the initial motion; the displacement distribution of the initial motion depends largely on its period; and when a spheroidal origin becomes a string with finite length or a circular plate, the azimuthal distribution of radial displacement of dilatational deformation is expressed by P_2 (cos η) and $-P_0$ (cos η) $+3.25\ P_2$ (cos η) respectively.—*M. C. R.*

172–41.   Kasahara, Keichi. The nature of seismic origins as inferred from seismological and geodetic observations (1): Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 3, p. 473–532, 1957.

Earthquake origins have been analyzed in relation to a revised model which permits consistent interpretation of both the seismological and geodetic evidence. This paper presents the first four chapters of the work, in which are considered spectral analyses of initial motions of seismograms, wave generation from explosions, the spectrum of seismic waves and magnitude of earthquakes, and analyses of crustal deformation accompanying great earthquakes (including model experiments on horizontal faulting).—*D. B. V.*

172–42.   Veldkamp, J. Mechanism of shallow and intermediate earthquakes in Sumatra: Koninkl. Nederland. Geol.-Mijnb. Genootschap Vehr., geol. ser., pt. 18, p. 295–303, 1957.

According to Vening Meinesz' plastic buckling hypothesis, shallow earthquakes in Sumatra should be generated mainly by horizontal block movements with displacements along northwest-southeast-trending fault planes in accordance with the supposed north-northwest compressive force. To determine whether this mechanism, demonstrated in the Tapanoeli earthquake of 1892, operates in all earthquakes in the region involved, Veldkamp has investigated 14 shallow and 9 intermediate (focal depths less than 150 km) earthquakes in Sumatra. All the facts point to the existence in the crust of Sumatra of shallow stress systems in which the greatest principal normal stress is mainly horizontal and the mean direction is almost perpendicular to the axis of gravity anomalies. The stresses responsible for the intermediate earthquakes show a less systematic pattern, with great dips of the principal components. The stress systems are widely variable from one focus to another; the variations may be ascribed to different processes such as contraction or mass displacements which deform a

uniform stress distribution, or to a discharging of earthquake energy along existing fault planes deviating from the theoretical position. The mean direction of principal stress is in accordance with the plastic buckling hypothesis, but more investigations are desirable especially in other parts of the Indonesian archipelago.—*D. B. V.*

172–43. Nanney, C. A. Possible correlations between earthquakes and microseisms: Nature, v. 181, no. 4612, p. 802–803, 1958.

A statistical analysis of data on microseisms and the occurrence of some 300 earthquakes during a period of three years indicates that microseism frequency began to increase approximately 24 hours before the occurrence of many large earthquakes. The frequency increased approximately until the occurrence of the earthquake and then decreased. The amplitude of the microseism similarly increased before earthquakes and decreased afterwards. For earthquakes of magnitude 6½ or greater, the average increase in frequency was 10 percent and in amplitude 20 percent. Maximum changes of 80 percent increase in frequency and several hundred percent in amplitude have been observed. In general the increases are observed for larger and for deep earthquakes. There is some evidence for correlation between the direction of propagation of microseisms and the azimuth of the great circle path from the microseism station to the location of the impending earthquake.—*M. C. R.*

172–44. Carder, Dean S. The seismograph and seismograph station: U. S. Coast and Geod. Survey, 24 p., 1956.

This is a brochure for those wishing to install and operate or to improve a seismograph station. It reviews the selection of a station site and suitable instruments for a particular site with a discussion of instrumental data obtainable from each type of instrument. A discussion of time control is included. A complete seismograph station is described with instructions for location of instruments and a discussion of background noises. A guide to construction of seismograph equipment is given.—*V. S. N.*

172–45. Miyamura, Setumi, and Tsujiura, Masaru. UHF multi-channel radio tele-recording seismograph. Part I [in Japanese with English summary]: Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 2, p. 381–394, 1957.

A description of the construction and performance of two new sets of ultrahigh-frequency multi-channel radio tele-recording seismographs of the type RTS–II, constructed for nonattended stations for observations of local shocks. The 9 schematic diagrams and 8 photographs have English captions. Experimental data showing characteristics of the equipment will be presented in a later publication.—*D. B. V.*

172–46. Press, Frank, Ewing, Maurice, and Lehner, Francis. A long period seismograph system: Am. Geophys. Union Trans., v. 39, no. 1, p. 106–107, 1958.

A seismograph system designed to record long-period surface and body waves is described. Matched vertical and horizontal seismometers with pendulum periods adjustable for stable operation in the 10 to 30 second range drive galvanometers with 90 second periods. Recordings are made on a triple-component drum recorder. Increased magnification in the period range 20–200

seconds has resulted in seismograms containing previously unavailable information.—*W. H. J.*

172–47.   Utsu, T[okuji].   Response curves of electromagnetic seismograph (1) : Quart. Jour. Seismology, v. 22, no. 1, p. 5–18, 1957.

Tables for the calculation of the magnification and phase angle of electromagnetic seismograph (Galitzin type) are prepared.   An example of response curves is shown.—*Author's abstract*

172–48.   Omote, Syun'itiro, and Yamazaki, Yoshio.   Seven–channel triggered magnetic tape recorder for routine seismic observations : Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 3, p. 595–612, 1957.

A detailed description of a seven-channel magnetic tape recorder seismograph MATS–2, constructed and recently put into operation as part of the telerecording seismic equipment of Japan.   At present MATS–2 is being used to record seismic ground vibrations in terms of three components at two different locations.   Its photographic record has a great advantage over other types of seismic records as the paper speed is over 10 times faster than in ordinary seismometers and the consumption of bromide paper only 1/10 to 1/100 of the amount used in other types.   The taped signal is permanently available just as recorded.   A play-back coupled with a filtering circuit should be particularly advantageous for further analysis of seismic waves, and furthermore these reproducible signals will always be available for analysis by whatever new techniques may be developed in the future.—*D. B. V.*

172–49.   Shimizu, Y[asuo].   Smoking chamber for seismographic recording paper : Quart. Jour. Seismology, v. 21, no. 4, p. 15–18, 1957.

Description of a new type of gas-burner using toluene for smoking seismographic recording papers.—*Author's abstract*

172–50.   Båth, Markus, and Vogel, Andreas.   Continental dispersion of seismic surface waves : Geofisica Pura e Appl., v. 38, p. 10–18, 1957.

Continental dispersion curves for Love and Rayleigh waves have been determined from the Uppsala seismograph records of three earthquakes near the south coast of Turkey in April 1957.   The path of these waves is relatively homogeneous across the whole of continental Europe ; the range of periods is wide (3 to 86 sec for Love waves and 5 to 61 sec for Rayleigh).   The curves obtained are relevant to determinations of average structure along the path traversed in particular and to determinations of crustal structure of the European continent in general.—*D. B. V.*

172–51.   Båth, Markus.   A continental channel wave, guided by the intermediate layer in the crust: Geofisica Pura e Appl., v. 38, p. 19–31, 1957.

A new channel wave, designated Li, has been studied, using 83 observations from Swedish seismic stations, mainly of earthquakes at normal depth.   Like Lg, Li travels only through continental structures and has mainly transverse horizontal motion ; its period is only slightly longer than that of Lg.   But the velocity of Li is higher (3.79 ± 0.07 kmps) and it is believed to propagate in the intermediate layer in the crust in a manner similar to Lg in the granitic layer.   In records of near earthquakes Li is identical with S^*, just as $Lg2$ is identical with Sg. Li usually exhibits no clear dispersion.—*D. B. V.*

172–52. Ryknnov, L. N.   Izucheniye kharaktera ulyvaniya amplitud voln v zone
teni na modeli zemli [Study of the nature of the decreased amplitudes
of waves in the shadow zone on an earth model] : Akad. Nauk SSSR
Izv. Ser. geofiz., no. 10, p. 1262–1265, 1957.

The effect of the core on the amplitude of waves propagating through the
earth at epicentral distances greater than 105° was studied on a model, using
ultrasonic waves produced by a special seismoscope.   The model was a sphere,
34 cm in diameter, of a paraffin-polyethylene mixture, and contained an inner
core that could be made of materials of different mechanical properties–air, water,
or gelatine–to obtain conditions of dynamic similarity.   The first study was of the
effect of the shear modulus of the core on the waves.—*S. T. V.*

172–53. Kanai, Kiyoshi.   Semi-empirical formula for the seismic characteristics
of the ground : Tokyo Univ. Earthquake Research Inst. Bull., v. 35,
pt. 2, p. 309–325, 1957.

A semi-empirical formula for the vibrational characteristics of the ground
is obtained by adding a theoretical interpretation to observations of earthquakes
and microtremors.   The general equation thus obtained, expressing the spectral
response of ground vibration, is $U_s = (4U_0/1+\alpha)[\{1-T/T_0)^2\}^2+\{kT/T_0)^2]^{-1/2}$
where U_s=absolute amplitude of earthquake motion at free surface, U_0=absolute
amplitude of seismic waves reaching lower boundary of surface layer,
T_0=predominant period of ground, T=period of seismic waves, α=impedance
ratio of neighboring layers, and k=theoretical damping coefficient.   Most of the
observed data on earthquakes and microtremor satisfy the special case repre-
sented by the formula $U_s = (cT/0.3)[\{1-(T/T_0)^2\}^2+\{(0.2/\sqrt{T_0})(T/T_0)\}^2]^{-1/2}$
where c is a constant; the damage to buildings in the Kwanto earthquake of
1923 can be explained qualitatively by this formula.—*D. B. V.*

172–54. Omote, Syun'itiro, Komaki, Shauzow, and Kobayashi, Naoyoshi.   Earth-
quake observations in Kawasaki and Turumi areas and the seismic
qualities of the ground : Tokyo Univ. Earthquake Research Inst. Bull.,
v. 34, pt. 4, p. 335–364, 1956, and v. 35, pt. 3, p. 613–619, 1957.

A detailed study of the observations of earthquake waves at nine stations.
Areas with the "best seismic qualities" are those where there are none or only
a few meters of unconsolidated sediments.   Longer periods are associated with
larger amplitudes and approach an asymptotic ratio that coincides with the cal-
culated period of standing waves that have a mode at the lower boundary
of the alluvium.   The second part of the paper is a comparison of these results
with those observed in the Tokyo area.—*M. C. R., D. B. V.*

ELASTICITY

172–55. Balakrishna, S.   Elastic behaviour of rocks :   Current Sci., v. 26, no. 12,
p. 377–379, 1957.

The methods and results of measurements of elastic wave velocities in rocks are
reviewed briefly, with special mention of some Indian rocks.   Velocities in
Indian granites are very high compared to those in American granites—probably
because of their low porosity and high compactness and their greater age;
depth of overburden and porosity seem to control the velocity.   Velocities are
different in the Deccan traps, so systematic investigations may throw some light
on the effect on velocity of environmental conditions at the time of formation.

An unusually high velocity of the order of 7,000 m per sec was found in the Manditog marbles. Study of the deformation of marbles and other rocks will throw light on the strength of rocks. Measurement of longitudinal velocities in rocks under simple compression, in directions parallel to and perpendicular to the direction of compression up to rupture point will give us some evidence for rock deformation; such studies may suggest possible explanations of the mechanism of rock bursts.—*D. B. V.*

172–56. Zvolinskiy, N. V. Otrazhennyye i golovnyye volny, voznikayushchiye na ploskoy grantise razdela dvukh uprugikh sred. I [Reflected and head waves, originating on a plane boundary between two elastic media, pt. 1]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 10, p. 1201–1218, 1957.

A mathematical study of the behavior of seismic waves in the zone of the first arrivals of the reflected and head waves, as well as of the formation of the pattern of interfering waves produced on the background of already existing waves. The case analyzed is that of $b_1 < a_1 < b_2 < a_2$, where a_1 and b_1 are the velocities of longitudinal and transverse waves in the first medium, and a_2 and b_2 are similar velocities in the second medium.—*S. T. V.*

172–57. Zvolinskiy, N. V. Otrazhennyye i golovnyye volny, voznikayushchiye na ploskoy granitze razdela dvukh uprugikh sred, II [Reflected and head waves originating on the plane boundary between two elastic media, pt. 2]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 1, p. 3–16, 1958.

When a spherical wave arrives at the plane boundary of two media, two reflected waves (PP and PS), two refracted waves (PP_1 and PS_1), and five head waves (PPP, PPS, PSP, PSS, and PP_1S_1) are produced. An approximate description of the converted wave PS and of the head waves is given. Formulas for the head waves are obtained by a mathematical procedure based on use of the theory of the complex variable.—*S. T. V.*

172–58. Oblogina, T. I. Lokal'noye predstavleniye sistemy golovnoy i skol'zyashchey voln [Local representation of systems of head and shear waves]: Vestnik Moskov. Univ., no. 1, p. 121–128, 1956.

Near points of contact of the fronts of head waves and shear waves, the head waves may appear as plane waves. The energy of propagation of head waves depends on the relation between velocity in the upper and lower mediums, density of upper medium, duration of propagation time, and kind of impulse near the wave front.—*Author's conclusions, D. B. V.*

172–59. Riznichenko, Yu. V., and Shamina, O. G. Ob uprugikh volnakh v tverdoy sloistoy srede po issledovaniyam na dvukhmernykh modelyakh [Elastic waves in a solid stratified medium, based on investigations on two-dimensional models]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 7, p. 855–873, 1957.

Model experiments on longitudinal wave propagation in elastic stratified mediums lead to the following conclusions: a thin layer of higher velocity surrounded by a medium of lower velocity can hardly be distinguished from a free thin layer; the coefficient of emanation in a thin layer of higher velocity lying on a semispace of lower velocity does not differ from that in a thin layer underlying a layer of lower velocity, but is twice as great when the thin layer of higher velocity is surrounded on both sides by a medium of lower velocity; the velocity of head waves (P_{121}) from a thick layer of duraluminum is about 8 per-

cent higher than from a thin layer of the same material but the frequency is about 8 percent lower. For a thick layer of higher velocity the effective index of divergence is higher than that for a semispace, and the coefficient of absorption and emanation are much lower (about 15 times).

Refracted waves in a free thin layer show strong anomalous dispersion but traveltime curves of the phases are parallel to one another, and the experimental data on wave and group velocities agree well with data from Davis' dispersion curves; this anomalous dispersion is greater for the thin layer overlying a semispace than for the free thin layer (the traveltime curves show a clearly fan-shaped aspect) and group and phase velocities are lower than for the free thin layer. No comparable refracted waves were detected in the case of a thin layer of higher velocity overlain by a layer of lower velocity with an undulating free surface. Waves reflected from a thin layer of higher velocity are well shown in all profiles whereas those reflected from a thick layer appear only at small distances from the source. No steady waves with velocities intermediate between those of the higher velocity layer and the surrounding medium were detected. The wave phenomena here investigated have the same character in three-dimensions as in two, so these results may also be applied to three-dimensional cases.—*D. B. V.*

172-60. Petrashen', G. I. O nekotorykh interferentsionnykh yavleniyakh v dvukhsloynoy srede [Certain interference phenomena in a two-layer medium]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 10, p. 1219–1231, 1957.

This is a mathematical analysis of the formation of interference waves in a two-layer consisting of a thin stratum spread over an elastic semispace in rigid contact with the upper stratum. It is assumed that the source of oscillations and the measuring seismographs are placed on the upper surface of the thin stratum. Solutions are given for the coefficient of damping, for the phase- and group-velocities of the waves, and for the general properties of the generated waves in a form making possible computations with any desired degree of precision.—*S. T. V.*

172-61. Sandner, Alfred. Das Problem der seismischen Grenzschichtwelle bei der Behandlung der Wellengleichung [The seismic boundary layer problem in the treatment of the wave equation]: Freiberger Forschungshefte C 29 Geophysik, 48 p., 1956.

Sinusoidal solutions of the wave equation are derived using modern mathematical techniques (Lamb and Sommerfeld integrations and saddle-point method), giving a theoretically unambiguous picture of seismic boundary waves. Substitution for Hankel functions by their asymptotic approximations is discussed and justified; this leads to results corresponding to Cagniard's calculations in which the Hankel function does not appear at all. The formulas obtained have yet to be tested in practice. If they correspond well with measured values it would be theoretically possible to calculate depth of the boundary plane from the law of distance; if they do not agree it would mean that the equations used do not correspond to physical reality in the crust.—*D. B. V.*

172-62. Sherwood, J. W. C. Elastic wave propagation in the semi-infinite solid medium: Phys. Soc. London Proc., v. 71, pt. 2, no. 458, p. 207–219, 1958.

A simple physical picture is given of plane waves possessing complex angles of propagation, which play an important role in the theory of elastic wave

radiation. Their utility is illustrated by studying continuous sinusoidal wave propagation parallel to the unstressed plane boundary of a semi-infinite, homogeneous and isotropic solid medium. The Rayleigh and head waves being particular features of the investigation. A novel study of the field due to an impulsive force acting at a line in the surface of a semi-infinite medium indicates a general method of solving important transient propagation problems encountered in seismology. The equivalent problem of an impulsive force acting at the edge and in the plane of a semi-infinite thin sheet has been simulated experimentally by detonating small explosive charges at the edge of an aluminum sheet. The displacements detected by a condenser microphone technique are in excellent agreement with the theoretical determinations.—*Author's abstract*

172–63. Takahashi, Takehito. The dispersion of Rayleigh waves in heterogeneous media : Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 2, p. 297–308, 1957.

An equation is developed for the dispersion of Rayleigh waves in heterogeneous media, analogous to that previously developed for Love waves (see Geophys. Abs. 165–91), and the relation between Rayleigh and Love waves is investigated. The method is applicable only when the range of wavelengths in the medium varies slowly, and thus is not suitable for long waves. An essential difficulty is that the phase velocity cannot be determined uniquely from observed group velocity. If a structure of the medium fitting both Love and Rayleigh waves could be found by trial and error, the ambiguity of the dispersion curves would disappear. The solutions are essentially first terms in the asymptotic expansions for small wave length. Further approximations will be discussed later.—*D. B. V.*

172–64. Nakamura, Kohei. On Rayleigh waves propagated over the surface of a medium with elastic afterworking: Tôhoku Univ. Sci. Repts., v. 9, no. 1, p. 36–44, 1957.

The problem on the propagation of Rayleigh waves over the surface of a medium which exhibits plasticity is investigated. In the case of Jeffrey's elasticoviscous medium, the Rayleigh motion can be characterized by a nondimensional parameter $\sigma = \omega t$. In this expression τ is the time of the relaxation of the stress due to the Maxwell's flow, ω is the angular frequency. It is shown that the trajectory of a surface element during the passage of the waves is represented by a Lissajou's figure which leans slightly backward, and that the ratio of the maximum value of vertical displacement to that of horizontal displacement increases with the decrease in σ to a certain limiting value which corresponds to an incompressible medium. When we introduce, in addition to τ, a new relaxation time τ' relevant to volume change, the Lissajou's figure leans forward only if $\tau' < \tau$. The Rayleigh waves propagated over a medium with elastic afterworking, whether the imperfection of the medium is specified by one or two relaxation times, show anomalous dispersion and attenuation.—*Author's abstract*

172–65. Aki, Keiiti. Space and time spectra of stationary stochastic waves, with special reference to microtremors: Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 3, p. 415–456, 1957.

One-dimensional stochastic waves having a single velocity are analyzed theoretically in some detail, and the reasoning extended to two-dimensional waves.

The spatial autocorrelation coefficient of the filtered waves is shown to play an important role in the spectral study of stationary stochastic waves. An apparatus is described with which the value of the coefficients of a given wave can be determined, in which the vibration of each seismometer is filtered by a resonator of assigned frequency, and with which the correlation coefficient is computed automatically. The method is then applied to microtremors measured at the Geophysical Institute in Tokyo. A perpendicularly polarized wave is found to be predominant in the horizontal motion of microtremors. Identifying the horizontal motion as a Love wave gives the velocity of the S-wave at different depths. The vertical motion also shows definite dispersion, but if it is identified as a Rayleigh wave the phase velocity obtained is twice as large as that expected theoretically. Marked anomalous dispersion is found where surface soil is hard. The method will be most effective applied to microseisms, where it will clarify the wave type, direction of propagation, and structure of the medium at the place of measurement; but it can also be applied to volcanic tremors and to the coda of earthquake waves. Furthermore, epicenters of very small earthquakes can be located from a single station, from the direction of propagation determined by this method and the S–P interval.—*D. B. V.*

172–66. Kanai, Kiyoshi. The requisite conditions for the predominant vibration of ground: Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 3, p. 457–471, 1957.

Mathematical analysis of the problem of vibration of the surface layer of the ground shows that in the multi–layered case, because there is interference between elastic waves reflected from different boundaries, the spectral response of the amplitude of the surface layer is very irregular and the maximum value of the peak is not as large as in the case of a single layer; that in special cases, when all the waves reflected at every boundary arrive at the free surface in phase, the surface amplitudes may become extremely large; that extremely large amplitudes will appear at the surface even if a rigid medium exists in the surface layer or in the intermediate layer; that the predominant period of ground vibration often coincides with the natural period of the uppermost layer; and, most important, that from the point of view of earthquake–resistant structural design, the distinction between good and bad ground from the vibrational point of view may differ from that of the static (bearing power of the ground) point of view.—*D. B. V.*

172–67. Silayeva, O. I., and Shamina, O. G. Rasprostraneniye uprugikh impul'sov v obraztsakh tsilindricheskoy formy [Propagation of elastic impulses in specimens of cylindrical shape]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 1, p. 32–45, 1958.

Experiments on the propagation of elastic impulses in metallic cylinders, using the ultrasonic impulse method, showed that longitudinal waves propagate through the specimens with two velocities: that of longitudinal waves in a thin rod as a guide, or that corresponding to longitudinal waves in infinite space filled with the metal of the rod. The longitudinal wave propagating with the former velocity is produced when the ratio of the radius of the rod to its length is less than 0.17. By appropriate selection of the dimensions of the rod, it is possible to obtain either of the two velocities.—*S. T. V.*

172–68. Giese, Peter. Die Bestimmung der elastischen Eigenschaften und der Mächtigkeit von Lockerböden mit Hilfe von speziellen Rayleigh-Wellen [Determination of the elastic properties and thickness of unconsolidated ground by use of special Rayleigh waves] : Gerlands Beitr. Geophysik, v. 66, no. 4, p. 274–312, 1957.

Dispersion curves of Rayleigh waves in a medium consisting of an elastic layer overlying rigid half space are but little affected by variation of Poisson's ratio from 0.25 to 0.45 in the layer. However, the orbital motion of low-frequency waves is negative and the motion of high-frequency waves is positive, and the change from negative to positive depends on Poisson's ratio. A second method of determining Poisson's ratio is based on the fact that theoretical dispersion curves show that the difference between the phase velocity at the point of change and the limiting velocity of normal Rayleigh waves in half space decrease with increasing Poisson's ratio. The velocity of compressional and transverse waves and the depth of the elastic layer can be calculated by using the coordinates of the point of change. The solution is difficult for dipping interfaces but an approximation can be obtained by dividing the interface into steps of different depths.—*M. C. R.*

172–69. Ullman, W., and Maaz, R. Zur Frage der "scheinbaren" und "wirklichen Neigung" [On the question of "apparent" and "real slope"] : Zeitschr. Geophysik, v. 23, no. 2, p. 75–82, 1957.

For plane disturbances that can be represented by Fourier polynomials exact interpretation is given of the "apparent" and "real slope" of the surface of the earth affected by the passage of seismic waves.—*M. C. R.*

ELECTRICAL EXPLORATION

172–70. Zaborovskiy, A. I. Elektrorazvedka v SSSR [Electrical exploration in the U. S. S. R.] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 11, p. 1359–1365, 1957.

This is a brief review of the development of electric and electromagnetic methods of exploration in the U. S. S. R. The electrical method was first used in a study of the Kursk anomaly in 1920, and the success of the undertaking prompted the application of the alternating-current method elsewhere, for example, in exploration for iron ore in the Altay Mountains of western Siberia. The direct-current method was not widely used until 1927, after the Schlumberger Co. had used direct-current surveys in exploration for oil in northern Caucasus. Equipotential line and telluric-current methods have also been used, especially in exploration for sulfide ores. Electrical logging and radiowave methods are also discussed. Airborne electrical surveys are reported to be currently under study.—*S. T. V.*

172–71. Tarkhov, A. G. Ob elektrorazvedochnykh metodakh chistoy anomalii [The methods of pure anomaly in electrical exploration] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 8, p. 979–989, 1957.

During recent years a great number of different modifications of direct-current exploration were suggested. These modifications claimed greater range in depth, as well as greater resolving power, in comparison to the usual procedures. The common feature of these modifications is a sharp decrease of the intensity of the primary field at the receiving station, thus producing greater effect of the

anomalies found underground. The author argues that the utilization of this advantage is made difficult by the distorting effect of surface heterogeneities. A similar procedure in application to the induction method was suggested by several geophysicists, but has not been received favorably.—*Author's summary, S. T. V.*

172–72. Wait, James R. On the theory of propagation of electromagnetic waves along a curved surface: Canadian Jour. Physics, v. 36, no. 1, p. 9–17, 1958.

The problem of propagation of vertically polarized waves along a surface whose curvature and electrical properties have a discontinuity is considered. The mutual impedance Z between two short vertical antennas on either side of the boundary of separation is considered to be the fundamental quantity which is sought. By utilizing the principle of stationary phase and the concept of surface impedance, an approximate expression is derived for Z. It is shown that to a first order of magnitude, the effects of the conductivity contrast and curvature change are additive corrections to the mutual impedance between dipoles over a single homogeneous spherical surface.—*Author's abstract*

172–73. Enenshteyn, B. S. K metodike interpretatsii krivykh elektromagnitnykh zondirovaniy [On the method of interpreting curves obtained in electromagnetic exploration]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 12, p. 1515–1519, 1957.

A progress report on the work of the Institute of Physics of the Earth of the Russian Academy of Sciences for the U. S. S. R. on different methods of electromagnetic exploration. The next step will be the preparation of a sufficient number of master charts to be used for interpretation. A special need is felt for the method of frequency sounding, which many Russian geophysicists believe capable of replacing the most frequently used direct–current method with four electrodes. In frequency sounding method two electrodes are placed at the ends of a profile and an alternating current of varying frequency is sent through them. These electrodes are not moved, which saves much time and significantly increases the efficiency of the crew.—*S. T. V.*

172–74. Wesley, James Paul. Response of dyke to oscillating dipole: Geophysics, v. 23, no. 1, p. 128–133, 1958.

The problem of a slowly oscillating magnetic dipole in the presence of a conducting dike is considered. A first approximation of the fields generated is obtained by considering the idealized case of a dike of infinite conductivity and vanishing thickness in a vacuum. Surprisingly, this idealized problem can be solved exactly in terms of a newly discovered Green's function for Laplace's equation (in three dimensions) which is simply expressed in closed form. The magnetic scaler potential and field for an arbitrary orientation and position of the magnetic dipole are given. The results have application to prospecting for thin dikes having high conductivity when the conductivity of the earth is negligible.—*F. F.*

172–75. Wesley, James Paul. Response of thin dykes to oscillating dipole: Geophysics, v. 23, no. 1, p. 134–143, 1958.

The electromagnetic response of a dike, having a finite thickness and a finite conductivity, to a slowly oscillating magnetic dipole is considered. By a type

of analytical continuation an approximation is found that agrees with both the exact solution for a dike of infinite conductivity and vanishing thickness (see Geophys. Abs. 172–74) and with the exact solution for an infinite slab of finite conductivity and nonvanishing thickness because the dike appears as an infinite slab when both source and observer are near the dike but far removed from the edge.

The approximation is for an arbitrary orientation of the dipole, for $\sigma \omega$ either large or small and for the ratio of thickness to skin depth either large or small. A Green's function which may be differentiated to yield the magnetic fields is given. The result can be used in prospecting for dikes when the source and the observer are removed from the edge of the dike and when the conductivity of the earth is negligible.—*F. F.*

172–76.   Chang Kuan-jên.   Influence of anisotropy of horizontally stratified ground on the self-potential curve [in Chinese with English abstract]: Acta Geophys. Sinica, v. 6, no. 1, p. 77–85, 1957.

In this paper, the potential problem of a self-polarized ore-body buried in a horizontally stratified anisotropic medium has been worked out for three different cases, namely, (1) polarized vertical cylinder, (2) polarized vertical plate, (3) uniformly polarized sphere. All calculations involve the assumption that the potential solutions can be obtained by the same procedure as in the case of isotropic medium except for a transformation of coordinates and by taking $P_m = \sqrt{P_n P_t}$ as the average resistivity of the anisotropic medium.

The result shows in general a diminution of the potential values as the coefficient of anisotropy (λ) increases, and also a broadening of the potential anomaly curve by (λ) times. It illustrates the fact that with the usual method of quantitative interpretation, the depth of burial of the ore-body should be multiplied by a factor $1/\lambda$ to account for the anisotropic correction.—*Author's abstract*

Lafargue, Maurice, and Millecamps, Rolland.   On the application of an original electroacoustic method to physical and mechanical measurements in glaciology. See Geophys. Abs. 172–103.

ELECTRICAL LOGGING

172–77.   Rülke, Otto.   Die Schlumberger-Verfahren bei Bohrungen zur Unterschung von Kohlenfeldern und bei Vorbohrungen für Schachtbauvorhaben [The Schlumberger method in exploratory borings in coal fields and in preliminary borings for shaft construction purposes]: Geol. Jahrb., v. 71, p. 221–242, 1955 (1956).

A review of geophysical logging methods applicable to study of coal formations and their overburden, including the various electrical methods, temperature logging, and gamma-ray logging. A combination of several methods is more trustworthy than any single method. Resistivity logging with different electrode arrangements combined with gamma-ray logging usually prevents errors in locating coal formations. Under certain conditions these should be supplemented by microlog and caliper logging. In the overburden, a combination of microlog, resistivity and gamma-ray logging is particularly advantageous. Several examples of logs obtained in coal and lignite areas are presented and interpreted.—*D. B. V.*

172–78. Polak, L. S.   O nekotorykh svyazyakh koeffitsienta memsrannoy e. d. s. i anomaliy PS s fizicheskimi svoystvami kollektorov [On some relations between the coefficient of the membrane e. m. f. and the self potential anomalies with the physical properties of the collectors] : Prikladnaya geofiz., no. 16, p. 227–234, 1957.

In an electrochemical study of phenomena observed during electric logging of drill holes in the Ural-Emba region the following correlation coefficients were obtained between the coefficient of the membrane e. m. f. and the amount of the argillaceous material in sands and sandstones, as high as 0.88; between the coefficient of the membrane e. m. f. and the porosity of the sands and sandstones as high as 0.73; between the coefficient of the membrane e. m. f. and the mean hydraulic radius of the pores, 0.60; between the coefficient of the membrane e. m. f. and the average specific surface of granular rocks, 0.40; between the degree of anomaly on the self potential curve and the content of the argillaceous fraction of sands and sandstones, 0.65. The argillaceous fraction can be determined on the basis of the self potential anomalies with an error of not more than 30 percent.—*S. T. V.*

172–79. Fatt, I.   Effect of overburden and reservoir pressure on electric logging formation factor : Am. Assoc. Petroleum Geologists Bull., v. 41, no. 11, p. 2456–2466, 1957.

Electrical resistance of 21 brine-saturated reservoir sandstones was measured at various internal and external pressures. The resistance, and therefore the electric logging formation factor, increased with increase in the difference between the external and internal pressure. The exponents and coefficients in the Archie and Winsauer relations between formation factor and porosity were found to be functions of this difference in pressure. For a given sandstone, formation factor increases more rapidly with decrease in porosity during compression than would be expected from the average line through the formation factor versus porosity data for the 21 core samples.—*Author's abstract*

ELECTRICAL PROPERTIES

172–80. Parkhomenko, E. I.   P'yezoelektricheskiy effekt gornykh porod [The piezoelectric effect in rocks] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 12, p. 1535–1536, 1957.

A laboratory investigation established that a piezoelectric effect can be produced by granite, gneiss, and quartzite if these quartz granules are oriented in a definite manner. Generation of the electromotive force was also observed. One modification of quartz gave piezoelectric textures denoted in crystallography by ∞ and $\infty : 2$; other quartz form produced the type $\infty : m$. Methods of measuring the piezoelectric moduli in the case of longitudinal and transverse compression have been worked out. In pieces of rocks of about 10 cm^3 volume the piezoelectric effect can be produced evidently at the expense of imbedded granula of quartz. Experiments on models of granite have shown the generation, besides an elastic wave, of two electromagnetic waves with different velocities of propagation. It is suggested that the results can be applied in the study of the physics of earthquakes and in exploration by seismic and electrical methods.—*S. T. V.*

172–81. Wait, James R., Frische, Richard H., and Buttlar, Haro von. Discussion on a theoretical study of induced electrical polarization: Geophysics, v. 23, no. 1, p. 144–153, 1958.

Discussions on the paper by Frische and von Buttlar, 1957—Geophys. Abs. 170–129, are in agreement that a contribution has been made by Wait's suggested experimental method for measuring the induced polarization ratio $\Delta\phi/v$ of a two-layer flat earth containing an aquifer. There is disagreement on whether or not the aquifer is a "linear medium" and whether the "dielectric constant" of the aquifer is of the order of unity or of 10^5.—*F. F.*

172–82. Kudymov, B. Ya., and Kotov, P. T. Sravnitel'nyye issledovaniya vyzvannoy polyarizatsii osadochnykh gornykh porod [Comparative investigations of induced polarization of the sedimentary rocks]: Prikladnaya geofiz., no. 16, p. 213–226, 1957.

Repetition of some laboratory experiments on induced polarization many times give contradictory results in spite of extreme precautions. Induced polarization is influenced by the chemical nature of the materials involved and by their physical condition. Results of these experiments differ in many points from those obtained previously by V. N. Dakhnov and his coworkers.—*S. T. V.*

EXPLORATION SUMMARIES AND STATISTICS

172–83. Reyre, D., and Vallet, J. M. Étude de dômes de sel au Gabon (Afrique Équatoriale Française) [Study of the salt domes in Gabon (French Equatorial Africa)]: Geophys. Prosp., v. 6, no. 1, p. 58–74, 1958.

Case histories of two typical salt domes in western Gabon: the N'Daminzé done in the zone of savannas, and the Ouzouri in the Ogooué delta. Because of scarcity of outcrops geophysical exploration has been particularly valuable. Anomalies first revealed by gravity surveys were investigated further by telluric and seismic methods. In the N'Daminzé region, contours on a shallow reflecting horizon show a major structural depression at Lake N'Daminzé and a minor one at Lake N'Goleu, both corresponding to positive telluric and negative gravity anomalies as well as to the topography of the region. The telluric results do not coincide perfectly with the others, however; in the gravity survey, the effect of the Cirques series (kaolinitic sands filling the depression created by solution of the top of the salt diapir) is merely added to that of the salt, whereas the telluric survey is affected by local variations in thickness of the Cirques series whose resistivity is 30 to 40 times greater than that of the subjacent Cretaceous and which, in the depression, lies directly on the cap rock of the salt. At Ouzouri the seismic survey was carried on under extremely difficult conditions due to the swampy nature of the terrain; marine and fluvial equipment was used as well as land equipment. The results show a gentle somewhat faulted high, trending northwest-southeast. The gravity anomaly is weak, being due to the salt alone. The nature of the diapirism is quite different from that at N'Daminzé.— *D. B. V.*

GENERAL

172–84. Kailasam, L. N. The use of geophysics in prospecting for metallic ores: Indian Mining Jour., v. 5, no. 10, p. 63–75, 81, 1957.

A discussion of the application of geophysical methods to prospecting for metallic ores that includes an explanation of principles underlying the various geo-

physical methods and instruments, especially the magnetic and electrical methods. Careful evaluation of geological conditions before selecting a geophysical method of investigation is emphasized.—*V. S. N.*

172–85. Nieuwenkamp, W. Petrography and geophysics: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 231–237, 1957.

That petrography can profit from cooperation with geophysics and physical chemistry is illustrated by the work of Bowen. His findings concerning the eutectic compositon of igneous rocks consisting mainly of quartz and feldspar indicate that a melt must have been present, which necessarily originated through fusion of pre-existing rocks. Migmatitic phenomena are easily explained along these lines. Derivation of basaltic magma from the peridotite mantle works satisfactorily only if convection currents provide fresh peridotite at times in the uppermost layer of the mantle.—*D. B. V.*

172–86. Akademiya Nauk SSSR. Sovetskaya geofizika k sorokaletiyu Velikoy Oktyabr'skoy sotsialisticheskoy Revolyutsii [Soviet geophysics at the fortieth anniversary of the great October socialist revolution] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 11, p. 1313–1322, 1957.

An editorial article as a contribution to the celebration of the 40th anniversary of the revolution of October 25, 1917. The role of the Communist party and the party membership of individual Russian scientists are emphasized.—*S. T. V.*

GEODESY

172–87. Heiskanen, W. A. International co-operation in physical geodesy: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 177–181, 1957.

No country, no matter how large, can alone solve the problem of the shape of the earth; but any country, no matter how small, can give invaluable contributions to physical geodesy, such as: selection of points where the geoid distance and components of deflection of the vertical are needed; carrying out local gravity surveys to distances of 20 to 40 km around these points (this is most important and too often neglected) ; computing local topographic corrections of gravity anomalies; making regional gravity surveys at intervals of 5 to 15 km along roads and railways or other places where elevations are known; making underwater gravity surveys in lakes and coastal waters; making various local observations and computations; and making theoretical studies of the gravimetric method.—*D. B. V.*

172–88. de Graaff-Hunter, J[ames]. Gravity anomalies in relation to level: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 149–155, 1957.

The deduction, from observations of gravity at a single point P_1 at the earth's surface, of the gravity anomaly at a point P_2 at another level on the same vertical cannot be made with useful precision owing to the fact that the mean curvature of the actual gravity isopotential surfaces ("geops") between P_1 and P_2 cannot be found. Even that for the geop through P_1 at ground level is generally unknown and difficult to obtain. Such observation of g will however, give the local anomaly at P_1 in relation to a three-dimensional reference system, which can have useful significance. Indeed the anomaly at ground level has greater practical value and convenience than what can be inferred for another level by use of speculative

assumptions involving unknown underground densities. On the other hand, if surface observations are sufficient to yield an adequate representative value of anomaly at ground surface, it is possible to derive the generalized anomaly at another level in a form suitable for application in the Stokes integral for N_1, the rise of the local geop above the corresponding reference "sherop" (iso-spheroidal potential), that is at P_1; and from that the value of N at other levels on the same vertical can be found quite easily.

Accordingly it is recommended that the family of sherops, of the same potentials as corresponding geops, be used as a reference system for γ (the theoretical or spheroidal value of gravity) at all levels. From this, anomalies of both force and direction of gravity at any ground surface point may be expressed independent of speculative assumptions or hypotheses. The necessary formulas are given. The anomalies apply to ground level, and are based on data in the form of potential difference from geoidal level, a quantity which can be deduced from spirit-levelling and gravity observations at the surface without any need for hypothesis.—*D. B. V.*

172–89. Bendefy, László. Módszer szintváltozások abszolút mértékének meghatározására 1. Kozlemény [Method for determination of the absolute measure of level-variations. Part 1] : Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, v. 5, no. 4, p. 15–20, 1956.

A method is proposed which eliminates sources of error inherent in the usual application of heights above sea level from adjusted networks in investigations of variations in level. The new method consists of examining the difference in elevation between two levelling base points rather than the variation of elevation at every point. It is more laborious but yields absolute values. Orthometric or dynamic corrections are not required, and as the question of differences in base levels between different networks does not enter, the method is eminently suitable for geokinetic examination of levelling networks in international situations.—*D. B. V.*

172–90. Bonchkovskiy, V. F., and Karmaleyeva, P. M. Issledovaniye vliyaniya krucheniya nitey na pokazaniya mayatnikov naklonomerov [Investigation of the effect of the twisting of strings on the indications of the pendulums of inclinometers] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 9, p. 1181–1184, 1957.

A theoretical and experimental investigation of the effect of twisting of strings supporting the pendulum of the inclinometer on its readings became necessary, because quite often discrepancies were observed between the readings of two instruments installed in parallel positions. A theoretical analysis of the functioning of the instrument, provided with a Zelner's suspension, has shown that the twisting of the supporting strings cannot have any serious effect on the readings of the inclinometer. To confirm this conclusion a calibration was made of two inclinometers on a measuring plate of rigid construction capable to be inclined through a precisely measured angle with high accuracy. These experiments have shown that in an inclinometer provided with steel spring of 0.1 mm diameter the error of the measurements is equal to ±0.05 sec. This is the limit of accuracy of the calibrating plate. If the diameter of the spring is made equal to ±0.2 mm, the error of the readings becomes equal to ±0.20 sec. The calibration was done also after the strings were twisted through an angle from −360° to +360° with similar results.—*S. T. V.*

17291. Hédervári, Péter. A hold tágulásának morfológiai bizonyitékai [Morphological proofs of the expansion of the moon]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, v. 6, no. 3–4, p. 9–17, 1957.

Examination of various rifts, fracture systems, valleys and other surface features of the moon strongly suggests deformation due to expansion, and thus indirectly supports the theory of expansion of the earth.—*D. B. V.*

GEOTECTONICS

172–92. Stovas, M. V. Neravnomerost' vrashcheniya Zemli, kak planetarno-geomorfologicheskiy i geotektonicheskiy faktory [Irregularity of the earth's rotation as planetary-geomorphological and geotectonic factor (in Ukrainian with Russian summary)]: Akad. Nauk Ukraynskoy RSR Geol. Zhur., v. 17, no. 3, p. 58–69, 1957.

Rotation of the earth determines its ellipticity and is shown to be a principal factor in determining its geomorphology on a planetary scale. Irregularity in rotation produces changes in the potential of forces of deformation; together with the effect of precession of the critical parallels, changes in internal constitution, and denudation of the surface, it determines the structural plan of the surface figure of the earth for geologic time.—*Author's summary, D. B. V.*

172–93. Egyed, László. The role of tectonics and morphology in the development of the drainage pattern: Gerlands Beitr. Geophysik, v. 66, no. 4, p. 271–273, 1957.

In the Esztergom basin of Hungary, an area of about 60 sq. km, the directions of buried structure (as represented by gravity contours) and surface morphology (determined from analysis of 50-meter isohypses) do not coincide. The directions of drainage patterns contain two maximums which correspond to both structure and morphology; apparently deep structural movements and morphology are both important in development of the drainage pattern. The sense of rotation from present day morphology to basement relief conforms to the trend of pole shifts reported by Irving.—*M. C. R.*

172–94. Hess, H. H. The Vening Meinesz negative gravity anomaly belt of island arcs 1926–1956: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 183–188, 1957.

Recent knowledge that the oceans have a crust of 5 km of basalt requires modification in the quantitative values of the tectogene concept but hardly changes the essential structural picture; in fact, the new understanding of the crust gives a simpler picture with more precise values for densities and thicknesses, and puts the tectogene concept on a firmer basis. Hess challenges the Lamont group's interpretation of the Puerto Rico trench (see Geophys. Abs. 163–257) which casts doubt on the hypothesis. Pressure at the base of the standard oceanic column is more than 1,000 kg per cm^2 less under the trench than under a normal oceanic column, which can only mean that the trench is far out of isostatic equilibrium, as the isostatic anomalies also suggest. But if it were being pulled apart it could hardly depart much from floating equilibrium. Under compression the explanation is simple; the forces acting on the column beneath the trench have a vertical component acting downward in such a way as to equal the 1,000 kg per cm^2 deficiency, establishing a dynamic

(but not isostatic) equilibrium. Viscous drag of currents in the mantle is one possible explanation of such a force.—*D. B. V.*

Vening Meinesz, F. A. Instability in the earth's mantle because of the phase-transition-layer. See Geophys. Abs. 172–143.

172–95. Runcorn, S. K[eith]. Convection currents in the mantle and recent developments in geophysics: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 271–277, 1957.

It is deemed reasonable to suppose that the polar wandering inferred from paleomagnetic studies has an origin below the crust. Convection currents postulated as the cause must be asymmetrical but perhaps the distribution of continents and oceans suggests a deep-seated asymmetry in the mantle. Paleomagnetic data suggest that continental drift has taken place as well. No plausible mechanism has as yet been advanced for continental drift, perhaps because our geophysical earth models are too simple and restrictive; until a physically plausible set of motions below the crust is postulated, however, a physical theory of continental drift can hardly be framed. Convection cells in the mantle will produce steady (d-c) currents at the surface which in principle could be detected. Thermoelectric forces could be set up at surfaces of discontinuity of chemical composition or physical properties, such as the Mohorovičić discontinuity at about 40 km, and the 20° discontinuity between 300 and 1,000 km.—*D. B. V.*

172–96. Stille, Hans. "Atlantische" und "pazifische" Tektonik ["Atlantic" and "Pacific" tectonics]: Geol. Jahrb., v. 74, p. 677–686, 1957.

The first part of this paper is devoted to critical remarks on the concept of "Atlantic" and "Pacific" tectonics. The Pacific Ocean region is in an early stage of geotectonic development, the Atlantic in a late stage. The evolution of the former is nothing more than alpinotype, the latter germanotype; the circumatlantic features present the normal picture of geotectonic development in which alpinotype mountain building has been overtaken by germantoype. In geomagmatic development also, the circumpacific area lags behind the circumatlantic. The second part of the paper deals with compensation tectonics, in which the Pacific features have been of a greater order of magnitude than the Atlantic features from the time of the "Algonkian Umbruch" when the primary geosynclines were formed around the peripheries of the two oceans, through subsequent folding, to recent tectonics.—*D. B. V.*

172–97. Glennie, E. A. Plastic buckling in the Indian Peninsula and Ceylon: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 117–123, 1957.

The "modified topographic" gravity anomalies (see Geophys. Abs. 172–121) are calculated for the region including the Indo-Gangetic alluvial plains, the Salt Range and Potwar Plateau in the north, and the whole of Peninsular India and Ceylon together with their continental shelf. On the broad assumption that those anomalies are due solely to the gravity effect of deep-seated buckling of the Mohorovičić discontinuity, a contour map of the surface of the mantle is drawn showing the topography between 25 and 40 km below sea level. It is shown that in the southern two-thirds of Peninsular India and Ceylon there is a typical series of buckling lines superimposed on a downwarp, the whole representing a striking and complex system of plastic buckling.—*D. B. V.*

172–98. Fowler, Phillip. Faults and folds of south-central Texas: Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 37–42, 1956.

In south-central Texas, two types of deformation are observed that were contemporaneous in late Cretaceous and early Cenozoic time: great belts of normal faults, striking northeastward, in the San Marcos arch area representing superficial crustal extension in the subsiding Gulf coastal plain; and gentle southeast-plunging folds in the Upper Rio Grande embayment, belonging to the Sierra Madre Oriental orogenic province of northeastern Mexico, representing superficial shortening of the crust.—*V. S. N.*

172–99. Humphrey, William E. Tectonic framework of northeast Mexico: Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 25–35, 1956.

The tectonic framework of northeast Mexico is a southward extension of the pre-Tertiary composition of the southern United States modified by differential deformation of distinct Mesozoic sedimentary areas by the Laramide revolution.—*V. S. N.*

172–100. Woods, R. D. The northern structural rim of the Gulf Basin: Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 3–11, 1956.

A series of Paleozoic tectonic elements rims the Gulf of Mexico basin and has influenced the shape, sedimentary facies, and structural features of the basin for a large part of its history. The northern rim, the exposed southern Appalachians and the largely buried structural belt here called Llanoria but also known as the Ouachita system is the only part known in detail. The Llanoria belt has recently been mapped by studies of metamorphic facies which show metamorphic patterns similar to those characterizing the Appalachians and mark comparable structural zones. Regional gravity profiles across the two belts are also similar. Further study is needed, however, for complete understanding of the relation between Llanoria and the Appalachian and other Paleozoic structures.—*V. S. N.*

172–101. Muehlberger, William R., and Kurie, Andrew E. Fracture study of central Travis County, Texas, a preliminary statement: Gulf Coast Assoc. Geol. Soc. Trans., v. 6, p. 43–49, 1956.

A study of faults and shear joints within the Balcones fault zone along the outcrop of the Austin group south from Austin, Tex., shows a decrease in importance of shear fractures from Austin west onto the Edwards Plateau and south toward the San Marcos Arch. This decrease is thought to reflect the increasing stability of the underlying basement as the Texas craton is approached from the Ouachita foldbelt.—*V. S. N.*

172–102. Blanchet, P. H. Development of fracture analysis as exploration method: Am. Assoc. Petroleum Geologists Bull., v. 41, no. 8, p. 1748–1759, 1957.

Fracture analysis is based on the premise that the earth's crust is systematically fractured and that this fracturing can be recognized and analyzed on aerial photographs. This fracturing is due to external forces which have been active throughout geologic time. Four sets of fractures arranged in two groups of two, the orientation of which is regionally systematic, have been found in all areas studied. The local deviations in the statistical mean direction of the fracture

sets, when measured and analyzed, are found to be related to structure or stratigraphic anomalies.—*Author's abstract*

GLACIERS

172–103.   Lafargue, Maurice, and Millecamps, Rolland. Sur l'application d'une méthode électroacoustique originale à des mesures physiques et mécaniques de glaciologie [On the application of an original electroacoustic method to physical and mechanical measurements in glaciology] : Acad. Sci. Paris Comptes Rendus, v. 246, no. 6, p. 970–973, 1958.

Measurements of ice deformation were made on the Mer de Glace in the Alps in the summer of 1957 using a new electroacoustic apparatus. Four holes 150 m deep and 8 cm in diameter were drilled in the ice, delineating a vertical prism 10 m square at the base. In these holes 56 piezoelectric ceramics were anchored to the walls at 10–meter intervals beginning from the surface. Distances between these ceramics can be calculated with an accuracy of ±1 to 2 percent from the propagation time of an ultraacoustic wave from one to another; the sending and receiving apparatus are described briefly. Variations of velocity of the signals is of the order of 20 percent for an ice thickness of 50 m, showing that compressibility changes with depth; this is compatible with the idea of those authors who suggest an increase in coefficient of elasticity with depth. Quantitative results will be presented in later publications.—*D. B. V.*

GRAVITY

172–104.   Haubrich, Richard A., Rose, John C., and Woollard, G[eorge] P[rior]. A method for the measurement of absolute gravity: Am. Geophys. Union Trans., v. 39, no. 1, p. 27–34, 1958.

The greatest difficulty in measurements of absolute gravity with either pendulums or falling bodies is the distance determination. It is proposed to avoid the distance measurement in a falling-body experiment by determining g in terms of c, the velocity of light. A pulse of light is directed up toward and reflected from a falling ball. The reflected light pulse, upon being detected by a photomultiplier, initiates a new pulse. A pulse recycle oscillator is thus set up whose frequency is a function of the position of the ball. By measuring the frequency for three successive time intervals, g may be determined in units of c independent of the time and position at the release of the ball.—*Authors' abstract*

172–105.   Romanyuk, V. A. Opredeleniye sily tyazhesti na more mayatnikovym sposobom, III [Determination of gravity at sea by the pendulum method, pt. 3] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 1, p. 54–64, 1958.

In this last of three articles the differential approximate equations for the motion of the inclinometer and accelerometer are derived, and solutions containing second-order terms are obtained. Limits of admissible errors in the measurement of the components of acceleration and of the inclination of the supports as function of their magnitude are also determined and some practical examples are included. It is concluded that pendulum measurements can be made on ships above the water when the accelerations of the ship do not exceed

20 gals. If the accelerations are greater, then it is necessary to determine the acceleration of the ship and the inclination of the pendulum installation. The damping attachment of the pendulum installation must be made independent of the motion of the ship. (For previous papers on this investigation see Geophys. Abs. 170–167 and 168.)—*S. T. V.*

172–106. Lambert, Walter D. Simple approximate formulas for gravity and geopotential at high elevations: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 197–202, 1957.

Approximate formulas are derived for gravity and geopotential at high elevations, that is, at elevations for which the term h^3 is appreciable (40 km or more). For results correct within a milligal or two, a slight further correction is needed beyond 100 km. Only the normal values of gravity and geopotential are considered, not the effect of anomalies at the earth's surface on gravity in outer space.—*D. B. V.*

172–107. Cassinis, G. On the use of the geographical network for reductions of gravity measurements: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 43–47, 1957.

When using average height maps for computing gravity reductions it is necessary to use the "absolute" geographic network (having its poles in the poles of the earth and thus not dependent on the position of the gravimetric stations), rather than the "relative" network at each station as suggested by Hayford. Because the analytical and numerical problem then becomes somewhat complicated, it is suggested that the time has come to prepare a system of "absolute" numerical tables. A suggested procedure for drawing up such tables is outlined.—*D. B. V.*

172–108. Baeschlin, C. F. Einheitliche Zonen- und Sektoren-Einteilung für alle Arten der Berechnung des Einflusses der Topographie und der isostatischen Kompensation [Schwerereduktion, Lotabweichung und Potential (Bowie-Effekt)] [Uniform zone and sector subdivision for all types of calculation of the effect of topography and isostatic compensation; Gravity reduction, deflection of the vertical and potential (Bowie effect)]: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 1–11, 1957.

The advantages of having one set of tables from which gravity reductions, Bowie effect, and the components of the deflection of the vertical could be calculated from a single reading of mean altitude, are put forth. This could be accomplished by choosing suitable uniform zone and sector subdivisions of the earth and would necessitate recomputing reduction tables. Baeschlin has proposed that the International Association of Geodesy test the feasibility of the proposal by having student groups test the question carefully.—*D. B. V.*

172–109. Steiner, Ferenc. A magassági korrekció koefficiensének meghatározása gravimeteres méréseknél [Determination of the coefficient of altitude correction in gravimeter measurements]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, v. 6, no. 3–4, p. 45–52, 1957.

A method is developed—based on Egyed's extension of Nettleton's method (see Geophys. Abs. 165–172)—for calculating the coefficient of altitude correction

and mean density in gravimeter measurements. The basic assumption is that the four points of the anomaly surface forming a (convex) quadrangle lie approximately in the same plane. An example is given of its application, and the change in mean density with altitude is determined for the area.—*D. B. V.*

172–110. Shalaev, S. V. Opyt vychisleniya potentsial'noy funktsii v nizhney poluploskosti po yeye znacheniyam, zamerennym na poverkhnosti zemli [Attempt at computation of the potential function in the lower half-plane from its values measured on the earth's surface] : Akad. Nauk SSSR Doklady, v. 117, no. 3, p. 403–406, 1957.

Formulas are derived for computing the gravity or magnetic potential function in the lower half-plane from values measured at the surface, and their use is illustrated by an example from the Kursk magnetic anomaly.—*D. B. V.*

172–111. Celmiņš, Aivars. Direkte Verfahren zur Auswertung von Schweremessungen bei zweidimensionaler Massenverteilung [Direct method of evaluating gravity measurements for two-dimensional mass distribution] : Geofisica Pura e Appl., v. 38, p. 81–122, 1957.

A method is given for direct determination of underground masses causing gravity anomalies, in which the unknown density is not assumed to be concentrated in a horizontal plane, as is usually done; thus the method can be applied in cases where the largest dimension of the disturbing body is the vertical one, and, further, can take into account changes of density with depth. Some new possibilities of estimating the boundaries of a mass from the anomaly where density is known are also considered. The uniqueness of the solution is treated, leading to a uniqueness theorem that minimizes the number of possible solutions. By way of illustration the suggested new methods are applied to several examples: horst, graben, salt dome, and fault.—*D. B. V.*

172–112. Goguel, Jean, and Lemoine, Jeannine. Étude de l'atténuation de l'influence des anomalies superficielles dans le calcul de la dérivée seconde de la gravité [Study of the attenuation of the influence of shallow sources in the calculation of the second derivative of gravity] : Geophys. Prosp., v. 5, no. 4, p. 407–420, 1957.

The second derivative of gravity is accurately computed for an isolated mass and for a homogeneous half plane. The results are used to point out the particular smoothing qualities of approximation methods that use a finite number of grid points. This procedure may be used in choosing a second derivative computation method which has selective smoothing qualities. An appended discussion by V. Baranov gives a mathematical analysis of the results.—*M. F. K.*

172–113. Chastenet de Géry, Jérôme, and Naudy, Henri. Sur l'interprétation des anomalies gravimétriques et magnétiques [On the interpretation of gravity and magnetic anomalies] : Geophys. Prosp., v. 5, no. 4, p. 421–448, 1957.

Two types of master curves are proposed for the interpretation of gravity and magnetic anomalies (aeromagnetic and ground magnetic). The first set of curves applies to the vertical gradient of gravity and to the similar gradient obtained by reducing magnetic values to the magnetic pole. The second set of curves can be applied directly to magnetic anomalies. The features of the method are discussed and several examples of application are given.—*M. F. K.*

172–114. Lejay, Pierre. Remarques sur la précision et les applications des anomalies gravimétriques à la surface des océans [Remarks on the precision and the applications of gravimetric anomalies at the surface of the oceans] : Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 215–221, 1957.

Although gravity measurements at sea are made in the immediate vicinity of the geoid, the imperfectly known topography and composition of the ocean floor pose even greater problems than unknown densities do on land. This paper analyzes the question in an attempt to determine to what extent and in what form the results are usable.—*D. B. V.*

172–115. Barta, György. A gravitációs tér időbeli változásaról [Concerning the periodic variations of the gravitational field] : Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, v. 5, no. 4, p. 7–13, 1956.

In the first part of this paper attention is drawn to the possibility of inferring past variations of the earth's gravity field from the variation of mean annual sea level, and even of determining movements of the core relative to the crust from worldwide maregraph data. In the second part the gravitational variation cause by migration of masses due to meteorological phenomena is calculated to be 0.1 mgal at the maximum.—*D. B. V.*

de Graaff-Hunter, J[ames]. Gravity anomalies in relation to level. See Geophys. Abs. 172–88.

172–116. Okuda, Toyozo; Inoue, Eiji; and Suzuki, Hiromiti. Determination of the differences in gravity values at the Coast and Geodetic Survey (C&GS), the National Bureau of Standards (NBS), Washington, D. C., and the Geographical Survey Institute (GSI), Chiba, Japan: Geog. Survey Inst. Japan Bull., v. 5, pt. 1–2, p. 1–12, 1957.

The differences in gravity values at C&GS, NBS, and GSI, determined by means of a Geographical Survey Institute Pendulum apparatus, are as follows: g C&GS—g GSI=+329.8±0.3 mgal and g NBS—g GSI=310.4±0.3 mgal.

The GSI pendulum apparatus and the three gravity stations occupied are described; the gravity observations made and the calculations to determine differences in gravity values are also given.—*V. S. N.*

172–117. Weelden, A. van. History of gravity observations in the Netherlands: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 305–309, 1957.

This note accompanying the Bouguer gravity map of the Netherlands (1:500,000, isogam interval 2 mgal) includes an outline of the history of the gravity observations from which the map was compiled, and mentions the accuracy (overall, better than ±2 mgal, probably better than 1 mgal), the isostatic correction (with a table of 18 isostatically corrected points), and the international reference gravity value used (new De Bilt value, 981.269).—*D. B. V.*

172–118. Bott, Martin Harold Phillips, and Masson-Smith, David. The geological interpretation of a gravity survey of the Alston block and the Durham coalfield: Geol. Soc. London Quart. Jour., v. 113, pt. 1, p. 93–117, 1957.

The Bouguer anomaly map of the Alston block is dominated by a large nega-tive anomaly. Detailed physical and geological interpretation uphold the earlier conclusion that this anomaly is caused by an unexposed granite. The shape of the gravity anomaly has a close resemblance to the mineralized zones and the volatile content of the coal seams. The anomaly decreases across the Stublick fault system and across the Butterknowle fault as a result of thickening of the Lower Carboniferous rocks. A study of the background Bouguer anomaly sug-gests a North Pennine crustal mass deficiency in addition to the granite. It is considered that the granite mass deficiency, if accompanied by an additional crustal deficiency, could account isostatically for the present North Pennine up-lift, and for the general stability since the Lower Carboniferous.—*M. C. R.*

172–119. Bollo, Robert, Goguel, Jean, and Jaeger, Jean-Louis. Sur quelques anomalies gravimétriques en Bretagne [On some gravimetric anom-alies in Brittany] : Acad. Sci. Paris Comptes Rendus, v. 246, no. 4, p. 622–624, 1958.

In the gravity survey of Brittany now in progress, four areas show anomalies that cut across regional geologic trends. These occupy relatively small areas, are elongated in a north-south or north–northwest-south–southeast direction, and are characterized by very rapid decrease in g (6 to 8 mgal per km). They seem to coincide with the Tertiary formations that crop out sparingly. It is sug-gested that they indicate narrow local Tertiary basins, perhaps grabens, contain-ing greater thicknesses of light sediments than has been recognized from the limited outcrops.—*D. B. V.*

172–120. Goguel, Jean. Gravimétrie et fossé rhénan [Gravimetry and Rhine graben] : Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 125–147, 1957.

Gravity profiles across the Rhine graben are compared with theoretical pro-files calculated according to two different views of the deep structure of the graben (tension versus compression faulting). In the northern part, the hypoth-esis of regional isostatic compensation combined with rupture due to tension best explains the characteristics of the graben, including the thickness of Tertiary deposits accumulated during subsidence and the observed gravity values. The hypothesis of rupture by compression seems to be less satisfactory as it does not account for the subsidence. The uplift of the Hautes Vosges and Black Forest is not a simple opposite motion to the subsidence of the Rhine graben but rather a counter-stroke of Alpine movements.—*D. B. V.*

172–121. Glennie, E. A. Gravity data and crustal warping in northwest Paki-stan and adjacent parts of India : Royal Astron. Soc. Monthly No-tices, Geophys. Supp., v. 7, no. 4, p. 162–175, 1956.

Gravity data are used to investigate the geologic structure of an area of about 160,000 mi [2] in northwestern Pakistan and India, in the light of the crustal warp-ing hypothesis. A new anomaly, the "Modified Topo Anomaly", leads automati-cally to the detailed contouring of the basement, which is assumed to be the up-per surface of the crust. The basement contours show a ridge about 300 miles long separating the Indus Basin from the Lahore Basin, hidden by alluvium ex-cept for a few outcrops near the northern end. This ridge has apparently suf-fered subaerial erosion under typical monsoon conditions, extending in places to more than 3,000 ft below sea level. Contoured charts show the simple crustal

upwarp underlying the ridge and the eroded basement surface. A deep valley with its bottom far below sea level cuts through the ridge. In Sind a similar valley leads from the direction of the sea to the Indus Basin but the interpretation here is uncertain. It is concluded that the hypothesis yields results giving depths to the basement of the right order in deeply downwarped areas, but in upwarped areas erosion and other concealing factors lead to uncertainty of interpretation unless the area includes a complete section of the upwarp.—*D. B. V.*

172–122. Chirvinskaya, M. V. Kharakteristika skladchatykh i razryvnykh dislokatziy osadochnoy tolshchi Dnepro–Donetskoy vpadiny po dannym geofiziki [Characteristics of folded and discontinuous dislocations of the sedimentary layer of the Dnieper–Donetz depression according to geophysical data] : Akad. Ukraynsk SSR Inst. geol. Nauk Trudy, ser. geofiz., no. 1, p. 21–35, 1956.

The Dnieper–Donetz region has been studied by many geologists because of its great industrial value, and several geologic profiles of the area have been constructed. Recent extensive gravimetric and magnetic surveys in search for oil have been used to complete the geologic description of the area. The most important newly established feature is the existence of several faults and the presence of several salt domes amidst these faults which are of different ages.—*S. T. V.*

172–123. Liogen'kiy, S. Ya. O plotnosti porod rud Rudnogo Altaya [On the density of rocks and ores of the Rudniy Altay] : Akad. Nauk SSSR Doklady, v. 117, no. 3, p. 476–478, 1957.

The results of density determinations on thousands of samples representing eight different rocks and ores of the Rudniy Altay are tabulated and discussed briefly. The densest is a lower Paleozoic metamorphic schist (2.8–2.9 g per cm^3) that forms the core and limbs of the Aleyskiy anticlinorium. The large Aleysko-Rubtsovskaya gravity anomaly is related to the eroded outcrop of these rocks, and there is a large negative anomaly in the Gorniy Altay and Kalba-Narymskoy structure-facies zone where they lie at great depth. In general the differences in density between geologic units are sharp enough that gravity surveys are recommended for studies of structure in the Altay Territory.—*D. B. V.*

172–124. Mitchell, Raoul C. Die geologische Bedeutung von Schwereuntersuchungen auf Puerto Rico [The geological significance of gravity investigations in Puerto Rico] : Neues Jahrb. Geologie u. Paläontologie Monatsh., v. 1957, no. 5, p. 206–215.

Little correlation is evident between the results of the recent gravity reconnaissance survey of Puerto Rico (see Geophys. Abs. 165–207) and the geology. Variations in gravity must reflect features of the underlying basement complex, nowhere exposed in the island but believed to be the buried eastern extension of the crystalline complex of the Cordillera Central of the Dominican Republic.—*D. B. V.*

172–125. Ewing, Maurice, Worzel, J. Lamar, and Shurbet, G. Lynn. Gravity observations at sea in U. S. Submarines *Barracuda, Tusk, Conger, Argonaut*, and *Medregal:* Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol., ser., pt. 18, p. 49–115, 1957.

A report on 594 gravity observations made in 1947 and 1948 on five U. S. submarines off the Atlantic coast of North America, off the north and west coasts of South America, and around Cuba and the Bahamas. In the first part the primary base stations, temperature and density coefficients, computational procedures, and accuracy of observations, which are common to all cruises, are described. In the second part matters concerning individual cruises are covered. and finally the principal facts are tabulated.   Free-air and simple Bouguer anomalies are given for all cruises, and Hayford isostatic anomalies are given for the *Barracuda* cruise. All observations were made with the Vening Meinesz pendulum apparatus (with minor improvements) having periods of about 1.006 sec per cycle.—*D. B. V.*

Tsuboi, Chuji. Crustal structure along a certain profile across the East Indies as deduced by a new calculation method. See Geophys. Abs. 172–146.

HEAT AND HEAT FLOW

172–126.   Belov, N. V., and Lebedev, V. I.   Istochniki energii geokhimicheskikh protsessov [Sources of energy of geochemical processes] : Priroda, no. 5, p. 11–20, 1957.

 The hypothesis that solar energy absorbed through weathering processes plays an important role in the metamorphic cycle in the crust is discussed and summarized diagrammatically.—*D. B. V.*

172–127.   Dergunov, I. D.   Sovremennoye predstavleniye o termicheskom rezhime zemnoy kory [Modern notions on the thermal regime of the crust of the earth] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 1, p. 65–74, 1958.

A discussion is presented of thermal processes taking place in the crust of the earth. According to this theory these processes are caused primarily by the heat produced by radioactive disintegration of different elements contained in the crust. Theoretical conclusions drawn from this hypothesis are in agreement with the observed facts. The yet unexplained factor in the hypothetical process is the uncertainity of the depth to which the radioactive elements are distributed in the earth's crust. This question has not yet been sufficiently investigated experimentally.—*Author's summary, S. T. V.*

172–128.   Magnitskiy, V. A.   Temperatura plavleniya v obolochke Zemli [Melting temperature in the earth's mantle] : Vestnik Moskov. Univ., no. 2, p. 3–9, 1956.

As seismological data indicate that the earth's mantle is solid, determination of the melting temperature within the mantle would give an approximate upper limit of temperatures possible at various depths and consequently throw light on some questions concerning magmatism, granitization, and other physical and physico-chemical processes. On the basis of available data it can be calculated that the temperature at a depth of 100 km under the continents is about 1200–1300°C (this can be checked by data on electrical conductivity). Comparison with curves showing melting points of the materials of the earth's mantle at various depths suggests that melting is possible at least locally at depths of 50 to 150 km; this is consistent with seismological data showing a low-velocity layer in which shear wave velocity diminishes abruptly. If temperatures in the mantle vary with time and place, it may be that volcanic zones at the surface correspond to zones of higher temperature in the mantle. On the

other hand, the rate of diffusion is noticeably greater at temperatures eight- or nine-tenths as high as the melting point, which obliges us to consider the reality of active metasomatism leading to gradual growth at the underside of the crust under the continents during the course of geological history. A similar possibility may exist for suboceanic regions, although data are still insufficient for reliable calculations of temperatures under the ocean floor.—*D. B. V.*

172–129. Itō, Hidebumi. Temperature of granite magma of Kitashirakawa-granite, Kyōto, Japan, as estimated from a heat conduction theory of formation of wollastonite: Kyōto Univ. Coll. Sci. Mem., ser. B, v. 23, no. 2, p. 305–323, 1956.

The Kitashirakawa granite, intruded between Mount Daimonji and Mount Hiei, has metamorphosed the Paleozoic formations at Mount Daimonji and produced large quantities of wollastonite in a lenticular limestone east of Mount Daimonji. The temperature of granite magma required to produce the wollastonite is estimated to be between 1100°C and 1800°C if the depth of the intrusive level is assumed to be several thousand meters. If the effect of convection currents in the magma, as yet unknown, is considered, these temperatures may be different.—*V. S. N.*

172–130. Clark, Sydney P., Jr., and Niblett, E. R. Terrestrial heat flow in the Swiss Alps: Royal Astron. Soc. Monthly Notices, Geophys. Supp., v. 7, no. 4, p. 176–195, 1956.

Terrestrial heat flow has been measured in three Alpine railroad tunnels. The geothermal gradients were calculated from temperatures measured during the construction of the tunnels, and corrections for topographic irregularities were made. The thermal conductivity of 113 rock specimens from the vicinity of the tunnels was measured. The heat flow in the Gotthard tunnel was found to be 1.6×10^{-6} cal/cm^2 sec, in the Simplon 2.2×10^{-6} cal/cm^2 sec, and in the Loetschberg 1.9×10^{-6} cal/cm^2 sec. Most of the flux at the surface can be attributed to radioactive decay in a thickened crust, but a non-uniform distribution of radioactive elements may be required to explain the relatively high heat flow in the Simplon and Loetschberg tunnels.—*Authors' summary*

172–131. Maxwell, A[rthur] E., and Revelle, Roger. Heat flows for the Pacific Ocean basin: Bur. Central séismol. internat. Pubs., sér. A. Travaux sci., v. 19, no. 170, p. 395–405, 1956.

The average of 12 measurements of heat flow through the Pacific Ocean is 1.25×10^{-6} cal cm^{-2} sec^{-1}. Three other measurements give extremely high values. Investigation of the origin of the heat indicates that fast fluctuations of bottom water temperature and processes occurring in the sediments are probably negligible and that virtually all the heat must originate beneath the Mohorovičić discontinuity. The oceanic heat flow and the total radioactivity per unit area under the ocean could be the same as under the continent if one of the following three situations holds under the ocean: radioactivity is concentrated near the surface—but improbably high values of radioactivity are then necessary for the rocks in the outer part of the mantle; radioactivity is distributed more or less uniformly throughout a considerable thickness of the mantle—which requires a "cool" earth and relatively high thermal conductivity at all depths; the heat is transported from the earth interior by convection as well as conduction—which also requires a "cool" earth.—*M. C. R.*

172–132. Mekhtiyev, Sh. F., and Aliyev, S. A. O velichine geotermicheskoy stupeni neftyanykh mestorozhdeniy Azerbaydzhana [The geothermal gradient in the oilfields of Azerbaydzhan] : Akad. Nauk SSSR Doklady, v. 102, no. 1, p. 141–143, 1955.

Temperature measurements were made in 1,300 drill holes in 7 oilfields of the Azerbaydzhan S. S. R. in 1911–13 and 1951–54 using maximal mercury and electrical thermometers. The average geothermal gradient is 32–33 meters per 1° C in the northern part of Apsheron peninsula and 17–19 meters per 1° C in the southern part of the peninsula and the valley of the Kura River.—*S. T. V.*

172–133. Brewer, Max C. Some results of geothermal investigations of permafrost in northern Alaska : Am. Geophys. Union Trans., v. 39, no. 1, p. 19–26, 1958.

Frequent, regular thermal measurements in northern Alaska over a six-year period have provided information on many of the problems related to the temperature and distribution of permafrost in the Arctic. The maximum depth of permafrost near Barrow is 1,330 feet. The minimum permafrost temperature recorded, below the depth of measurable (0.01° C) seasonal fluctuation (70 to 100 feet), is —10.6° C. The temperature effect of medium-sized (40 by 100 feet) heated buildings resting on permafrost is measurable to depths well below 50 feet. It is doubtful that frozen ground at shallow depths extends outward more than a few tens of feet from the shore of the Arctic Ocean although it may be present at depths greater than 100 feet. Lakes deeper than about seven feet do not freeze to bottom and may have an unfrozen zone approaching several hundred feet in depth beneath them.—*Author's abstract*

172–134. Uyeda, Seiya. A geothermal survey at Yuba in Ooshima Island, Izu [in Japanese with English abstract] : Tokyo Univ. Earthquake Research Inst. Bull., v. 34, pt. 4, p. 365–371, 1956.

Temperatures were measured near the natural steam bath on the outer slope of the somma of Mihara by inserting vinyl tubes containing thermistors into the ground for depths of 1 to 2 in. Profiles of temperature in vertical sections and an isothermal contour map for a depth of 1 m show presence of an underground hot body separated from the steam bath. The amount of heat flow was estimated to be of the order of 10^{-5} cal per sec per cm^2.—*M. C. R.*

172–135. Voskoboynik, N. I. Termistornyy thermometr dlya izmereniya temperatur v neftyanykh skvazhinakh [The thermistor thermometer for measurement of temperature in oil wells] : Prikladnaya geofiz., no. 16, p. 235–242, 1957.

It is often impossible to use electrical resistivity thermometers in drill holes when heavy drilling mud is used, because of the difficulties of sinking cable into mud. Therefore it is advisable to use a single-core cable that can be sunk into the most heavy mud. Another problem is to select the resistivity element— either a metallic-wire coil or semiconductor element. The coil has the advantage of linearity of scale within the usual range of 0 to 150° C, and simplicity of replacement. The greatest advantage of the thermistor thermometer is its great thermal temperature coefficient, which is many times greater than that of metallic wire.

An analysis is given of the relation between the ohmic resistance of the cable and that of the measuring element, and the value of the additional resistance

to be inserted in series with the measuring element to obtain more accurate results or to make the scale linear is derived.—*S. T. V.*

172–136. Lachenbruch, Arthur H.   Three-dimensional heat conduction in permafrost beneath heated buildings: U. S. Geol. Survey Bull. 1052–B, p. 51–69, 1957.

The general Green's function solution has been integrated for the case of heat conduction in a homogeneous semi-infinite medium in which the temperature at the surface varies sinusoidally with time but the mean temperature and amplitude of the variation are different within and outside an arbitrarily shaped region at the surface. The amplitude and mean temperature can be treated as functions of position within the arbitrary surface region. For certain simple surface regions the results can be expressed in terms of tabulated functions. Numerical results for the general case can be obtained by simple graphical procedures.

The results can be applied to the study of disturbances in ground temperature caused by the presence of bodies of water or by engineering surface modifications such as those produced by erecting a heated building. The primary application of such studies is in high-latitude regions where much of the undisturbed ground is perennially frozen. In such areas, a method of predicting the extent of thawing induced by various modifications of the temperature of the ground surface is important in problems of engineering design and logistics.—*Author's abstract*

172–137. Debenedetti, Arturo.   On the mechanical activation of thermoluminescence in calcite: Nuovo Cimento, v. 7, no. 2, p. 251–254, 1958.

In the course of an investigation of the use of thermoluminescence as a geologic thermometer, glow curves of many samples of a Tertiary limestone were recorded. All show only two peaks, at 230° and 360°, although a test by nuclear plates failed to show the presence of radioactive elements which would account for the high temperature peak, and the rock could never have been buried deep enough to account for the absence of the normal low temperature peaks. Tests made on pure artificial calcite suggest that the thermoluminescence in calcite might be activated by pressure in the crushing and grinding of the samples (as also reported by Zeller and Daniels, see Geophys. Abs. 164–32). This conclusion was tested by recording the glow curves for two parts of a single calcite crystal; the part that was not crushed showed no thermoluminescence, whereas the part that was ground showed two peaks at 360° and 424°, the same behavior as was found for a compressed sample of artificial calcite. The effect produced by grinding is not lasting; it should be called tribophosphorescence and should be taken into account in studies of natural thermoluminescence of pulverized limestone.—*D. B. V.*

INTERNAL CONSTITUTION

172–138. Berlage, H. P.   The basic scheme of any planetary or satellite system: Koninkl. Nederland. Akad. Wetensch. Proc., ser. B, v. 60, no. 2, p. 75–87, 1957.

Mathematical analysis of the structure of a gaseous rotating disk leads to the inevitable conclusion that all the systems in the solar system, consisting of a prominent primary and a certain number of secondaries, must have passed

through the state of a nebular disk, through the state of concentric rings of gas or dust, to the state of individual bodies. A further conclusion is that it does not seem to make any essential difference whether the embryonic rotating disk is gaseous or corpuscular.—*D. B. V.*

172–139.   Bragard, L[ucien].   La masse de la terre et sa densité moyenne [The mass of the earth and its mean density] : Soc. Royale Sci. Liège Bull., v. 26, no. 6, p. 290–294, 1957.

Poincaré's equation for total mass is extended to the case of a level surface (geoid) partially covered by masses (topographic relief), expressing the mass of the earth as a function of the flattening of the international ellipsoid used in geodesy and of two constants.   The mass thus calculated is 5.979×10^{27} grams, and from this value a mean density $D = 5.519$ is deduced; both values agree with those obtained by Veronnet using another method.   The effect of topographic relief on the value of D is felt only in the third decimal place, which decreases as the relief increases.—*D. B. V.*

172–140.   Bullard, E. C.   The density within the earth : Koninkl. Nederland. Geol.-Minjb. Genootschap Verh., geol. ser., pt. 18, p. 23–41, 1957.

Calculation of a large number of integrations of the Adams-Williamson equations for the density within the earth on an electronic computer (Deuce), in order to determine the uncertainties introduced by likely errors in the assumptions, shows that the only sources of serious uncertainty in the density distribution are the uncertainties about the distribution of inhomogeneity and temperature in the mantle.   The effects of these greatly exceed the effect of uncertainties in distribution of seismic velocity and of a possible discontinuity at the surface of the inner core.   If the mantle is homogeneous below 984 km and the temperature gradient is adiabatic, densities obtained by Bullen's method should not be in error by more than ± 0.3 g per cm^3 in the mantle and 0.5 g per cm^3 in the core.   If the temperature is near the melting point the densities deep in the mantle may be reduced by 0.2 and those in the core raised by 0.1 to 0.2.—*D. B. V.*

172–141.   Jobert, Nelly.   Sur la période propre des oscillations spheroïdales de la Terre [On the natural period of spheroidal oscillations of the earth] : Acad. Sci. Paris Comptes Rendus, v. 245, no. 22, p. 1941–1943, 1957.

The Rayleigh principle is applied as in previous papers (see Geophys. Abs. 168–59 and 169–92) to three earth models in order to determine an approximate value of the natural period of spheroidal oscillations of the earth, taking into account the effect of gravitation.   For the first and simplest model, a gravitating sphere with a homogeneous liquid core and homogeneous elastic mantle, an exact value is found, using Kato's principle, to be $54.65 < T_0 > 56.45$ min.   For the second model (Bullen's model A) an approximate value is found to be $T = 53.4$ min, compared to 66 min found for the same model in the absence of gravitation. For the third (Bullen's model B) three values are found (depending on three different choices of the value for rigidity) : 51.9 min, 52.5 min, and 54.24 min. These correspond, within limits of error, with the periods of 57 min registered by Benioff and of 55 min calculated for model B by Pekeris and Jarosch by numerical integration of the equations of movement.—*D. B. V.*

172–142. Vvedenskaya, A. V., and Balakina, L. M. O nokotorykh osobennostyakh polya smeshcheniy prodol'nykh i poperechnykh voln, rasprostrany-ayushchiskhsya v oblochke zemli [Some peculiarities of the displacement-field of longitudinal and transverse waves, propagating through the mantle of the earth]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 8, p. 1052–1054, 1957.

An attempt is made to determine the structure of the mantle on the basis of a comparison of the ratio of the displacements of the longitudinal and transverse seismic waves caused by earthquakes with those produced in a homogeneous and perfectly elastic earth. Displacements and ratios of displacement were obtained for waves recorded by the Russian seismological network from 19 earthquakes in the U.S.S.R., China, and Turkey, for which the foci, direction of motion in the focus, and the angles of emergence of the waves at the surface have been computed. The same ratio calculated by assuming a perfectly elastic and homogeneous earth exposed to the same seismic impulses at the focus, were very nearly the same as those observed except for earthquakes at epicentral distances of 18 to 20°, 35 to 45°, 52 to 55°, and 68 to 71°, corresponding to depths of penetration of 250 to 500 km, 900 to 1,000 km, 1,200 to 1,300 km, 1,900 to 1,950 km, and 2,300 km. It is concluded, that at these depths the mechanical properties of the mantle are different. Discontinuities at these depths have been found by Galitzin, Repetti, Gutenberg, and Richter.— *S. T. V.*

172–143. Vening Meinesz, F. A. Instability in the earth's mantle because of the phase-transition layer: Koninkl. Nederland. Akad. Wetensch. Proc., v. 60, no. 5, p. 409–415, 1957.

New studies show that not only is it possible for convection currents to break through the critical layer in the earth (see Geophys. Abs. 166–242) if this is a transition layer between two modifications of olivine, but that such a layer must be a strong source of instability in the mantle and must necessarily lead to the development of convection currents and thus be a factor causing periodic tectonic activity and mountain building. The transition layer moves vertically, rising in the subsiding column of convection current where the percentage of heavy matter is increasing (that is, under island arc basins) and subsiding in the rising column of current (under island arcs themselves). The consequences of this vertical movement provide the key to several facts hitherto incompletely explained by the convection-current hypothesis: rapid subsidence of the basins and quick rising of the surrounding arcs, and similarity of order of depth of different island arc basins; persistence of these basins; and positive gravity anomalies over these basins. The currents involved here are the smaller type which probably do not reach farther down than the transition layer. Maximum vertical displacement of the transition layer for the small type of convection currents is computed, from the depth of subsided basins, to be 29 km. The larger type of currents involve the whole mantle and thus are related to major periods of tectonic activity. The rising currents must be accompanied by subsidence of the transition layer and, therefore, a rising of the earth's surface; the contrary must happen in areas of subsiding currents; this explains the regression of continents in the first periods of tectonic activity and the long persistence of this regression. The amount of vertical displacement of the transition layer in these larger currents can be computed only vaguely as there are

too many unknowns, but it is probably somewhat smaller than that produced by the smaller currents.—*D. B. V.*

172–144. Rikitake, Tsuneji. Electrical state and seismicity beneath Japan: Tokyo Univ. Earthquake Research Inst. Bull., v. 34, no. 4, p. 291–300, 1956.

A hypothetical model of the upper part of the earth's mantle beneath Japan is proposed. In order to account for the low electrical conductivity as has been derived from the study on geomagnetic daily variation, it is assumed that the substance, which usually consists of the layer between the earth's surface and the depth of 400 km, wedges into the lower part under Japan as deep as 700 km, the width of the wedge being taken to be 200 km. By this model, we can roughly explain the low conductivity there as well as the occurrence of deep focus earthquakes, the latter being likely to be caused by the shearing stresses due to the buoyancy force.—*Author's abstract*

172–145. Pettersson, Hans. Rate of accreation of cosmic dust on the earth: Nature, v. 181, no. 4605, p. 330, 1958.

Collections of cosmic dust made by filtering large volumes of air through fine port filters at Montalola and at the summit at Mt. Hakleakala all contain notable quantities of nickel, (14.3 micrograms per 1,000 cm^3 of air), a nickel-to-iron ratio of 0.9 percent and cobalt-to-iron of 0.2 percent. The weight of cosmic dust estimated from the nickel content by using average amount of nickel in meteorites of all kinds gives a weight of meteorite dust of 572 micrograms per thousand cubic meters of air. Assuming that the dust content of cosmic origin is uniform to the 100-kilometer level, the suspended dust of cosmic origin below that level is 28.6 million tons. If the rate of descent is similar to that of the volcanic dust from the Krakatoa eruption, the annual increment of such dust to the earth is 14.3 million metric tons. As this figure is very different from that of Van de Hulst and Watson, extended experiments at other high altitude observation points are urged.—*M. C. R.*

172–146. Tsuboi, Chuji. Crustal structure along a certain profile across the East Indies as deduced by a new calculation method: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 287–294, 1957.

The underground mass distribution and undulation of the geoid along Vening Meinesz' profile No. 17 across Indonesia and adjacent seas are calculated on the basis of Vening Meinesz' Bouguer anamoly values, by the Fourier series method (see Geophys. Abs. 92–4119 and 100–5310). The advantage of the method is that the solution is deduced directly. The fundamental assumptions are that the gravity anomalies are caused by undulations of the interface bounding the lighter crustal and denser subcrustal materials, and that the undulations of this interface are not too large as compared with the average thickness of the crust.—*D. B. V.*

Glennie, E. A. Plastic buckling in the Indian Peninsula and Ceylon. See Geophys. Abs. 172–97.

ISOSTASY

172–147. Axelrod, Daniel I. Paleoclimate as a measure of isostasy: Am. Jour. Sci., v. 255, no. 10, p. 690–696, 1957.

During Late Miocene and Early Pliocene 2,500–3,000 feet of andesite was added to the 3,000-foot summit region of the northern Sierra Nevada. A study of the sequence of Late Tertiary floras indicates that the height of the range was not increased by this amount as only a local rain shadow was developed on the east Sierran piedmont. These paleoecological relations suggest that vulcanism increased the altitude approximately 500 feet; this increase is consistent with the thesis that the Sierran block subsided isostatically under the accumulating volcanics to give a net increase in altitude of 500–600 feet.—*V. S. N.*

172–148. Strasser, Georg. Cent ans de la théorie de Pratt [A century of Pratt's theory] : Bull. géod., no. 40, p. 16–27, 1955.

A history of the Pratt theory of isostasy.—*M. C. R.*

ISOTOPE GEOLOGY

172–149. Fergusson, G. J. Reduction of atmospheric radiocarbon concentration by fossil fuel carbon dioxide and the mean life of carbon dioxide in the atmosphere : Royal Soc. London Proc., v. 243, no. 1235, p. 561–574, 1958.

It is generally accepted that the combustion of fossil fuels over the period 1860 to 1954 has produced an amount of carbon dioxide, containing no radiocarbon, that is equal to approximately 13 percent of the carbon dioxide in the atmosphere. The addition of this "old" carbon dioxide to the atmosphere has observably disturbed the steady-state distribution of carbon-14 in nature. In the present paper measurements are described of the carbon-14 concentration in sets of wood samples from the northern and southern hemispheres, and these show that the carbon-14 specific activity of atmospheric carbon dioxide has decreased by 2.03 ± 0.15 percent over the period 1860 to 1954, and that the present-day difference between the decrease in the northern and southern hemispheres is less than 0.50 percent.

The response of various mathematical models of the carbon cycle in nature to the addition of "old" carbon dioxide at an exponential rate has been considered. Using the above data in conjunction with these models it is deduced that: the mean life of a carbon dioxide molecule in the atmosphere before it is absorbed into other reservoirs of carbon must be less than 7 yr, and is probably of the order of 2 yr; the exchange time for mixing of the atmospheres of the two hemispheres (i. e. the mean life of a carbon dioxide molecule in the atmosphere of one hemisphere before transference to the other hemisphere) is less than 2 yr.—*Author's abstract*

172–150. Starik, I. Ye., and Sobotovich, E. V. Svinets v prirodnyky obrazovaniyakh i ego isotopnyy sostav [Lead in natural formations and its isotopic composition] : Akad. Nauk SSSR Izv. Ser. geol., no. 9, p. 81–85, 1957.

The isotopic composition of lead sublimated in a stream of hydrogen from samples of pitchblende from Joachimstal showed fractionation of lead at different temperatures, and the percentage of radiogenic isotopes increased with temperature. In similar investigations of an ancient granite from Northern Karelia, radiogenic isotopes were given off at a comparatively low temperature (880°). Two Caledonian granites from the Terskey Ala-Tau differed in their behavior ; in one there was a noticeable difference between the isotopes driven off in a stream of hydrogen and in a vacuum, in the other practically no difference.

This is attributed to a difference in their manner of occurrence. The sublimation method may be a valuable means of investigating the occurrence of lead in rocks and minerals and of determining their age. According to Sobotovich, determination of the total isotopic composition by this method is possible only if isolation of the lead is complete.—*D. B. V.*

172–151.   Kulp, J. Laurence, Amstutz, G. C., and Eckelmann, F. Donald.   Lead isotope composition of Peruvian galenas: Econ. Geology, v. 52, no. 8, p. 914–922, 1957.

Isotopic abundance measurements have been made on the lead from nineteen galena samples covering a wide range of geographical and geological settings in the Tertiary hydrothermal mineralization of the Central Peruvian Andes. The results are strikingly similar, suggesting origin from a homogeneous magmatic source derived from an average crustal environment with regard to its U/Pb and Th/Pb ratios. The consistency of the lead isotopes through all zones of mineralization and over great vertical and horizontal extent is further evidence against significant fractionation of these isotopes during transportation and deposition.—*Authors' abstract*

172–152.   Masuda, Akimasa.   Isotopic composition of primeval lead of the earth: Geochim. et Cosmochim. Acta. v. 13, no. 2–3, p. 143–152, 1958.

Based upon the variation of isotopic composition of lead ores from the same site, the age of the earth is estimated to be 4.55 billions years. . . . By assuming a fixed heterogeneity of two radioactive elements, thorium and uranium, we can obtain a self-consistent primeval lead with $^{204}Pb : {}^{206}Pb : {}^{207}Pb : {}^{208}Pb = 1 : 9.05 : 9.81 : 29.45$. These figures demonstrate for the first time that the isotopic composition of earth's primeval lead does not differ essentially from that of primeval lead of meteorites or troilite lead. It is the chief advantage of this approach that no knowledge of deposition time for vast majority of samples is required.

Although common igneous rocks are accountable for lead ores, mafic rock is of greater importance than felsic.—*Author's abstract*

172–153.   Feely, Herbert W., and Kulp, J. Laurence.   Origin of Gulf Coast salt-dome sulphur deposits: Am. Assoc. Petroleum Geologists Bull., v. 41, no. 8, p. 1802–1853, 1957.

The application of isotopic techniques, laboratory reactions, and bacteriological studies has made it possible to define more closely the origin of the Gulf Coast salt-dome sulfur deposits.

The available geologic and petrographic data suggest that the salt-dome sulfur originated through reduction of the anhydrite of the cap rock of the salt dome to hydrogen sulfide and subsequent oxidation of the sulfide to native sulfur. The present laboratory study confirms this mechanism and clarifies some of its details. Experiments designed to produce hydrogen sulfide or sulfur through the direct reduction of anhydrite by petroleum under salt-dome conditions gave negative results in time equivalents of 150 million years. On the other hand, sulfate-reducing bacteria, grown on hydrocarbon substrates, were able to produce hydrogen sulfide from dissolved sulfate. Other experiments showed that at salt-dome temperatures sulfate ion is capable of oxidizing hydrogen sulfide at measurable rates. It is concluded, therefore, that sulfate-reducing bacteria are the primary agents in the production of cap-rock sulfur. Dissolved sulfate is

reduced to hydrogen sulfide by the bacteria, after which part of this hydrogen sulfide is reoxidized to native sulfur by reaction with sulfate ion.

Isotopic analyses were made on the sulfur and carbon from a series of salt-dome materials. Samples of anhydrite from the salt stocks of 11 domes had the same ratio of sulfur–32 to sulfur–34 (about 21.85), probably indicating derivation of all of the salt domes from a single evaporite sequence. A sample of a Jurassic(?) sedimentary salt bed from Clarke County, Alabama, which is probably part of the stratigraphic unit from which the salt stocks were derived, has a S^{32}/S^{34} ratio of 21.83. Anhydrite cap rock has the same sulfur isotopic composition as the anhydrite inclusions of the salt, and evidently has been formed by their accumulation on top of the salt stock as the halite has been leached away by ground water.—*Authors' abstract*

MAGNETIC FIELD OF THE EARTH

172-154. Korneva, L. A. O nesimmetrichnoy otnostitel'no zemnoy osi chasti magnitnogo polya v rayonakh Arktiki i Mirovogo Okeana [The part of the magnetic field asymmetric with reference to the earth's axis in Arctic regions and over the World Ocean] : Akad. Nauk SSSR Doklady, v. 107, no. 5, p. 679–682, 1956.

Many hypotheses on the nature of geomagnetism attribute its origin to the rotation of the earth around its axis. Even if the main part of magnetism (the normal field),—that, is the part symmetrical with respect to the earth's axis,—is produced by rotation, it is still necessary to explain several phenomena associated with the asymmetric part of terrestrial magnetism, such as the displacement of the magnetic axis from the geographic poles, and the existence of the western and eastern declinations. Among the elements producing the asymmetric part of terrestrial magnetism the most important are the surface currents flowing over the World Ocean. Assuming that the symmetrical part of terrestrial magnetism is produced by a dipole having a magnetic moment M, maps of both parts of terrestrial magnetism have been computed for values of 10×10^{25}, 8×10^{25}, and 7.25×10^{25} gammas per cm^3. The best agreement with the observed values was the geomagnetic field corresponding to $M=7.25 \times 10^{25}$ gammas per cm^3. For the last, the contour of telluric currents equivalent to the normal part of the geomagnetic field follows the shore line between the World Ocean and the continents; this value of M is equal to the first member of the series into which the normal field can be developed. This cannot be accidental, and makes it probable that the normal geomagnetic field has been produced by the rotation. The asymmetric part was produced by the stream of ionized particles falling on the earth from the sun. If this stream reaches the earth a loop is produced by telluric currents flowing in the World Ocean. If this stream reaches just the upper atmosphere of the earth, the direction of telluric currents will have an opposite direction, but follow the same path. The direction of the telluric currents can be determined by an adequate network of observations.—*S. T. V.*

172-155. Tamao, Tsutomu. Distortion of the outer geomagnetic field : Tohoku Univ. Sci. Repts., 5th Ser., v. 9, no. 1, p. 1–21, 1957.

Interplanetary magnetic fields of the order of 10^{-5} to 10^{-3} gauss have been inferred from studies of cosmic ray propagation. The distortion of the outer magnetic field of the earth by relative motions of the earth and the interplanetary system is studied by assuming a simple model in which hydromagnetic equilibrium conditions are satisfied, and calculating radial and latitudinal

variations of the magnetic field and distribution of magnetic lines of force. Rotation, but not the revolution, of the earth is considered. It is shown that the westward toroidal magnetic field predominates in the transition region between the geomagnetic equator where the field is a maximum and the magnetic poles where the field vanishes. This westward field corresponds to the shift of the geomagnetic equator found by Simpson and coworkers.—*M. C. R.*

172–156.   Rikitake, Tsuneji. Stability of the earth's dynamo: Tokyo Univ. Earthquake Research Inst. Bull., v. 34, no. 4, p. 283–289, 1956.

Magneto-hydrodynamic oscillations of a simple mode are studied in relation to the stability condition of the earth's dynamo. The influence of the Coriolis force is found to be considerable. The previous result, that the toroidal magnetic field would not be large in order to have a stable dynamo, should be abandoned when we take the earth's rotation into account. It seems acceptable that strong magnetic fields which have been suggested by E. C. Bullard exist in the earth's core.—*Author's abstract*

172–157.   Siebert, Manfred, and Kertz, Walter. Zur Zerlegung eines lokalen erdmagnetischen Feldes in äusseren und inneren Anteil [On analysis of a local geomagnetic field into an external and internal component] : Akad. Wiss. Göttingen Nachr., Part 2a, no. 5, p. 87–112, 1957.

It is shown that in a local geomagnetic field profiles may appear for which the analysis of the field into an external and internal component is reduced to a two-dimensional problem. A semi-graphic procedure is given for finding such profiles. The formulism of the analysis is derived by the use of an integral operator and prepared for practical application. By way of example the method is tested for three different profiles of a bay disturbance on October 18, 1951, and compared with the results of an areal analysis of the same bay by Wiese.— *Authors' summary, D. B. V.*

172–158.   Egyed, László. A földi mágneses tér kapcsolata a föld belső szerkezetével [The magnetic field and the internal structure of the earth] : Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, v. 6, no. 3–4, p. 3–8, 1957.

The paper presents a possible explanation for the dipole field of the Earth on the basis of the momentum of oriented nuclei in the inner core. Furthermore, it is shown that the cause of the westerly drift of the dipole field, isoporic foci and non-dipole field may be referred to the expansion of the mantle and core of the Earth, causing also currents in the outer core. (See also Geophys. Abs. 168–210)—*Author's English summary*

172–159.   Yokoyama, Izumi. Geomagnetic studies of Volcano Mihara. The 8th paper. (Continuous observation of changes in geomagnetic declination during the period 1955–1956) : Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 3, p. 567–572, 1957.

Geomagnetic observations made at a new station established late in 1955 on the east side of Ooshima Island, Japan, and at the Nomashi station on the west side confirm the fact that variations in declination must be related to activity of the volcano Mihara. The declination drifts away from the volcano when it becomes active, toward it after subsidence of activity, and the amplitude of

change has decreased gradually, as has the activity, since the 1950–1951 eruption.—*D. B. V.*

172–160. Whitham, K[enneth], and Loomer, E. I. Characteristics of magnetic disturbance at the Canadian Arctic observatories; Part 1, Cyclic field changes on quiet and disturbed days. Part 2, Transient field changes: Dominion Observatory Ottawa Pub., v. 18, no. 12, 346 p., 1957.

An analysis is made of the outstanding features of magnetic disturbance at Resolute Bay and Baker Lake observatories. Part 1 discusses three classes of days at each observatory selected to correspond to "local disturbed", "local quiet", and "local very quiet" conditions at a time of sunspot minimum. The disturbance daily variation is harmonically analysed and the statistical properties of the cyclic disturbance waves examined. Part 2 extends the analysis of magnetic disturbance to include sudden commencements, sudden commencement storms, non-sudden commencement storms, and bay phenomena. The physical meaning of the mean disturbance field and non-cyclic changes is discussed.—*V. S. N.*

172–161. Duclaux, Françoise, and Leprêtre, Bernard. Étude statistique des crochets magnétiques à Tamanrasset [Statistical study of magnetic bays at Tamanrasset] : Acad. Sci. Paris Comptes Rendus, v. 246, no. 8, p. 1243–1245, 1958.

A statistical analysis of magnetic bays recorded at Tamanrasset, Algeria, from January 1, 1949 to July 1, 1957. A total of 225 are recognized, including doubtful ones, or 33 percent of the total number published for that period. Annual distribution shows no clean parallel with solar activity R. A clean minimum (20 percent of total) occurs in winter. Diurnal distribution shows a very broad maximum between 9 and 16^h (70 percent of total), with more bays after 12^h than before 11^h. Diurnal variation on the average is positive before 16^h, negative after. The statistical values of ΔH do not correspond very well with the MacNish law under the usual definition of diurnal variation (as the difference between the instantaneous value of an element and its mean value for the period 0^h–24^h). Maximum amplitude of the bays is 38λ. The relatively high percentage of bays not obeying generally accepted laws may be due to errors in interpretation of some bays; further study on the causes of "false bays" would clarify this aspect.—*D. B. V.*

172–162. Kalinin, Yu. D. Organizatsiya seti magnitnykh observatoriy v SSSR [Organization of the network of magnetic observatories in the U. S. S. R.] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 12, p. 1467–1477, 1957.

From 1917 to 1957 the network of magnetic observatories in Soviet Russia has increased by several times and continues to increase. The Scientific Research Institute of Terrestrial Magnetism, established in 1940, is at present an institution in which is concentrated the methodic guidance of almost all permanent magnetic observatories of the U. S. S. R. with the exception of the Arctic. An original method of critical analysis of observed data received from every observatory is developed. No country has anything similar. It is based on the juxtaposition of the observational data of a large group of observatories (the comparison of the variations of the averages by year, month, day, and hour).

During the last years a tendency is noticeable to construct new types of magnetometric instruments that can be installed in ordinary buildings, not in those of expensive massive construction. A series of new construction of such types is almost completed. The present considerable system of magnetic observatories gave enough observational material for the solution of important practical problems and of numerous theoretical investigations on geomagnetism.

The precision of the observational determination of the basic group of the permanent magnetic observatories due to skillful work of the staff and to new methods of control is higher than that of many foreign observatories.—*Author's summary, S. T. V.*

172–163. Wiese, Horst. Über erdmagnetische Absolut und Vergleichmessungen [On absolute and relative geomagnetic measurements] : Zeitschr. Geophysik, v. 23, no. 2, p. 63–74, 1957.

Owing to the number of difficult measurements needed in determining horizontal intensity very accurately by Gauss-Lamont method most of the observatories have calibrated their instruments relatively at observatories who have made an exact absolute determination. Uncertainties and errors of the absolutely determined fundamental constants—moment of inertia deflection constant—and the unnoticed slow changes of these constants—induction coefficient—are discussed. The accuracy can be raised considerably by technical improvements. The selection and treatment of the standard magnets is essential. The new magnets used in Niemegk hardly show a temporal change of their magnetic moment. The moment of inertia was determined very exactly. Direct and current indirect comparisons between the central European observatories are discussed.—*Author's abstract*

172–164. Hazard, Daniel L. Directions for magnetic measurements : U. S. Coast and Geod. Survey Serial no. 166, 3d ed. (1930) corrected, 129 p., 1957.

This is a corrected version of the third edition of a manual for the guidance of those doing work in terrestrial magnetism. It includes discussion of the theory of magnetic measurements with facts about magnets, the earth's magnetism, and methods for determining instrumental constants; directions for observation on land and sea; operation of a magnetic observatory; a brief statement of the nature of earthquake waves and the means of recording them; and tables to facilitate computations involved.—*V. S. N.*

MAGNETIC PROPERTIES

172–165. Narain, H., and Rao, V. Bhaskara. Magnetic properties of rocks: Royal Soc. New South Wales Jour. and Proc., v. 91, pt. 1, p. 36–54, 1957.

Susceptibility in 38 rock specimens from the Sydney Basin and the Prospect intrusion in New South Wales in general decreased with increasing field strength; in the magnetic field range of 44 to 176 oersteds the decrease was steep in initial stages and gradually became less and less. Susceptibility determined for a few specimens at 8.8 oersteds and extrapolated to the value at the next highest field observed, produced a curve whose shape resembles the $X—H$ curve of magnetite qualitatively. Hysteresis and change in shape of hysteresis loops with increasing field strength indicate the ferromagnetic be-

havior of the rocks. Coercivity values indicate that most of the rocks are magnetically "soft" and measures of hardness given by H_c and I_r/X_0 and their relationship with the rate of increase of susceptibility are not trustworthy. Variation of specific susceptibility with normative magnetite content was studied and attempts made to establsh empirical relationship between them but it was difficult to establish a relationship of universal prediction value. All results, though hard to analyse quantitatively, indicate qualitatively the ferromagnetic behavior of the rocks ; this behavior is primarily due to magnetite in the rock, though other magnetic minerals contribute a share to the phenomenon.—*V. S. N.*

172–166. Schmucker, Ulrich. Gesteinsmagnetische Untersuchungen und Experimente am Basalt des Steinberges bei Barlissen [Magnetic investigations and experiments on the Steinberg basalt near Barlissen] : Akad. Wiss. Göttingen Abh., math.-phys. Kl., ser. 3, no. 26, 100 p., 1958.

The Steinberg olivine basalt from the western edge of the Leinetal graben in Germany, upper Miocene in age, is studied geologically, mineralogically, and geophysically. The shape of the basalt body is determined from the magnetic anomalies and rock magnetization, using a newly calculated cylindrical model. The form of the Hoher Hagen-Süd basalt body, also upper Miocene, is determined in the same way. Detailed investigation of the magnetic properties of the rocks (thermoremanence, saturation curve, saturation magnetization as a function of temperature, Curie point, and susceptibility) leads to conclusions regarding the amount, grain size, and chemistry of the ferromagnetic mineral components which agree with the petrographic data. When heated to 850°C the titanomagnetite dissociates into magnetite and ferro-ilmenite ; this change can be detected magnetically. The thermoremanent magnetization is found to be very stable ; its direction is $i = -73°$, $D = 240°$ E of N for the Steinberg basalt and $i = +52°$, $D = 32°$ E of N for the Hoher Hagen-Süd basalt (present earth's field in this region, $i = +67°$, $D = 357°$ E of N). Detailed results are presented in a series of tables.—*D. B. V.*

172–167. Atwater, H. A., and Elliekson, R. T. Remanent magnetization of ancient bricks : Nature, v. 181, no. 4606, p. 404, 1958.

The remanent magnetization of clay bricks fired in ancient time has been used as evidence for the secular decrease in intensity of the earth's magnetic field and it has further been suggested that the effect of such a change in the magnetic field on the intensity of cosmic radiation incident upon the earth would tend to falsify radiocarbon dating procedures. However, the specific magnetization acquired by a given baked clay when fired at 670° in a constant magnetic field of 13 gauss can increase by a factor of 200 when the firing atmosphere is changed from nitrogen to illuminating gas. The apparently high value of remanent magnetization of ancient bricks may have been the result of the use of fuel heated kilns during the original firing. The presence of incompletely burned products of combustion in such kilns could produce a reducing atmosphere comparable in effect to illuminating gas.—*M. C. R.*

172–168. Clegg, J. A., Radakrishnamurty, C., and Sahasrabudhe, P. W. Remanent magnetism of the Rhamahal traps of northeastern India : Nature, v. 181, no. 4612, p. 830–831, 1958.

Samples of the Rhamahal trap from 5 places, about 20 miles apart, were studied. The specimens taken from quarries were found to be consistently magnetized

along an axis directed toward the north-northwest with a steep upward dip. Samples taken from stream beds showed widely scattered directions of magnetization and the results have not been used. The direction of magnetization observed is consistent with the assumption that the Indian land mass occupied a position south of the equator at the time when rocks acquired the magnetization. The position of the north geographic pole for the time would be in the southern Caribbean Sea, latitude 13° N, longitude 70° W. These results as well as the results previously obtained on Deccan trap are compatible with the supposition that there has been a continuous northward drift of the Indian land mass extending from the Jurassic to the Eocene.—*M. C. R.*

172–169.   Deutsch, E. R.   The remanent magnetism of some lavas in the Deccan Traps: Philos. Mag., v. 3, no. 26, p. 170–184, 1958.

The magnetizations of over 400 basalt specimens from the Deccan Traps have been found to be aligned in general along a NNW–SSE to NW–SE axis dipping towards the south. The results are consistent with the supposition that India has drifted northwards through over 50° of latitude and rotated 25° anticlockwise within the last 70 million years. In all three localities, the poles corresponding to the upper rocks are nearer the present geographical poles than those from the lower flows. The discrepancy may represent a northward drift of India during the formation of the Deccan Traps, but there are other possible explanations and further data are necessary to elucidate the problem.—*Author's abstract*

172–170.   Hsung Kwang-chu.   Effective susceptibility and magnetic concentration of a medium [in Chinese with English abstract]: Acta Geophys. Sinica, v. 6, no. 1, p. 69–76, 1957.

In this paper, the effective susceptibility of a medium with magnetic particles disseminated uniformly throughout it is studied. An exact formula connecting the susceptibility $\overline{K}$ and the concentration a cannot be determined on account of the difficulty of calculating the interactions of the magnetic particles. However, by analyzing some experimental data, it appears that there might exist a functional relationship between a and the interactions of the magnetic particles. A brief summary of some previously published formulae in this connection is given and their degrees of approximation are assessed. On this basis, it is shown that the dependence of $\overline{K}$ upon the shape of the particles is essentially the same whether Puzicha's formula or some other more complicated formula is used for the calculation.—*Author's abstract*

172–171.   Khramov, A. N.   O paleomagnetizme kak osnove novogo metoda korrelatsii i rascheleneniya osadochnykh tolshch [On paleomagnetism as the basis of a new method of correlation and subdivision of sedimentary strata]: Akad. Nauk SSSR Doklady, v. 112, no. 5, p. 849–852, 1957.

Study of 650 oriented specimens (4.5-cm cubes) from the red beds of the Chelekan peninsula and elsewhere in the western Turkmen S. S. R. shows reversals of remanent magnetization occupying definite stratigraphic positions. In all, seven normal and seven reverse zones are counted from the top of the Apsheronian stage to the bottom of the middle Pliocene of the Maly Balkhan range. The inversions seem to have taken place over periods of several tens of thousands of years. The paleomagnetic method offers the possibility of absolute correlation of any sections containing magnetically stable rocks, inde-

pendent of geographic position. Various events of geologic history may thus be synchronized with an accuracy of the order of 10^4 or 10^5 years. The age of core samples can also be determined by the paleomagnetic method, if the position of the top of the sample is known; in addition the alternation of normally and inversely magnetized zones and the considerable intensity of remanent magnetization in some sedimentary rocks opens new perspectives in the magnetic well logging.—*D. B. V.*

172–172. Einarsson Trausti. Über den Wert alter Sedimente für paläomagnetische Zwecke [On the value of old sediments for paleomagnetic purposes]: Neues Jahrb. Geologie u. Paläontologie Monatsh., v. 1957, no. 5, p. 193–195.

The natural magnetization of old red beds can be affected substantially by tectonic stress, as suggested by the striking parallelism between the rock magnetism and tectonic trend in England and North America, among others. In any case inferences on the geomagnetic field are problematic at present. On the other hand, basalt flows can offer reliable paleomagnetic material and merit particular attention.—*Author's summary, D. B. V.*

172–173. Komarov, A. G. Ostatochnoye namagnicheniye gornykh porod i ikh vozrast (Paleomagnetizm i dvizheniye polyusov) [Remanent magnetization of rocks and their age (Paleomagnetism and wandering of the poles)]: Akad. Nauk SSSR Izv. Ser. geol., no. 10, p. 48–60, 1957.

The origin of remanent magnetism in igneous and sedimentary rocks and its use in determining past pole positions are reviewed. Such determinations are valid only if the rocks studied are magnetically stable. Magnetic stability can be determined by comparison of the directions of magnetization in different pebbles of a conglomerate or in different parts of a folded bed, or in the laboratory by artificial demagnetization. A third method is proposed, based on the fact that natural remanent magnetization decreases with age. The measured intensity of remanent magnetization for the rock in question is compared with that expected for a rock of its age; two curves showing the intensity of remanent magnetization for rocks of different ages of the gabbro-basalt group, for a platform region and for a geosyncline, are presented for this purpose and their use illustrated by several examples. The fact that the decrease of intensity with age is systematic indicates that heating above the Curie point during metamorphism is not widespread in nature, particularly in old platforms. The intensity of magnetization can be used as a criterion for the geologic age of a rock (see Geophys. Abs. 168–234). As for polar wandering, each geologic epoch seems to have its own pole position; it is suggested that the mean direction of remanent magnetization can be used as a criterion of age in some cases, along with intensity.—*D. B. V.*

MAGNETIC SURVEYS

172–174. Pudovkin, I. M. Sposob priblizhennoy otsenki elementov zaleganiya magnitnykh ovzmushchaynshchikh tel [A method of approximate estimation of the parameters of localization of magnetic disturbing bodies]: Prikladnaya geofiz., no. 16, p. 175–187, 1957.

A critical analysis is presented of several procedures for approximate determination of the parameters determining the position of magnetic disturbing bodies.

The best procedure for interpretation of data obtained from a total-intensity survey as in many other problems, is a comparison of field patterns with those obtained from model experiments.

Starting from the totally inadmissible "method of tangents," often used for the determination of the depth of the disturbing magnetic body, the author computes the depth of the center of a horizontal cylinder, of a string of poles, and of a single pole. Accurate formulas are available for these bodies. Comparing the obtained results with those given by the approximate formula the author found discrepancies amounting to 50. Many recommended formulas give acceptable values only in special cases, many existing master charts, graphs, or tables can be used with more justification. Special emphasis is given to procedures suggested by Pudovkin, himself, and master charts computed by him.—*S. T. V.*

172-175. Zhogolev, L. P. Opredeniye glubiny zaleganiya namagnicheniykh tel po vysshim proizvodnym magnitnogo potentsiala [The determination of depth of magnetized bodies by forming higher derivatives of the magnetic potential]: Leningrad Univ. Vestnik, no. 12, Ser. geol. i geog., no. 2, p. 48–59, 1957.

The use of higher derivatives of the magnetic potential function makes it possible to work out a method of determining the depth of certain bodies of simple form, such as, a sphere, a single pole, a horizontal cylinder, and a thread of poles, without making any assumptions as to intensity of magnetization of these bodies. For this purpose the maximum value of the vertical component Z_{am} is written in the form of $Z_{am} = \dfrac{A}{\sqrt{h^n}}$, where A is a constant determined by the shape of the body, by the intensity and the direction of its magnetization, and n is an integer also determined by the shape of the body. Forming the first, second, and third derivatives of this expression, constant n and h can be determined from the resulting system of differential equations. The same procedure can be applied to a stratum of finite thickness and infinite extent. The obtained result will be accurate to 10 percent, if the ratio b/h is less than 0.35, where $2b$ is the thickness of the stratum, h the depth of its upper surface.

Ten approximate formulas for the determination of the parameters of magnetic bodies were checked. Errors were computed for the obtained results and plotted on curves. Zhogolev concludes the best results were obtained by the formulas of Henderson and Zietz, and by that of Rosenbach.—*S. T. V.*

172-176. Devitsyn, V. M., and Lapina, M. I. O tochnosti opredeleniya glubin vozmushchayushshchikh mass na primere magnitnykh anomaliy Bashkirii [On the accuracy of the determinations of depths disturbing masses from magnetic anomalies in the Bashkir SSR]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 10, p. 1266–1272, 1957.

The depths of the upper edge of the disturbing masses were calculated for 18 anomalies in the Bashkir S. S. R., by the following procedures: comparison of the Z and ΔT values with those of a body of regular shape; the method of tangents in modifications suggested by Kolyubakim, Pyatnitskiy, and Simonenko; the master charts by Henderson and Zietz; simplified formulas suggested by A. A. Logachev; and the integral method of T. N. Simonenko. No one of these formulas gave satisfactory results in all cases. The article contains a geologic map of the area concerned, and the graphs of the results obtained by every formula are included.—*S. T. V.*

172–177. Hall, Donald H. Least squares magnetic and gravity interpretation: Am. Geophys. Union Tran⊕., v. 39, no. 1, p. 35–39, 1958.

The interpretation of magnetic data by successively varying the parameters of two-dimensional bodies until the theoretical curve fits the one observed, involves human decision making at intermediate steps of the calculation. In this paper, the least squares method is advocated for its objectivity and adaptability to the electronic computer. The simultaneous equations developed for the general case are illustrated by application to problems in which simplifications are effected by first order approximations. Magnetic and gravity data can be treated in the same way.—*R. G. H.*

172–178. Dean, William C. Frequency analysis for gravity and magnetic interpretation: Geophysics, v. 23, no. 1, p. 97–127, 1958.

The operations of second derivative, analytic continuation, smoothing, the removing of residuals or regionals, and others in gravity and magnetic interpretation are analogous mathematically to the filtering action of electric circuits. The main difference between the two is that electrical filters act on functions of one variable (time), whereas the geophysical filters must act on functions of the two space variables (x and y). This paper develops linear filter theory for gravity and magnetic interpretation. As an application of the theory, downward continuation is discussed in some detail. The frequency response of upward continuation is an exponential function decreasing with increasing frequency. The inverse process of downward continuation has a frequency response which is the reciprocal of the upward continuation response. This paper discusses a method of matching frequency responses by coefficient sets and shows by examples some of the inherent difficulties in downward continuation. A final example calculated analytically shows how good a downward continuation can be expected from a finite coefficient set.—*Author's abstract*

Shalaev, S. V. Attempt at computation of the potential function in the lower half-plane from its values measured on the earth's surface. See Geophys. Abs. 172–110.

172–179. Serson, P. H., Mack, S. Z., and Whitham, K[enneth]. A three-component airborne magnetometer: Dominion Observatory Ottawa Pub., v. 19, no. 2, 97 p., 1957.

A three-component airborne magnetometer designed and built at the Dominion Observatory is described in detail. Sources of error in survey operations are discussed and the reduction of survey results and determination of corrections for the magnetic field of the aircraft described. The probable error of a survey observation as plotted on a chart is about 100 gammas in any component and is due principally to errors in navigation and plotting.—*V. S. N.*

172–180. Domzalski, W. Some problems of aeromagnetic surveys: Geophys. Prosp., v. 5, no. 4, p. 469–479, 1957.

Aeromagnetic observations are susceptible to errors in measurements of horizontal and vertical positioning, time variations of the earth's field and to instrumental errors. Positioning errors may be estimated in distances but final magnetic errors depend on horizontal and vertical gradients. Instrumental errors may be estimated in gammas and may be partly eliminated by closed traverses. Errors due to time variations are most difficult to estimate and nearly impossible to correct. Some scientific group should collate and study

time variation data for use in exploration magnetic surveys. Local magnetic anomalies should be studied in relation to the regional gradient. The observed regional gradient is preferred over tabulated or mapped regional gradient prepared for studies of the earth's main magnetic field.—*W. J. D.*

172–181.   Poomarev, V. N., and Suvorov, Ye. A.   Skvazhinnaya magnitometricheskaya ustanovka [A magnetometric installation for drill holes] :   Akad. Nauk SSSR Izv. Vostochnykh Filialov, no. 9, p. 46–52, 1957.

At present magnetic measurements in drill holes are limited to the determination of magnetic susceptibility along the wall and do not give any indication on the possible presence of magnetic bodies at some distance from the hole.   Such disturbing bodies can be revealed by an instrument, currently in development, that uses as indicators the vertical component of the magnetic field and the magnetic susceptibility.   This instrument consists of a magneto-sensitive thin plate of Mo-permalloy and a coil surrounding the plate.   The coil has two equal halves, each having 2,000 turns and producing magnetic fields of opposite directions.   Because of great leakage of the magnetic field the scale of the instrument is determined by calibration in a hole of known geologic properties.   The intensity of the field is measured by the zero-method, using an auxiliary coil carrying electric current of known amperage but of variable intensity.   The magnetic susceptibility is measured with the aid of an unbalanced Maxwell bridge.   To complete development of the instrument it is necessary to develop a method for determining on which side of the hole the disturbing body lies.—*S. T. V.*

172–182.   Fortier, Y. O., and Morley, L. W.   Geological unity of the Arctic Island, *in* Ocean floors around Canada (a symposium) :   Royal Soc. Canada Trans., ser. 3, v. 50, p. 3–11, 1956.

As a check of the hypothesis that the Canadian Arctic Archipelago is part of the North American continent, an airborne magnetometer survey was made along flight lines selected to intercept main geological regions of the northern islands.   Continuous magnetic recordings were maintained along any line whether over land or sea.   The resulting profiles can be classified into three regions that coincide with the major geologic regions.   If this correlation holds, the bedrock geology of the islands generally extends beneath the intervening arms of the sea as indicated by the continuity of the profiles.   The physiographic origin of the Archipelago is tentatively traced to an earlier Tertiary system of rivers draining a land totally above sea level and extending over the whole of the present Archipelago.—*V. S. N.*

172–183.   Bott, Martin Harold Phillips, and Masson-Smith, David.   Interpretation of a vertical field magnetic survey in north-east England [with discussion] :   Geol. Soc. London Quart. Jour., v. 113, pt. 1, p. 119–136, 1957.

A negative magnetic anomaly over the Alston Block is interpreted as another manifestation of a concealed grantite under Weardale.   Similar anomalies occur over exposed mineralized granites elsewhere, and arise from granite with low polarization existing in country rocks with higher polarization.   The magnetic minima are displaced to the south-east of the correspondng gravity minima, and it is thought that this is caused by permanent polarization directed westwards in the country rocks.   A violent positive anomaly lies immediately to the north at Blanchland and is tentatively interpreted as a marginal feature of the assumed granite.

A magnetic anomaly of Caledonian strike in Northumberland probably marks the southern limit of low-polarization basement rocks. This may well represent the south-eastern limit of the sub-Carboniferous outcrop of the Southern Uplands Upper Ordovician and Silurian rocks.—*Authors' summary*

172–184.   Henson, Frederick A.   An aeromagnetic survey of the Church Stretton area, Shropshire (with discussion) : Geologists' Assoc. Proc., v. 68, pt. 2, p. 107–114, 1957.

As the distribution of the various rock types is well known for the Church Stretton area in Shropshire, England, this survey provides a good opportunity to compare an aeromagnetic map with known geology.   The survey method is outlined and the magnetic profiles over major geological features are discussed. The most important conclusion is that there are many applications of the aeromagnetic method, both in regional surveys and in prospecting.   The wide range in age and lithology of the rocks of the area make this map extremely informative geologically.   The highest anomaly (positive) is related ot the Uriconian rocks, old volcanic rocks which form the topographic backbone of the region. Sharp changes in the magnetic field emphasize the throw of the Church Stretton Fault and also indicate that the Langmyndian sediments and Carboniferous rocks west of the fault are of considerable thickness.   The southern and eastern boundaries are less clearly defined and show that the Uriconian rocks probably underlie the lower Paleozoic at shallow depths.   Over the Wenlock and Aymestry limestones little magnetic variation was shown despite variations in relief and flying height.   In such areas the basement rocks are deeply buried but do exhibit the same southwest-northeast magnetization as the Uriconian.   The Carboniferous rocks are shown to occur in a clearly defined trough delineated on the east by the Church Stretton Fault.—*D. B. V.*

172–185.   Vogelsang, Dieter.   Geomagnetisches Strukturbild des Rodderberg-Vulkans südlich Bonn [Geomagnetic structural picture of the Rodderberg volcano south of Bonn] : Neues Jahrb. Geologie u. Paläontologie Monatsh., no. 1, p. 21–25, 1958.

The results of measurements of the vertical (27 stations) and horizontal (7 stations) magnetic anomalies at the Rodderberg volcano south of Bonn, Germany, are presented, with a map of vertical anomalies and north-south profiles of vertical and horizontal intensity.   The maximum vertical intensity appears over the crater-shaped depression at Broichhof, ringed by walls of ash.   The structural picture thus obtained is clearly that of a volcano, not an essentially tectonic depression as this has been considered.   A basalt plug has solidified in the central supply vent; ash falls and apophyses emanated from this main vent and partly from lateral supply channels.—*D. B. V.*

172–186.   Kutscher, Fritz.   Erdmagnetische Messungen auf Basalte in Hessen [Geomagnetic measurements on basalts in Hesse] : Deutsch. Geol. Gesell. Zeitschr., v. 109, pt. 2, p. 550–558, 1957 (1958).

A review of geomagnetic measurements in areas containing basalts in Hesse, Germany (various places in northern Hesse, in the Rhone basalts, in the Lahn-Dill basin, in the Taunus area, in the Vogelsberg, and in the Odenwald) shows that the use of magnetic methods provides a firm basis for geological research on basalts, and should be applied extensively in such studies.—*D. B. V.*

172–187.   Yokoyama, Izumi.   Geomagnetic anomaly on volcanoes with relation to their subterranean structure: Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 2, p. 327–357, 1957.

The results of the almost-completed survey of magnetic dip on the volcanic Seven Izu Islands, Japan, are considered in terms of interpretation of the underground structure of volcanoes.   Various theoretical aspects are treated—representation of the anomalies of a volcano by a dipole field, magnetization of igneous rocks and its range, and bulk density of the mountain mass.   For Volcano Mihara the depth of sources of the anomaly is determined by analyzing the vertical magnetic component; results of the gravity survey of Mihara (see Geophys. Abs. 172–159), the gravity and magnetic results around its parasite cones, anomalies of magnetic declination around the craters of Asama and Mihara, and results of aeromagnetic surveys of some Alaskan volcanoes are also discussed.—*D. B. V.*

172–188.   Geographical Survey Institute.   The second order magnetic survey of Japan (2): Geog. Survey Inst. Japan Bull., v. 5, pt. 1–2, p. 13–29, 1957.

The observed and reduced values of magnetic elements obtained are given in tabular form for 357 second-order stations in the Tohoku, Kanto, Chubu, and Kinki districts of central Japan, and for 37 third-order magnetic stations in the Izu peninsula.   In general, distribution of the anomalies in the geomagnetic vertical component seemed in harmony with underground structures but did not correlate with gravity anomalies.—*V. S. N.*

172–189.   Roze, T. N.   Skhema izogips poverkhnosti magnitnykh mass skladchatogo fundamenta Zapadm-Sibirskoy nizmennosti [Topography of the magnetic masses in the folded basement of the western Siberian lowland]: Akad. Nauk SSSR Doklady, v. 106, no. 5, p. 897–900, 1956.

The basement below the western Siberian lowland is believed to be a folded geosyncline, consolidated during the Paleozoic, on which lie almost horizontal sedimentary rock layers of Mesozoic age, as much as 3,000 meters thick.   An aeromagnetic survey has been made of the area south of parallel 62° N and magnetic properties of drill specimens have been investigated.   Depths were computed from the data on 1,200 anomalies characterized by the greatest horizontal gradients, and from these a contour map was constructed.   The differences between the depth of the magnetic mass and the upper surface of the basement were found with an error of not more than ±20 percent from 80 points of comparison.   It is concluded that the basement of the west Siberian lowland is an immense depression, slightly undulating in some parts.   Along the right bank of the Irtysh river the depth to the basement is 3.5 km along the line Ust-'Tshim-Tara.   North of this line the depth is slightly less.   In the northern Urals and farther eastward at latitude 64° N the depth of the basement is about 1.5 km at a distance of 60 km from the Ural ridge.   North of Ust-'Topsuy the magnetic data show a depression of more than 2 km.   In the region between the Ob' and Yenisey rivers the surface of the basement is about 2 km deep.   In the eastern half of the western Siberian lowland the magnetic anomaly varies smoothly, with a horizontal gradient of 5 to 10 γ per km.   A map indicating the main magnetic masses of the area studied is included.—*S. T. V.*

172–190.   Simonenko, T. N.   Ispol'zovaniye rezul'tatov aeromagnitnoy s'emki dlya vyyasneniya structury poverkhnosti fundamenta Zapadno-Sibirskoy nizmennosti [The use of data obtained from aeromagnetic

surveys in investigating the surface of the basement of the western
Siberian lowland]: Vses. nauchno-issled. geol. inst. Informat-
sionyy Sbornik, no. 3, p. 96–102, 1956.

The folded basement of the western Siberian lowland is composed of deformed
and metamorphosed sedimentary rocks of Paleozoic age (more precisely of pre-
Jurassic) and eruptive rocks. On this basement rest almost horizontal layers of
sedimentary rocks almost 4 km thick. These sedimentary rocks are practically
nonmagnetic, whereas the metamorphosed and erupted rocks possess significant
magnetic susceptibility and remanent magnetization; thus the source of the mag-
netic anomalies is in the basement. The entire area of this lowland has been
covered by a total-intensity areomagnetic survey. The depth of the disturbing
bodies was determined by several procedures including Simonenko's "integral
method". The depths of magnetic bodies were checked by drilling in 11 cases.
On the basis of determinations at more than 3,000 points, several geologic profiles
and a contour map were prepared. Results of drilling of 45 holes confirmed the
magnetic interpretations on the geology of the western Siberian lowland (see
Geophys. Abs. 172–189).—*S. T. V.*

172–191. Krulc, Zvonimir. Primjena geomagnetske metode na željeznim rudi-
            štima malog magnetskog susceptibiliteta u Bešlincu [Application
            of the geomagnetic method to iron ore occurrences of low magnetic
            susceptibility in Bešlinac (with Germany summary)]: Geol.
            Vjesnik, no. 10, p. 123–134, 1956 (1957).

A magnetic survey of the limonite deposits of the Bešlinac district in Croatia
was made using the step method. At Meterize an anomaly of 95γ corresponded
in its elongation and shape to the strike, dip, and form of an ore body already
known from borings. At Likarevac the anomaly corresponded to a lens-shaped
ore body; the southeast edge of the maximum corresponded to an old mine tun-
nel from which the ore apparently was only partially mined out. At Jokin
Potok also, a lens-shaped ore body was indicated by a small anomaly (65γ)
whose irregular shape is explained by the fact that the ore body consists for the
most part of "burnt iron". It is concluded that the step method with small in-
tervals between points may be used successfully in exploration for iron ores
of low magnetic susceptibility, in conjunction with subsequent mining-geological
investigations or borings.—*D. B. V.*

MICROSEISMS

172–192. Iyer, H. M., Lambeth, D., and Hinde, B. J. Refraction of micro-
            seisms: Nature, v. 181, no. 4609, p. 646–647, 1958.

The effect of ocean depth on the Rayleigh wave component on microseisms
can be calculated. Darbyshire has constructed refraction diagrams for Ber-
muda and the British Isles, for microseisms arriving from various directions
but has assumed straight and parallel wave fronts and used a method of geo-
metrical construction. Because the amount of refraction depends on the actual
position of the storm with respect to the recording station, parallel wave front
theory cannot be applied from microseisms generated by storms in the deep
ocean. New refraction diagrams have been constructed using the reciprocity
principle—that is, the Rayleigh waves are supposed to originate from the record-
ing station and travel outwards, circularly to start but becoming distorted as
the wave progresses through the Atlantic Ocean. From these wave fronts rays

are drawn at 2½° intervals. The source of the microseisms can be found by following a ray along the refracted path. It is suggested that many anomalies in the measured intensity and direction of arrival of microseisms can be explained by constructing such refraction diagrams and the aid of "microseismic barriers" may be unnecessary.—*M. C. R.*

172–193. Nanda, J. N., Achyuthan, K., and Balachandran, N. K. Periodicity in sea roughness, an origin of microseisms: Nature, v. 181, no. 4069, p. 646, 1958.

As radar clutter increases in amplitude with sea roughness it should be possible to estimate sea roughness by observations of radar clutter and hence to determine whether periods observed in microseisms are related to the periods of sea roughness. Recent observations by this method showed strong periods of 0.8 sec and 4.6 sec and a weak period of 1.2 sec. Nanda has proposed that periods in sea roughness produce corresponding periods in eddy viscosity at the sea surface, which in turn cause periodic changes in wind stress over the sea and thus pulsations in pressure over wide areas at the sea bottom.—*M. C. R.*

172–194. Bossolasco, M[ario], Cavo, A, and Dagnino, I. Sulla genesi dei microsismi [On the genesis of microseisms]: Geofisica Pura e Appl., v. 38, p. 45–56, 1957.

From seismic and sea-wave records made in Genoa during the period March 1, 1953 to May 31, 1954, it is shown that great agitation of the sea provokes corresponding microseismic activity. Analysis of many other microseisms shows that they are all generated by the direct action of the wind on the ground surface, as a result of wind turbulence, particularly on mountain sides. It is further demonstrated that the Alps and Appennines act as a barrier to microseisms around Genoa. These results show that in general the cause of microseisms is purely meteorological in nature.—*D. B. V.*

172–195. Hardtwig, E. Über die Enstehung der Mikroseismik [On the origin of microseisms]: Zeitschr. Geophysik, v. 23, no. 2, p. 83–112, 1957.

If the earth's crust is considered as an elastic layer lying on a weak substratum, it may behave like a free vibrating plate. Microseisms might then be regarded as free vibrations of the crust. Results in good agreement with observations of microseisms can be calculated by assuming a granitic crust 33 km thick.—*M. C. R.*

172–196. Annau, Edgar, and Posgay, Károly. A talajnyugtalanság [Ground tremor]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, v. 5, no. 4, p. 3–6, 1956.

Inasmuch as the character of microseisms depends on the depth of the basement and nature of its cover, it is suggested that systematic observations of ground tremor could be used in favorable cases as a geophysical prospecting method comparable to gravity or telluric methods, but even faster and cheaper. —*D. B. V.*

172–197. Kishinouye, Fuyuhiko. Studies of microseisms by observations: Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 3, p. 533–543, 1957.

Correlations between microseisms recorded at Hongo, Tokyo and meteorological data (sea waves, swell, wind velocity, wind direction, air pressure) are sometimes close, sometimes not; although the data are numerous no definite conclusion can be obtained. Analysis of their annual variation shows that microseisms are small in spring and large in late autumn and early winter, and very large in summer when a typhoon passes at sea along the east coast of northern Japan. Simultaneous tripartite observations at various stations show correlation in period of all stations north of the Tama river; difference in movement at one station south of the river recalls an earlier idea of Kishinouye's considering microseisms to be vibrations of blocks of land, but because of the insufficiency of data and small signal–to-noise ratio, no definite conclusion is drawn.—*D. B. V.*

172–198. Kishinouye, Fuyuhiko, and Shida, Isamu. Tripartite observation of microseisms at Sakata: Tokyo Univ., Earthquake Research Inst. Bull., v. 34, no. 4, p. 301–306, 1956.

Observations of microseisms on February 5, 1956, at a tripartite station indicate they were propagated with a velocity of 750 meters per sec from the east. Relations between microseisms and weather conditions indicate that microseisms at Sakata, as well as at Tokyo are caused by sea waves off the northeastern coast of Japan and are propagated along the sea bed toward land.—*M. C. R.*

RADIOACTIVITY

172–199. Lavrukhina, N. N. Yadernye reaktsii v prirode [Nuclear reactions in nature]: Priroda, no. 3, p. 24–30, 1957.

A review of radioactive transformations occurring in nature, giving tables of the abundance of 21 elements in the crust and in the cosmos, and of the type of decay, half-life, and stable end product of the decomposition of 26 naturally radioactive isotopes.—*D. B. V.*

172–200. Sakakura, A[rthur] Y. Scattered gamma rays from thick uranium sources: U. S. Geol. Survey Bull., no. 1052–A, 50 p., 1957.

A numerical and analytical investigation of certain simple source types of air-scattered gamma rays, never found in nature, but covering the entire range of variation in shape and size found in natural sources, was undertaken to advance airborne surveying from the qualitative to the semiquantitative estimation of natural-source parameters. The results establish the expression for the elementary-source intensity, a comparison of experimental results with existing theoretical knowledge, and the effect on the apparent peak intensity of the finite cone of response and resolving time of a counting rate meter. Characteristics of selected source types are established and a possible mode of interpreting airborne radioactivity measurements in terms of natural-source parameters is outlined.—*V. S. N.*

172–201. Korshev, A. A. Opredeleniye intensivnosti gamma-izlncheniya v ob'emnykh radioaktivnykh istochnikakh s uchetom effekta rasseyaniya [The determination of gamma radiation from volumetric radioactive sources taking into consideration scattering]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 9, p. 1189–1193, 1957.

A summary of the basic laws of γ-radiation from spatial sources, both monochromatic and mixed radiation. The case is also treated of radiation crossing the boundary of two media.—*S. T. V.*

172–202.   Schumann, G.   Radioaktivität der Atmosphäre, der Erde, und des Ozeans [Radioactivity of the atmosphere, the earth, and the ocean] : Umschau, v. 58, no. 5, p. 141–143, 1958.

A review of the sources of radioactivity in the earth, air and oceans (natural substances in the crust and their emanations into the atmosphere; cosmic–ray produced radioisotopes in the upper atmosphere; and artificial radioactivity generated by atomic explosions) and of the IGY program of measurements of the earth's radioactivity. Systematic measurements of atmospheric radioactivity close to the earth's surface are expected to contribute not only to direct knowledge of the worldwide distribution of radioactivity, but also indirectly, through radioactive tracers, to knowledge of atmospheric and oceanic currents and related meteorological problems.—*D. B. V.*

172–203.   Hamilton, E.   Distribution of radioactivity in rocks and minerals, and the effect of weathering on determinations of uranium : Nature, v. 181, no. 4610, p. 697–698, 1958.

A plot of total alpha particle radioactivity against uranium content can indicate whether or not the uranium-thorium ratio is constant, and the effect of weathering on the ratio. The radioactivity of the major rock forming minerals is essentially constant. Weathering can lead to a loss of about 50 percent of the total radioactivity and sometimes up to 50 percent of the uranium content. The distribution of such rare accessory minerals as uraninite and thorite may be far more common than realized. The presence of such minerals prevents the determination of purely intercrystal radioactivity by acid leaching studies. In some accessory and even major minerals, appreciable amounts of radioactivity may be present in "iron haloes" surrounding the mineral and on cracks within the mineral. The radioactive material in such locations is easily leached.—*Author's conclusions*

172–204.   Adams, John A. S., and Weaver, Charles E.   Thorium-to-uranium ratios as indicators of sedimentary processes: Example of concept of geochemical facies: Am. Assoc. Petroleum Geologists Bull., v. 42, no. 2, p. 387–430, 1958.

Because of analytical difficulties, few data are available on the thorium and uranium contents of sedimentary rocks. More than 200 new thorium and uranium determinations have been made by a gamma-ray spectral technique and by an alpha activity-fluorometric uranium technique. Together these two independent techniques can be used as an experimental test of secular radioactive equilibrium. Only rarely in this study have fresh samples of ancient sedimentary rocks been found out of radioactive equilibrium. The accuracy of the thorium-to-uranium ratio determinations is more than sufficient for many geologic studies.

The thorium-to-uranium ratios in sedimentary rocks range from less than 0.02 to more than 21. Ratios in many oxidized continental deposits are above 7, whereas most marine deposits have ratios much below 7. Thus, the thorium-to-uranium ratio varies with sedimentary processing and depositional environment. A cyclothem and several other sedimentary sequences illustrate the use of this ratio to distinguish environments and processes. The thorium

content of shales varies much less than the uranium content. By mineral and trace-element analysis an attempt has been made to evaluate the resistate, hydrolyzate, clay, and precipitate (evaporite) contributions to the thorium and uranium contents of sedimentary rocks. These data also provide some insight into the details of the mobilization, transportation, and fixation of thorium and uranium in the sedimentary cycle.

Field tests indicate that quantitative potassium, uranium, and thorium determinations can be made with a spectral gamma-ray logging instrument. Logs obtained with such instruments may provide an important additional means for subsurface interpretations.—*Authors' abstract*

172–205. Homilius, J., and Lorch, S. Density determination on near-surface layers by gamma absorption: Geophys. Prosp., v. 5, no. 4, p. 449–468, 1957.

A technique is described whereby soil density to depths of 80 to 100 cm can be determined by measurements of gamma-ray absorption. A cobalt–60 or cesium–137 gamma source, attached to the end of a probe, is inserted in the soil and the radiation flux is measured at the surface by a pair of symmetrically arranged Geiger counters.

Absorption of gamma radiation is a function of density so that observations of two quantities, source-counter distance and radiation intensity at the surface, will yield by means of calibration curves or appropriate equations, the density of the medium.

Examples of calibration curves based on empirical measurements in media of known density are given. Experiments with multi-layered media of different densities show that the slope of curve changes abruptly at the interfaces.

Comparison of the observed data with theoretical consideration shows satisfactory agreement. Accuracy of the densities in homogeneous media calculated by the gamma-ray absorption technique is ± one percent.—*R. M. M.*

172–206. Hayase, Ichikazu. The radioactivity of rocks and minerals studied with nuclear emulsion IV: Thorium-uranium ratio measurement of the minute radioactive minerals by the photographic method: Kyōto Univ. Coll. Sci. Mem., ser. B, v. 23, no. 2, p. 255–274, 1956.

The uranium-thorium ratio of the minute grains of radioactive accessory minerals in granites can be determined photographically from a study of the total alpha track length distribution—a comparative abundance of long tracks indicates a greater abundance of thorium content. Long time exposures are important to avoid the effects from leakage of radon or thoron. The distribution of the radioactive material can be detected exactly by inserting a silver foil absorber, equivalent in thickness to the alpha range of the RaC (Bi^{214}) between the photo plate and the thin section of rock with the result that the photo plate catches only the residual track of ThC (Bi^{212}). The ratio of this residual track number to the total track number measures the thorium-uranium ratio.—*V. S. N.*

172–207. Mahadevan, C., and Sastry, A. V. R. Distribution of radioactivity in the rocks of south India. Part 4, Fluorine-bearing granites of Podili-Kanigiri area and associated rocks: Indian Acad. Sci. Proc., v. 46, no. 5, p. 333–342, 1957.

Radioactivity of 27 granites and associated rocks (8 granites, 6 feldspathized schists and gneisses, 3 schists, 4 batholithic(?) granites, and 6 phyllites and slates) from the Podili-Kanigiri area of India has been measured and found to range from 5.20×10^{-6} eU per g (in a silicified schist) to 45.86×10^{-6} eU per g (in a pink granite). Comparison with chemical and modal analyses shows that metasomatically formed granites are more radioactive than the normal batholithic type; that granitization enhances the radioactivity of the country rocks; and that radioactivity increases with feldspathization of the country rocks. The radioactivity in rocks therefore should be a clue to the petrogenetic history.—*D. B. V.*

Roubault, Marcel, and Coppens, René. Study of the distribution of radioactivity and of lead in a zircon crystal. See Geophys. Abs. 172–8.

172–208. Hatuda, Zin'itiro, and Nishimura, Susumu. Variation in radioactivity across igneous contacts: Kyōto Univ. Coll. Sci. Mem., ser. B, v. 23, no. 2, p. 285–295, 1956.

Distribution of radioactivity across igneous contacts was investigated with a radioscope with a Lauritsen element to test pulverized samples of feebly radioactive rocks and minerals. Variations in radioactivity were found in both wall rock and intrusive rock but the more conspicuous variation was in the intrusive rock. Profiles obtained across contacts were tentatively classified into five types to be modified in the future when more data are available.—*V. S. N.*

172–209. Terentiuk, F. Measurement of artificial radioactivity in the atmosphere at Ottawa, Canada: Canadian Jour. Physics, v. 36, no. 1, p. 136–139, 1958.

Daily variations in gross beta activity of the atmosphere measured by dust filters at Ottawa from May 21, 1956 to May 21, 1957 show a number of high maximums that can roughly be correlated with reports of nuclear explosions (11 by U. S. S. R. and 1 by U. S. A.) gleaned from unofficial accounts. Following a series of explosions, activities up to approximately 10^{-14} curies per liter were observed. Increased activity persists for some time after the tests. No detailed attempt is made here to correlate with meteorological phenomena but some evidence of scavenging action of rain is indicated.—*D. B. V.*

172–210. Daddi, Lino; Franceschi, Luciano de; del Corse, Giancarlo; and Michelassi, Lionello. Misure della radioattività dell'aria [Measurements of the radioactivity of the air]: Ricerca Sci., v. 27, no. 11, p. 3313–3322, 1957.

This reports the results of measurements of radioactivity of the air made by the physics laboratory of the Naval Academy at Livorno, Italy. Natural radioactivity (radon, thoron, and derivatives) ranges between 111.5 and 747 millimicrocuries per m^3 for the period March 20 to June 15, 1957, and artificial radioactivity (fission products), recorded from May 28 through June 15, 1957, ranges between 0.40 and 1.75 millimicrocuries per m^3; these values are all well below permissible levels according to the Atomic Energy Commission.—*D. B. V.*

RADIOACTIVITY LOGGING AND SURVEYING

172–211. Bowie, S. H. U. Radiometric and geochemical survey techniques: Nature, v. 181, no. 4609, p. 594–596, 1958.

A report of the geophysical discussion of the Royal Astronomical Society on January 31. Bowie reported that most discoveries of uranium in the past decade have been made by "the sound application of geological knowledge aided by instruments capable of detecting and measuring the gamma radiation from near surface mineral occurrences," and described the use of such instruments in both airborne and ground surveys. J. S. Webb reported on geochemical methods of mineral exploration. J. E. T. Horne spoke on the determination of the age of radioactive minerals and the importance of such work in search for further deposits, and outlined the principles of dating minerals by various lead ratios. The last speaker, W. Bullerwell, discussed drill hole methods.—*M. C. R.*

172–212. Budde, E. Radon measurements as a geophysical method: Geophys. Prosp., v. 6, no. 1, p. 25–34, 1958.

Uranium deposits concealed by unconsolidated overburden may be revealed by anomalous radon concentration in soil gas. In order to predict the distance which radon will travel through unconsolidated materials, field, laboratory and theoretical studies were made on the relation of radon diffusion coefficients to grain size and moisture content of several media. Dry samples all have coefficients equal to that in open air. Diffusion column experiments on naturally moist samples show that the order of diffusion coefficient can be predicted solely from grain size analyses. Thus, the distance at which anomalous radon can be detected from a point source may be computed. Computations show that such distances vary from less than 5 cm in boulder clay to more than one meter in sand.— *R. M. M.*

172–213. Zaslavskiy, Yu. S., and Kreyn, S. E. Radioaktivnye isotopy v neftyanoy promyshlennosti [Radioactive isotopes in the petroleum industry]: Priroda, no. 8, p. 35–44, 1957.

A review of the various uses of radio-isotopes in the petroleum industry, including exploration, exploitation, and refining.—*D. B. V.*

172–214. Rothé, J[ean]-P[ierre]. La radioactivité des Vosges hercyniennes [The radioactivity of the Hercynian Vosges]: Koninkl. Nederland. Geol.-Mijnb. Genootschap Verh., geol. ser., pt. 18, p. 253–270, 1957.

A description of the techniques, procedures, and operation of radioactivity surveys of the Hercynian Vosges; results are presented in the form of graphs and a radiogeologic map. Numerous geological correlations can be made from such maps, revealing the fundamental structural characteristics of the Vosges. Unanswered questions concern the origin of the different degrees of radioactivity of the different petrographic units; relation of radioactivity to petrographic facies; and possible correlation of radioactivity with the age of emplacement of the various units. With regard to the last, there are two alternatives: either the pre-Hercynian basement was characterized by weaker radioactivity, or else the radioactivity—weak at first—reached a maximum at the time of the Hercynian orogenic paroxysm and then decreased.—*D. B. V.*

172–215. Caldwell, Richard L., and Sippel, Robert F. New developments in radioactive well-logging research: Am. Assoc. Petroleum Geologists Bull., v. 42, no. 1, p. 159–172, 1958.

Laboratory experiments on the interactions of neutrons and gamma rays with common earth elements, sedimentary rocks, and the fluids found in these rocks

and in the borehole show that several common elements can be identified by the gamma rays produced when rocks are bombarded with high-energy neutrons. Carbon, oxygen, hydrogen, sulfur, magnesium, and silicon can be identified by observing the "prompt gamma rays" emitted during neutron bombardment and oxygen, aluminum, and silicon can be identified on the basis of "delayed gamma rays". The density of formations, borehole fluids, and of cement behind steel pipe can be measured by use of a collimated source of gamma rays in a scintillation detector.—*M. C. R.*

172–216.   Przewłocki, K., Krzuk, J., Jurkiewicz, L., and Owsiak, T.   Aparatura do profilowania naturalnego promieniowania beta i gamma w poziomych odwiertach dla poszukiwań soli potasowych [Apparatus for logging natural beta and gamma radioactivity in horizontal boreholes in exploration for potassium salts] : Acta Geophys. Polonica, v. 5, no. 4, p. 283–307, 1957.

Apparatus developing logging in horizontal boreholes 66 mm in diameter consists of: a probe containing a Geiger counter (either a beta counter with 0.15 mm aluminum walls or a gamma counter with 1 mm brass walls), high voltage supply and preamplifier; an integrating circuit connected to the probe by a 3-core cable; an oscilloscope; stabilized power supplies; a Selsyn indicator of the depth at which the probe is located; and drums for cable and steel rope. The probe is moved along the borehole with the help of a stiff rod or steel rope. By use of such equipment logging can be carried out to depth of 200 m, and potassium salts can be located and distinguished from rock salt and clay. In thick beds it may be possible to determine the concentration of potassium.—*M. C. R.*

172–217.   Buckles, R. S.   Locating the gas-oil contact in partially depleted reservoirs: Canadian Oil and Gas Industries, v. 11, no. 2, p. 47–52, 1958.

Examples are presented to show the successful use of the neutron log in detecting the exact position of reservoir fluid contacts in two Alberta reef fields.—*V. S. N.*

172–218.   Cutmore, T. P.   Reservoir parameters from the gamma ray log Cardium sand—Pembina Field: Canadian Oil and Gas Industries, v. 11, no. 2, p. 39–46, 1958.

Weighted average porosity data, dimensionless capacity, and permeability distribution curves are determined in the Cardium sand, Pembina Field, Alberta, by using a combination of gamma ray logs and micrologs. These logs are used as a substitute for core analysis, thereby reducing the amount of coring necessary.—*V. S. N.*

SEISMIC EXPLORATION

172–219.   Berzon, I. S.   Razvitiye metodov seysmicheskoy razvedki v Sovetskom Soyuze [Development of seismic exploration methods in the Soviet Union] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 11, p. 1347–1358, 1957.

This is a review of the progress in seismic exploration in the U. S. S. R. during the last ten years. The most important developments were: use of higher- and lower-frequency waves; the use of the dynamic characteristics of waves, their amplitudes, shape, frequency spectrum, type of polarization of the

transverse waves; the study and the use of various nonlongitudinal waves (transverse, surface, converted).—*S. T. V.*

172–220. Gamburtsev, G. A. O nekotorykh novykh metodakh seysmologicheskikh issledovaniy [Some new methods of seismologic investigations]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 12, p. 1431–1437, 1957.

A great improvement in seismic exploration methods was the introduction of continuous identification of recorded waves on the seismogram by the so-called "correlation method of refracted waves," denoted in Russian scientific literature by the symbol *KMRV*, (correlation here means identification.) Two types of correlation are used in seismic exploration. In the first the maximums and minimums of a wave are traced from point to point; thus the phase is a function of the position of the seismograph on the profile. This phase correlation is called "positional" correlation. The second correlation is azimuthal. Here the observer remains at one station but has several identical seismographs oriented at different angles with relation to the profile and as a rule inclined towards the earth's surface. The azimuthal correlation shows clearly longitudinal, transverse, and surface waves, as well as irregular and regular waves. Comparison of the two kinds of correlation charge (positional and azimuthal) makes it possible to distinguish regular and irregular (disturbing) waves such as microseisms.

Low-frequency waves are recorded with special seismographs, called seismoinclinometers, which record the velocity of the inclination of a natural period ranging from several minutes to tens of minutes. The spectra of waves from earthquakes at epicentral distances of not more than 100 km usually contain such predominantly low-frequency waves that weak sesimic shocks produce transverse waves of greater intensity than the longitudinal waves. As a rule in seismically active regions the hypocenters of the weak and the strong shocks geometrically coincide. Transverse waves are absent from those artificially produced by explosions. To be in the position to observe high frequency seismic shocks of low intensity it is necessary to install the seismographs in firm rock, in places not exposed to the action of wind, far from inhabited or industrial centers, and from roads. Using sufficiently high amplifications (up to several millions) and the frequency of the waves in the region from 10–30 cycles per second, it is possible to obtain good seismologic and seismic methods; the author suggested increasing depth and naturally the length of used profiles. Profiles as much as 400 km long were used in exploration of the northern Tien Shan. The success of this procedure led to its application in many other regions and made it possible to obtain more reliable and more detailed data on deep geologic formations.—*S. T. V.*

172–221. Riznichenko, Yu. V. Dopolneniye k stat'ye Gamburtseva "O nekotorykh novykh metodakh seysmologicheskikh issledovaniy" [A supplement to the G. A. Gamburtsev's article "Some new methods of seismological investigations"]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 12 p. 1435–1436, 1957.

The fundamental features of recent seismological methods developed and applied in many surveys by a group of Russian seismologists under the leadership of G. A. Gamburtsev are: the extension of the diapason of recorded frequencies and amplitudes of waves produced by earthquakes or artificial explosions; the application in the study of the earth's crust of the methods borrowed from "experimental seismology," primarily of deep seismic sounding, suggested again

by Gamburtsev. During the years 1956–1957 the method of observing waves, using "azimuthal arrangement" of seismographs was introduced. In this recording several identical seismographs are installed at one station, making varying angles with the profile. This method was used in the investigation of Tian Shan and Pamir Mountains. Similar methods were used in the central Caspian Sea and later the transition zone connecting the continent of Asia with the Pacific Ocean in the region of the Sea of Okhotsk. This investigation forms a part of the International Geophysical Year.—*S. T. V.*

172–222. Voyutskiy, V. S. Obnaruzheniye slabykh seysmicheskikh signalov sposobom nakopleniya [The detection of feeble seismic signals by the method of accumulation]: Prikladnaya geofiz., no. 15, p. 14–23, 1956.

The detection and recording of seismic signals is always done against a background of noise. The condition of signal reception can be characterized by the signal-to-noise ratio. When the signal-to-noise ratio approaches unity or becomes less than unity, the reception of useful signals by ordinary methods becomes impossible. If the frequency of useful signals is constant, resonant amplifiers may be used. When the frequency of the noise is different from that of the signals, or is variable, useful signals can be amplified and recorded. This method can be applied in many investigations of vibrations, but not in seismic studies. A method is suggested for use when the duration of signals is not too short and when the disturbances are not coherent—that is when they are purely accidental, not subject to any law. In this method, an electronic device indicates the difference between two quantities; one the sum of the signals and the disturbances, the other only the disturbances.

The method has lower resolving power than the procedures usually employed, but often gives valuable information.—*S. T. V.*

172–223. Gal'perin, E. I. Gruppirovaniye pervogo roda i sposob polncheniya mnogokomponentnykh azimutal'nykh seysmogramm [The grouping of the first kind of multiple seismographs and the method of receiving multicomponent azimuthal seismograms]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 9, p. 1081–1098, 1957.

The propagation of elastic waves can be described by two parameters: the direction of the particle in the path of wave, and the direction of the propagating wave. To these two parameters correspond two methods of observation: the point method and the profile method. In the point method the total vector of an oscillating point is studied. It is used mainly in the study of earthquakes, on the basis of material recorded by a single station. In the profile method only one, usually the vertical, component of the oscillating vector along the line of observation is studied at several points, called seismic profile. A detailed discussion is presented of the azimuthal grouping, called "first kind of grouping." This grouping makes possible the changing of axial direction and by this manner varying the directional sensitivity of the diagram. Equations for this type of grouping are derived and the method of obtaining multicomponent azimuthal seismograms is described. A brief description of the corresponding instruments, especially of the polarizing seismic analyzer, is given. Examples are given of azimuthal seismograms obtained by this procedure. In this grouping the diagram giving the direction of the group coincides with the directional diagram of any seismographs of the group. The difference between the diagrams consists

only in amplitudes. The azimuthal grouping makes it possible to increase the sensitivity of the set up. The properties indicated above can be used for the approximate determination of the displacement of longitudinal waves. It is also useful in the studies of polarization of microseismic waves. This type of grouping allows many combinations of different positional and azimuthal versions of grouping. The article contains numerous seismograms and figures.—*Author's summary, S. T. V.*

172–224. Veytsmann, P. S. Korrelyatsiya seysmicheskikh voln pri glubinnom seysmicheskom zondirovanii zemnoy kory [The correlation of seismic waves recorded by deep seismic profiling of the crust of the earth]: Akad. Nauk SSSR Izv. Ser. no. 12, p. 1438–1452, 1957.

Deep seismic profiling, suggested by G. A. Gamburtsev for investigation of deep seismic boundary surfaces of the crust, is based on the correlation of the front waves refracted on boundary surfaces. The waves are excited by relatively small explosions and are recorded at great distances—as much as several hundreds kilometers from the shot point. On the seismograms' seismic sounding are recorded numerous clearly visible groups of waves, each group showing similar kinematic and dynamic characteristics that remain unchanged all the way from the shot point, but differ from group to group. $P°$, $P*$ and P on the seismograms of deep profiling correspond to $\bar{P}$, $P*$ and P on the seismograms of earthquakes; however $\bar{P}$ is always the wave propagating in granite, and $P°$ is the front wave refracted on the boundary surface of this layer or on some inner surface of it. The first waves of the groups $P*$ and P are the longitudinal front waves, related to the basalt surface or to the Mohorovičić discontinuity. On the basis of the analysis of kinematic and dynamic characteristics of seismic records at different distances from the shot point, criteria are found for the separation and identification of groups of waves even if they are recorded on disrupted seismograms. The principles of correlation make it possible to analyze simultaneously material obtained from points separated by hundreds of kilometers.

Surveys have been successfully made in the Tien Shan, southwestern Turkmenistan (1953), and Pamir (1955).—*S. T. V.*

172–225. Ryazanova, Yu. V. Ispol'zovaniye ploshchadnoy s'yemki is odnogo punkta vzryvav metode otrazhennykh voln pri razvedke pologikh struktur [Use of area surveying from one shot point in the method of reflected waves while exploring dipping structures]: Akad. Neftyanoy Promyshlennosti Trudy, no. 3, p. 92–96, 1956.

To increase reliability of the seismic method over dipping structures, area sounding can be used. The most reliable correlation of the reflected waves is obtained in this way, and repeated checks of the correlation of waves on closed polygons are possible. Either one shot from one point or additional shots from different shot points are used. Individual squares are assumed to be horizontal and covered with a homogeneous layer. Where the dip is not greater than 2°, the depth is 3,000 m and the horizontal distance is 1,500 m; the errors in depths are not greater than a few tens of meters at most.—*S. T. V.*

172–226. Ryabinkin, L. A. Osnovy razreshaynshchey sposobnosti reguliruyemogo napravlennogo priyema (RNP) seysmicheskikh voln [Principles of the resolving capacity of adjustable directed reception of seismic waves]: Prikladnaya geofiz., no. 16, p. 3–36, 1957.

At the present time the greatest difficulties in the interpretation of seismic records are due to interference of waves. A method which makes possible separating of the waves in the zones of the seismic profile where these waves are mixed, was suggested by F. Rieber in 1936, but had little success because of the lack of instruments that could be used in the procedure without a great amount of laboratory work. In 1944–1947 the "All Union Institute of Geophysical Methods of Exploration" undertook a study of the method; special instruments were built; and the theoretical and experimental aspects of the method were thoroughly investigated. In 1949 the powerful resolving power of this method, that is, the capacity to separate from several interfering seismic waves the singular component waves, was discovered. The method consists in the optical recording of nine points on the profile, a photoelectric summation of the seismograms with the ensuing additional frequency filtration during the summation and, finally the separation of the waves on the films based on the presence of common characteristics.—*S. T. V.*

172–227. Puzyrev, N. N. Primeneniye chislennykh metodov osredneniya pri opredelenii skorostey po godografam otrazhennykh voln [Use of numerical methods of averaging in determining velocities from traveltime curves of reflected waves]: Prikladnaya geofiz., no. 16, p. 50–84, 1957.

To determine effective velocities from traveltime curves of reflected waves, several recorded moments of time are selected, related either to one traveltime curve or to two going in opposite direction. If the boundary surface is plane and the medium is homogeneous, it is sufficient to use three points only. Usually there are many points available for such calculations which make it possible to average the obtained results. To simplify the mathematical treatment the traveltime curves are transformed into straight lines. Several practical examples are worked out and discussed. The methods exclude possibility of errors intrinsic to the graphical method but make necessary the use of calculating machines.—*S. T. V.*

172–228. Weber, Max. Die abschnittsweise Darstellung einer gemessenen Laufzeitkurve mit abgebrochenen Potenzreihen und ihre Auswertung in der Refraktionsseismik [The sectional construction of an observed traveltime curve with discontinuous power series and its evaluation in seismic refraction]: Geofisica Pura e Appl., v. 38, p. 57–80, 1957.

A method is developed for the direct interpretation of traveltime curves in seismic refraction work that is simple and particularly convenient for numerical calculation. By way of illustration the method is applied to Röthlisberger's measurements of ice thickness in Baffin Island.—*D. B. V.*

172–229. Bogdanov, A. I. Prinemy interpretatsii lineynykh prodol'nykh godografov otrazhennykh voln v shichaye nepreryvnykh sred [Procedures of interpretation of longitudinal traveltime curves of reflected waves in the case of continuous media]: Akad. neftyanoy promyshlennosti Trudy, no. 3, p. 97–105, 1956.

The equation for the velocity of a wave propagating along the seismic ray had been previously established in the form: $v_H = v_o(1+\beta_n H)^{1/n}$. In the present study is discussed the procedure of determining the parameters v_o, β_n, n from measurements in drill holes as well as the determination by a graphoanalytical

procedure of the position of reflecting surfaces from the traveltime curves of the reflected waves.—*S. T. V.*

172–230. Bortfeld, R[einhard]. A method of dip corrections for expanding spread velocity measurements: Geofisica Pura e Appl., v. 38, p. 32–44, 1957.

A method is described which takes account of the dip of the reflecting interfaces by applying corrections to the travel-times. This correction simultaneously provides a smoothing of that portion of the scattering of the x^2—t^2 data which is caused merely by the dip of the reflecting beds. Furthermore, a new reflection correlation control is derived. The average velocity is determined using the method of least squares. Finally, a numerical example is treated. —*Author's summary*

172–231. Kilczer, Gyula. Kiékelödö réteg adatainak meghatározása szeizmikus refrakciós méréssel [Determination of a pinched-out layer by seismic refraction measurements]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, v. 6, no. 3–4, p. 19–23, 1957.

Dip, velocity, and depth data for a pinched-out layer are easy to determine if the apparent velocity of the layer it covers can be obtained from the traveltime diagram. The determination of these data is equally possible not only for normal but also for abnormal velocity distributions (inversion). Dip and velocity are calculated from the known formulas of multilayered problems, depth by means of the travel time.—*Author's German summary, D. B. V.*

172–232. Mituch, Erzsébet. Szeizmikus refrakciós mérések kiértékelése idöellenörzéssel. [Evaluation of seismic refraction measurements by means of time checking]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, v. 6, no. 3–4, p. 25–43, 1957.

A discussion of the principles and value of Kilczer's "time checking" method of interpreting refraction measurements (see Geophys. Abs. 156–93, 165–345, and 172–231). The dip of interfaces is constructed from the shortest time paths; conclusions as to depth are drawn from comparison of the calculated times and observed arrivals. The method has been used for several years by groups of the Roland Eötvös Geophysical Institute and found to be very useful even in complicated structures.—*D. B. V.*

172–233. Karapetyan, B. K. Rezul'taty seysmometrichesikikh nablyudeniy pri massovykh vzryvakh [Results of seismometric observations of mass explosions]: Akad. Nauk Armyanskoy SSR Izv., v. 10, no. 3, p. 21–33, 1957.

Seismometric measurements were made of many large quarry blasts in 1955–56 in different parts of the Armenian S. S. R. Thirteen seismometers were differently distributed around the shot points. The amount of explosives ranged from 1,700 to 26,800 kg; the depth of the bore pits in which the explosives were placed ranged from 3 to 9 meters, and the total number of pits from 6 to 40. The effect of the explosion is determined by the geologic conditions of the surrounding area, by the distance from the shot point, by the relative positions of the shot point and the point of the observation—no simple relation among all factors could be determined. Results are shown graphically and in tables of data characterizing the explosion as the seismic acceleration expressed in fractions of g.—*S. T. V.*

172–234. Obert, Leonard, and Duvall, Wilbur I. Microseismic method of determining the stability of underground openings : U. S. Bur. Mines Bull., no. 573, 18 p. 1957.

This is a summary of investigations conducted from 1940 to 1955 to determine to what extent the seismic disturbances, termed "microseismims," generated by rock under stress can be used to detect, localize, and determine the magnitude of areas of instability in and around mine openings. Characteristics of microseismims and microseismic equipment are reviewed and experimental procedure and analysis of results are discussed. Microseismic investigations to date have been concerned with the structural stability of underground openings. There are two classes of investigations : In the first, the stope is normally stable but changes in the stress pattern are induced by continued mining. In the second, there is pre-existing evidence of excessive stress such as visible indications of ground movement. A detailed discussion of investigations in the Cliffs-Shaft mine, Ishpeming, Michigan and in the Zinc Mines Works, Jefferson City, Tennessee is given to illustrate these two types of stability studies. The application of the method to the prediction of rock bursts in the Ahmeek mine, Ahmeek, Michigan is also described.—*V. S. N.*

172–235. Krey, Theodor. Erweiterte Möglichkeiten für die Refraktionsseismik durch die Verwendung von Geophonen mit niedriger Eigenfrequenz [Greater possibilities for seismic refraction by the use of geophones with low fundamental frequency] : Geol. Jahrb., v. 74, p. 523–530, 1957.

The use of geophones of low fundamental (natural) frequency in seismic refraction permits not only the treatment of greater depths with reasonable amounts of explosive, in general; it also makes it possible to discern certain deep horizons of higher velocity when intermediate layers with similarly high velocities are present in the overlying rocks. The only assumption is that the thickness of the intermediate layers individually is of a smaller order of magnitude than the longest wave length still clearly measurable. In this way many problems are open to treatment today by seismic refraction which formerly were considered unsuitable for this method. For evaluation, the theory of anisotropy of layered media can be applied advantageously.—*Author's summary, D. B. V.*

172–236. Ruprecht, Leo, and Zettel, Waldemar. Beispiele aus der seismischen Bodenforschung [Examples from the seismic investigation of the ground] : Geol. Jahrb., v. 74, p. 653–676, 1957.

A review of progress in seismic reflection and refraction instruments, methods, techniques, and interpretations in recent years, illustrated by numerous reproductions of seismograms.—*D. B. V.*

172–237. Sultanov, F. S. Vyyavleniye nalichiya i prichin azimutal'nykh anomaliy v rayone rabot Shemakhinskoy seysmicheskoy ekspeditsii v 1953 g [Discovery of azimuthal anomalies and their causes in the region explored by the Shemakha seismic expedition of 1953] : Akad. Nauk Azerbaydzhan. SSR Doklady, v. 13, p. 623–628, 1957.

The azimuthal angle of the arriving seismic ray coincides with the azimuth toward the source when strata between the station and the epicenter are horizontal but is different when the surrounding strata are inclined or are not plane. These "azimuthal anomalies" are also observed in the angle of emergence of

the seismic ray. A graphoanalytical method of determining the plane inclined boundary separating the strata is presented. The method is based on established relations between the azimuthal anomaly and the angle of the arrival of the seismic ray. The suggested procedure makes it possible to determine seismic velocities in the media on either side of the separating plane.—*S. T. V.*

172–238. Bereza, G. V. Apparatura dlya laboratornogo chastotnogo analiza seysmicheskikh kolebaniy [Instrumental equipment for frequency analysis of seismic oscillations in the laboratory] : Prikladnaya geofiz., no. 16, p. 37–49, 1957.

A two-channel outfit for the recording of seismic waves in the field and their subsequent frequency analysis in the laboratory makes it possible to obtain in the field a record of an almost perfect, unmutilated explosion wave and the resulting seismic waves which can be later reproduced in the laboratory and analyzed for frequency. Details are given of different component parts of the new installation—seismographs, broad-band amplifiers, and recording elements. Most of the components are taken from existing instruments. Numerous illustrations of component instruments and many seismograms obtained in the field are included.—*S. T. V.*

172–239. Ledoux, Y. Quelques exemples de diffractions en sismique-réfraction et leur application à la détermination des vitesses verticales [Some examples of diffractions in seismic refraction and their application to the determination of vertical velocities] : Geophys. Prosp., v. 5, no. 4, p. 392–406, 1957.

Progress in seismic refraction recording in recent years makes possible the systematic study of secondary arrivals. A considerable part of these secondary arrivals results from diffraction from faults or other velocity anomalies in the marker bed or overburden.

For a seismic refraction profile crossing a fault, the edge of the fault acts as a point source of diffracted energy and the diffracted arrivals describe an hyperbola on the traveltime curve of the form: $\theta^2 = \theta_0^2 + X^2/V_1^2$ where θ is the oblique traveltime from the edge of the fault corresponding to a horizontal distance X from the fault, θ_0 the vertical traveltime from the edge of the fault to the surface ($\theta_0 = \text{depth}/V_1$), and V_1 the velocity of the overburden. The axis of the hyperbola gives the position of the fault and the asymptotes of the hyperbola have a slope of $1/V_1$.

In arc shooting, where the geophone spread crosses the fault and the source is far removed in the direction of the fault, the edge of the fault acts as a line source of diffracted energy and the hyperbola has the form: $\theta^2 = \theta_0^2 + X^2 \cos^2 i/V_1^2$ where $\theta_0 = \text{depth } x \cos i/V_1$, and $\sin i = V_1/V_2$, as usual. In arc shooting, the axis of the hyperbola still gives the position of the fault, but the asymptotes of the hyperbola have a slope of $\cos i/V_1$.

Several examples show that analysis of the branches of the traveltime curve caused by diffraction may lead to a new method of calculating horizontal offsets and vertical velocities independent of the usual methods.—*L. C. P.*

172–240. Knox, W. A. A slide rule for near-surface refraction problems : Geophysics, v. 23, no. 1, p. 154–163, 1958.

A slide rule is described that is useful for rapid calculation of the thickness and vertical time through one or more layers where the straight-path refraction

formula can be applied. The slide rule can also be used to correct prior computations for the effect of a layer that was previously not considered.—*R. E. W.*

172–241.   O'Brien, P. N. S.   Multiply reflected refractions in a shallow layer:
Geophys. Prosp., v. 5, no. 4, p. 371–380, 1957.

A strong late arrival, with several cycles, has been observed in line refraction shooting, for distances ranging from 5,000 to 30,000 feet. Using equations given by Officer (see Geophys. Abs. 14897) it has been possible to establish that this event is a multiply reflected refraction. The conclusive factor was its very large amplitude which was about 60 times that expected for the simple head wave, at the distances involved. The wave-guide was bounded by the surface of the earth and by the base of the Low Velocity layer, at a depth of about 80 feet. An earlier paper (O'Brien, 1957a) gave a study of the head wave pulse refracted from this interface and the conclusions in the two papers are altogether compatible.—*Author's abstract*

172–242.   Riznichenko, Yu. V.   Razvitiye ul'trazvukovykh metodov v seysmologii
[The development of ultrasonic methods in seismology]: Akad.
Nauk SSSR Izv. Ser. geofiz., no. 11, p. 1341–1346, 1957.

Ultrasonic waves (frequencies of 10^3 to 10^5 per second) are intensely absorbed in the rocks, and therefore their use is almost exclusively limited to experimental seismology where the distances are so small that the incoming waves are not damped to an imperceptible level. Ultrasonic waves can be used: the modelling of seismic waves; the study of the elastic properties of rocks on specimens and in place; the study of the state of rigid bodies under conditions of growing stresses, up to complete destruction, studies which are related to rock bursts.—*S. T. V.*

172–243.   Musgrave, Albert, W., Ehlert, G. W., and Nash, D. M., Jr.   Directivity
effect of elongated charges: Geophysics, v. 23, no. 1, p. 81–96, 1958.

After years of development it has been determined that the energy from the detonation of a low velocity explosive in an elongated column approaches a unidirectional pattern. This column is placed in the sub-weathering material extending ¼ to 2 wavelengths in lengths depending on the frequency of energy desired. A study of the theory of propagation showed that greater directivity can be obtained from the same length of charge by using a powder with a detonation rate less than the side wall velocity of the shot hole. As the detonation rate of the column is lowered relative to the side wall the directivity increases and the downward energy decreases. The optimum balance of these factors is a detonation rate about ⅘ of the side wall velocity. Experiments on elongated charges indicate that a very important effect of directivity is the elimination of "ghosts" as well as the reduction of horizontal energy. Interpretation may be greatly facilitated by a reduction in unwanted energy. Character is no longer dependent upon hole depth. Records have a more uniform appearance. Elongated charges produce many of the same effects as shallow pattern holes, but under many circumstances they are easier or less expensive to use.—*Authors' abstract*

172–244.   Evison, F. F.   The pulsed vibrator as a seismic source: Geophys.
Prosp., v. 5, no. 4, p. 381–392, 1957.

Non-explosive seismic sources, notably the falling weight and the eccentric machine, have occasionally proved advantageous in experimental and practical seismology in spite of their relative feebleness. Another alternative is the

pulsed vibrator, which offers the advantage of a completely controllable wave-form.   Recent theory shows that such a source is quite well adapted to the radiation of high-frequency waves from the surface of the ground; it is estimated, for example, that in typical circumstances reflections should be obtainable from depths of the order of 200 meters.   The theory shows that resonances can be avoided by selecting a light vibrator base and taking care that the main mass of the vibrator is not excited into resonance with its supports.—*I. Z.*

172–245.   Savit, Carl H., Brustad, John T., and Sider, Joseph.   The moveout filter: Geophysics, v. 23, no. 1, p. 1–25, 1958.

The moveout filters in the form of seismometer arrays are analyzed both theoretically and by field experiments.   A general theory of arrays is presented and compared to the antenna theory approach.   The antenna theory is shown to be inadequate in the seismic case because the velocity of the incident energy is not unique.

In areas where the noise has a high moveout and the same frequency composition as the desired signal the linear tapered group was found to be superior to two-dimensional arrays.   The field records illustrate that the linear tapered group yielded records of equal or better apparent quality than the compared two-dimensional arrays.   The effective ground overlap between the groups in the linear tapered array is less than in non-tapered arrays.—*R. E. W.*

172–246.   White, J. E.   Transient behavior of patterns: Geophysics, v. 23, no. 1, p. 26–43, 1958.

A method is described for computing the waveform resultant from a pattern of shots or detectors when the individual signal is a pulse.   Four distributions of strength, or sensitivity, of the array are compared and the waveforms are listed graphically for varying differential time delay across the pattern.   Comparison is made of a gradational versus a uniform sensitivity seven-element pattern.   For small values of differential time delay the variation in the strength distribution have very little effect on the resulting waveform.—*R. E. W.*

172–247.   Neitzel, Edwin B.   Seismic reflection records obtained by dropping a weight: Geophysics, v. 23, no. 1, p. 58–80, 1958.

Measurements of the wave shape of the seismic transient generated by dropping a weight indicate that the weight drop has a much higher efficiency than shooting dynamite.   The surface wave which is generated by the weight drop is very large, but it is minimized by the use of large seismometer groups, many drops per trace, and large offset distances.   For experimental studies, a special recording instrument adaptable for either shooting or weight dropping is used.   The weight truck is hydraulically operated.   Weight dropping versus shooting studies indicate that the quality of weight drop records is limited by the large surface wave generated by the weight impact on the ground.—*Author's abstract*

172–248.   Smith, Mark K.   A review of methods of filtering seismic data: Geophysics, v. 23, no. 1, p. 44–57, 1958.

Various filtering are described and compared by illustrations of the effects of the filters on an impulse signal and on a portion of a seismic record.—*R. E. W.*

172–249.   Schillemeit, Jost, and Celmiņš, Aivars.   Richtcharakteristiken von Geophongruppen mit Berucksichtigung der Einzelcharakteristiken

[Directional sensitivities of geophone groups with regard to the individual characteristics] : Geophys. Prosp., v. 6, no. 1, p. 35–45, 1958.

The influence of the directional sensitivities of individual geophones on the sensitivities of an array of geophones is investigated. General formulas are derived for directional sensitivities. For a single geophone the direction sensitivity to P waves (E_0) is found to be $E_0(\theta,\phi)=R_0^2(\theta,\phi)$ where θ and ϕ are the angle in spherical coordinates, R_0 is the directional factor of the geophone; similarly the directional sensitivity to S waves (E) is found to be $E(\theta,\phi)=\sin^2(ng).\delta_E$ where ng defines the plane of incidence and δ_E is the energy of the component vibrating in that plane. Directional sensitivities are then computed for some of the more important cases. Diagrams show graphically the P and S waves without regard to directional sensitivities of individual geophones, and the P and S waves in two similarly polarized geophones in upright and horizontal position, and the same for two oppositely polarized geophones.—*D. B. V.*

172–250. Chin Hsin-ling, Tseng Jung-sheng, and Kung Wei-shu. The principles of shaking tables and the testing of a seismic geophone [In Chinese with English abstract] : Acta Geophys. Sinica, v. 6, no. 1, p. 15–34, 1957.

For testing the characteristics of seismic geophones, shaking tables of both electrical and mechanical drive were constructed. In order to examine the effect of transients on the geophone, the electrically driven shaking table was also provided with a generator of arbitrary wave form, using the principle of variable area sound-on-film method.

This paper describes the principles underlying the various kinds of measurements, and the experimental techniques and results. In addition, the method of testing by feeding the geophone with a sinusoidal electrical signal of variable frequency is also discussed briefly as regards to its principle and the limitations of its use.—*Author's abstract*

172–251. Khalevin, N. I. K interval'nomu karottazhu akusticheskikh voln [On interval logging of acoustic waves] : Akad. Nauk SSSR Doklady, v. 115, no. 1, p. 88–90, 1957.

The results of one of a series of measurements made using the interval method of acoustic logging are presented. High frequency acoustic waves are generated electromagnetically in the borehole, picked up by a seismic receiver on the surface some meters away from the generator, amplified, and registered as magneto-electric oscillations MPO–2. The most important conclusion is that the velocity of Lamb waves is very dependent on the composition of the rock traversed; the graph of maximum amplitudes $A_m=A_m(H)$ correlates with the electric logging and velocity curves but the anomalies are 40 percent larger, sometimes as much as 100 percent. This means that structural details may be obtained by the interval logging method that cannot be determined from other physical parameters.—*D. B. V.*

172–252. Dufour, J., and Degorse, A. Quelques récents aspects du forage sismique [Some recent aspects of seismic drilling] : Geophys. Prosp., v. 6, no. 1, p. 46–57, 1958.

Recent developments in shothole drilling for seismic surveying have been conditioned by several lithologic, geographic, and seismic factors as prospecting has been extended into more complex formations and into desert regions and

as new modifications of the seismic methods themselves have arisen such as multiple charges and shallow holes. Detailed descriptions are given of the Mouton-Delmag rig for spudding through pebbles and loose gravels; of a mud-mixing water truck and an extensible derrick for drilling multiple medium-depth holes through caving sands; of a compressed air drill for regions with limited water; and of the Wagon–Jack and jeep–mounted Warsop hammer which can be used for drilling multiple shallow holes in various types of rock.—*D. B. V.*

172–253.   Schmidt, Gerhard.   Entwicklung, Ergebnisse und Ziele der Seismik unter Tage [Development, results and aims of underground seismic surveys]: Geol. Jahrb., v. 71, p. 667–670, 1956.

The chief source of trouble in underground reflection measurements of the Siegerland siderite deposits is the unsatisfactory relation between energy produced and that reflected, which, owing to the short travel times and high velocities involved, may completely obscure the reflection arrivals. To develop underground reflection surveying into a routine method, the range should be increased, through deeper shotholes and larger charges, and the accuracy improved, probably by using transverse instead of longitudinal wave onsets.— *D. B. V.*

172–254.   Angino, Ernest E.   The operations of a seismic field party: Compass, v. 35, no. 2, p. 92–97, 1958.

Describes the five basic operations of a seismic field party for the benefit of geologists who have had little or no experience with seismic operations. A glossary of technical terms is included.—*V. S. N.*

172–255.   Willmore, P. L., and Scheidegger, A. E.   Seismic observations in the Gulf of St. Lawrence, *in* Ocean floors around Canada (a symposium): Royal Soc. Canada Trans., ser. 3, v. 50, p. 21–38, 1956.

A seismic refraction survey was made to investigate the reason for the circular sweep of the Gulf of St. Lawrence formed by the north coasts of Cape Breton Island and Nova Scotia, and by the east coast of New Brunswick. Studies of other circular features in Canada indicate some of these features may be meteorite craters. Although the circular part of the Gulf of St. Lawrence is far larger than any proven meteorite crater on earth, existing geological and geophysical evidence shows little possibility of a large deep-seated structure to explain its form. Explosive charges were fired under water and the seismic waves detected on land; the survey covered a sufficient area to allow P_1 and possibly P_n to be recorded as first arrivals.

From the survey it was concluded that: the circular part of the Gulf contains about 6 km of sediments in the center and probably a greater thickness near St. Peter's in Prince Edward Island; there is a change of structure east of the Magdalen Islands toward Cabot Strait, which could be caused by 3 km of sand or by a much greater thickness of consolidated sediments; the Mohorovičić discontinuity seems to slope upward towards the point of greatest sediment thickness although a gravity survey is needed to check whether the mean depth of this discontinuity is greater or less under the Gulf than under the Canadian Shield; there is little doubt that the pre-Carboniferous layer is thinner than elsewhere. The dimensions of the cavity in the crust are comparable to those expected from a meteorite explosion.—*V. S. N.*

172–256. Reich, Hermann. Über die Geschwindigkeit tertiärer Ablagerungen in verschiedenen Gebieten Mittel-Europas [On the velocity of Tertiary deposits in different regions of central Europe]: Geol. Jahrb., v. 74, p. 31–38, 1957.

Comparison of several hundred seismic refraction observations in different Tertiary basins of central Europe shows that velocity in the sediments of basins that have not been subjected to orogenic stress (such as the Hungarian Lowland and Vienna Basin) is lower than that in basins of the Alpine and Carpathian foreland. The differences are attributed to changes in texture, particularly in porosity.—*D. B. V.*

172–257. Posgay, Károly. 1955. évi szeizmikus mérések az Esztergomvidéki szénmedencében [1955 seismic survey in the Esztergom coal basin]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, v. 5, no. 4, p. 39–47, 1956.

The depth and structure of the Triassic basement in the Esztergom coal basin in Hungary has been determined by seismic refraction measurements. The results in part confirm previous knowledge of the region, in part throw new light on it; parts of the area should be investigated further by means of refraction and reflection surveys and borings.—*D. B. V.*

172–258. Clasen, Gerhard, and Dohr, Gerhard. Reflexionsseismische Messungen in der gefalteten Molasse Oberbayerns [Seismic reflection measurements in the folded Molasse of Upper Bavaria]: Deutsch. Geol. Gesell. Zeitschr., v. 109, pt. 2, p. 612–623, 1957 (1958).

Satisfactory reflection results have been achieved in the last few years even in the most complicated area of the folded Molasse of upper Bavaria. Structural details brought out in the basin areas of the Molasse and in the underlying formations have allowed mapping of formations to unusually great depths. An average velocity of 4,500 meters per sec is assumed for the Molasse layers, with reflection times up to 3.0 sec; 5,500 meters per sec for the formations underlying the Molasse, with arrivals up to 4.5 sec; and 6,000 m per sec for all deeper zones. Reflections at 6.5 to 7.0 sec, corresponding to depths of 18–19 km, are attributed to the Conrad discontinuity; these do not show in all parts of the area. Reflections at 11 sec, corresponding to depths of 30–31 km, must be from the Mohorovičić discontinuity.—*D. B. V.*

172–259. Ryazanova, Yu. V. Interpretatsiya chastichno kratnykh otrazheniy v usloviyakh severnogo borta Predkavkazskoy depressii [Interpretation of the in part multiply reflected waves in conditions prevailing in the region of northern border of the Precaucasian depression]: Akad. Neftyanoy Promyshelnnosti Trudy, no. 3, p. 106–113, 1956.

The first step in the interpretation of multiple reflections is the choice of the structure scheme by which the multiplicity of suspected reflections can be produced. In the eastern part of the area here considered, the depth of the weathered layer is only 5 to 7 m, and the velocity in this layer is about 350 m per sec. In the lower layer the velocity is 1,700 m per sec. These conditions produce clearly pronounced maxima of the traveltime curves. The geologic profile con-

structed from the known data on the geology of the region shows the main reflecting horizon with a reflection coefficient of some 30 percent. The time interval from the shot to the arrival of the wave reflected from this horizon is 2 to 3 sec. In addition two or three secondary reflections can be observed with times of arrival of 0.6, 1.0, and 1.3 seconds. The first wave is interpreted as a simple reflection, the other as multiple reflections.

It is concluded that simply reflected and multiply reflected waves are intermixed on the seismograms. Analysis of these seismograms makes it possible to find the depth of the strata which produce the multiple reflections and the angle of inclination of these planes with the horizontal. The main reflecting horizon can be also located without difficulty. In many cases, however, especially when the layer is a monocline or overturned fold, the determination of its position is impossible.—*S. T. V.*

172-260. Yurchenko, B. I. Metodika seysmicheskoy razvedki pologikh struktur Severo-vostochnogo Predkabkas'ya [The methods of seismic exploration of the dipping structures of northeastern Caucasus foreland] : Akad. Neftyanoy Promyshlennosti Trudy, v. 3, p. 79–92, 1956.

Previous surveys of the northeastern Caucasian foreland had indicated several structures of platform type in the Mesozoic rocks underlying Tertiary sediments, but the results in many places were not confirmed by drilling. These discrepancies presumably were caused by errors in the correlation of seismic waves. In 1953 the surveys were repeated with special attention to the question of the changes produced by the filters on the shape of the waves. It is concluded that it is more advantageous to record the complete wave with an oscillograph first and then to proceed as in the usual frequency analysis, taking as many pictures as necessary. Yurchenko's observations confirmed the hypothesis that the subsurface structure in the region is very complex, contains many slightly inclined planes, and is in addition covered with multilayer sedimentary rocks, producing reflected waves composed of waves showing frequencies ranging from 10 to 180 cycles per sec. The application of the described procedure made possible the obtaining of continuously correlated waves propagating not only in Tertiary but also in Cretaceous stratum. As a kind of "short cut" it is recommended that the investigation be started with a "two-frequency" procedure, using first one filter for low frequency and then the other for a much higher frequency, then analyzing the obtained waves. This often gives an indication as to dominant frequencies of the component waves.—*S. T. V.*

SUBMARINE GEOLOGY

172-261. Hamilton, Edwin L. The last geographic frontier: the sea floor: Sci. Monthly, v. 85, no. 6, p. 294–314, 1957.

This is a review of the development of the science of marine geology and a summary of present day information on ocean basins. The historical development of marine geology is discussed with emphasis on the contribution made in the last ten years by geophysical methods: gravity, seismic, and heat flow measurements.

The major features of Atlantic and Pacific Ocean basins are described in the light of modern knowledge and the major contributions of various scientists discussed.—*V. S. N.*

VOLCANOLOGY

172–262. Grebe, Willi-Herbert. Fumarolen und Thermalquellen in den älteren vulkanischen Gebirgen von El Salvador [Fumaroles and thermal springs in the older volcanic mountains of El Salvador]: Petermanns geog. Mitt., v. 101, no. 1, p. 31–35, 1957.

Condensed German version of a paper that appeared in the Anales del Servicio Geologico Nacional de El Salvador (see Geophys. Abs. 167–282).—*D. B. V.*

172–263. Macdonald, Gordon A., and Eaton, Jerry P. Hawaiian volcanoes during 1954: U. S. Geol. Survey Bull., no. 1061–B, 72 p., 1957.

This is a systematic account of conditions at the Hawaiian volcanoes during the year 1954. It includes a general discussion of seismographs and tiltmeters with detailed discussion of the time-control device developed for the seismographs of the Hawaiian Volcano Observatory. Earthquake statistics are given in detail.

Kilauea was uneasy throughout 1954. Many small earthquakes were recorded from epicenters beneath the caldera and along the adjacent east rift zone, and two strong earthquakes probably along normal faults south of the east rift zone were recorded on March 30. Tilting of the surface at the rim of Kilauea caldera indicated a gradual tumescence of the volcano probably caused by increasing magmatic pressures. An eruption occurred on May 31 (see Geophys. Abs. 159–196) in Halemaumau crater and the adjacent floor of the caldera and continued until June 3. The eruption caused no reduction in magmatic pressure which continued to increase throughout the year. Mauna Loa remained quiet throughout the year.—*V. S. N.*

172–264. Aramaki, Shiego. The 1783 activity of Asama Volcano. Part I: Japanese Jour. Geology and Geography, v. 27, no. 2—4, 189–229, 1956.

Mt. Asama, a composite volcano in central Honshu, Japan, has three major cones of which the youngest, Maekake, is active. The pumice deposits, two nuée ardente flows, and a liquid lava flow from the great eruption of Maekake, May 9—August 5, 1783, are described in detail. Measurement of the natural remanent magnetism made of materials from the two nuée ardente flows showed that the orientation was the same for both flows indicating the high temperature at the time of emplacement as well as the direction of the earth's magnetic field at the time temperatures passed the Curie point. No eruption of equal magnitude has occurred since 1783.—*V. S. N.*

172–265. Yoshimura, J. On the volcanic activity of Sakurajima and the soil temperature at Kagoshima: Quart. Jour. Seismology, v. 21, no. 4, p. 35–43, 1957.

Variations of soil temperatures at Kagoshima near Sakurajima include long-term, short-term (one-year), and sudden irregular variations. The long-term variation seems to originate from a change of temperature of magma and to be related to sun-spots. Sudden irregular variations occur a few months before the eruption of Sakurajima; analysis of soil temperatures is an effective method for predicting volcanic activity.—*Author's abstract.*

172–266. Tsuya, Hiromichi. On the recent explosive eruption of Volcano Sakura-jima, southern Kyushu, Japan: Tokyo Univ. Earthquake Research Inst. Bull., v. 34, pt. 4, p. 307–333, 1956.

A preliminary report on the explosive activity at Sakura-jima which began suddenly on October 13, 1955, subsided briefly from late October to January 6, 1956 and then resumed and was still continuing at the time of writing (May 1956). A history of previous volcanic activity is included.—*M. C. R.*

172–267. Suwa, A[kira], Tanaka, Y., and Tazawa, K. The changes in the temperatures of the lava in the crater of Miharayama, Oshima, in connection with the activities of the volcano during January, 1955—June, 1956: Quart. Jour. Seismology, v. 21, no. 4, p. 27–34, 1957.

Temperatures inside the lava fissures at the permanent observation points in the summit crater of Miharayama were measured periodically from January 1955 to June 1956.

At observation points at the southern part and the marginal circular area of the central sink, nearly coinciding with the former central pit in the summit crater, temperatures have risen gradually or rapidly prior to the outbreak of eruptions and of volcanic swarm earthquakes.—*M. C. R.*

Yokoyama, Izumi. Geomagnetic studies of Volcano Mihara. See Geophys. Abs. 172–159.

172–268. Gorshkov, G. S. O glubine magmaticheskogo ochaga Klyuchevskogo vulkana [The depth of magmatic focus of Klyuchevoskoy volcano]: Akad. Nauk SSSR Doklady, v. 106, no. 4, p. 703–705, 1956.

Transverse waves from earthquakes between parallels 24° and 38° N and meridians 130° and 145° E, which would ordinarily arrive with azimuthal angles of 210° to 230° and angles of emergence of 58° to 62° at Klyuchi Observatory on the summit of volcano Klyuchevskoy on Kamchatka Peninsula, are not observed. Transverse waves are recorded normally from other angles. It is suggested that the transverse waves are screened by the magmatic mass beneath the volcano.—*S. T. V.*

172–269. Guest, N. J., and Leedal, G. F. The volcanic activity of Mount Meru: Tanganyika Geol. Survey Recs., v. 3, p. 40, 1953 [1956].

Mount Meru, a volcano 14,979 feet high in Northern Province, Tanganyika, has been sporadically active for the last 75 years, including some explosive activity associated with consistent fumarolic and lesser solfataric action. Regular detailed investigations are recommended to discover intensified periods of activity and to determine any association with activity in Mt. Kibo on the Kilimanjaro massif or the active Oldonyo L'Engai.—*V. S. N.*

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