Geophysical Abstracts 171 October–December 1957

GEOLOGICAL SURVEY BULLETIN 1066-D

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

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

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GEOPHYSICAL ABSTRACTS 171, OCTOBER–DECEMBER 1957

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 circulation (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 161–170.

Akad. Athenon Praktika—Praktika Les Akademias Athenon. Athens.

Akad. Nauk SSR Lab. gidrogeol. problem Trudy—Akademiya Nauk SSSR Trudy Laboratorii gidrogeologicheskikh problem. Moskva.

Akad. Nauk Ukraynsk SSR Inst. geol. nauk Trudy, ser. geofiz—Akademiya Nauk Ukraynsk SSR Instytut geologischnykh Nauk. Kiev.

Eiszeitalter und Gegenwart—Eiszeitalter und Gegenwart Jahrbuch der Deutschen Quärtarvereinigung. Hannover.

Le Monde Souterrain—Groupe d'Études et de coordination de l'Urbanisme Souterrain, Comité permanente international d'Urbanisme souterrain. Paris.

New Zealand Sci. Rev.—The New Zealand Science Review. Wellington.

Royal Soc. South Africa Trans.—Transactions of the Royal Society of South Africa. Cape Town.

Service Carte géol. France Bull.—Bulletin du Service de la Carte géologique de la France. Ministère de l'Industrie et du Commerce. Paris.

Service géol. du Maroc Notes et Mém.—Notes du Service Géologique du Maroc. Rabat, Morocco.

Sopron Műszaki Egyetemi Karok, Bányamérnöki és Földmérőmérnöki Karok Közleményei—Technical University Faculties of Sopron, Publications of the Faculties of Mining and Geotecnics. Budapest.

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 James R. Balsley, P. Edward Byerly, Beryl T. Everett, Frank Frischknecht, Wanda L. Grimes, Roland G. Henderson, Arthur H. Lachenbruch, Don R. Mabey, Virginia S. Neuschel, and Isidore Zietz, 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

171–1. Knopf, Adolph. Measuring geologic time: Sci. Monthly, v. 85, no. 5, p. 225–235, 1957.

A discussion of the age of the earth including a review of past and present methods of age determination.—*V. S. N.*

171–2. Keller, Gerhard. Fortschritte in der Methodik und Ergebnisse geologischer Zeitrechnung [Advances in methods and results of geological time reckoning]: Naturw. Rundschau, Jahrg. 10, Heft 3, p. 169–172, 1957.

A brief, semipopular review of relative and absolute methods of estimating the age of the earth.—*D. B. V.*

171–3. Picciotto, E. [E.]. Données actuelles sur l'âge de la Terre et du système solaire [Present data on the age of the earth and of the solar system]: Ciel et Terre, 73e année, no. 9–10, p. 413–435, 1957.

A comprehensive review of the question of the age of the earth, solar system, universe, elements, and beginning of expansion of the universe—largely a discussion of the different radioactive methods and their results.—*D. B. V.*

171–4. Singer, S. F. The origin and age of meteorites: Irish Astron, Jour., v. 4, no. 6, p. 165–180, 1957.

It is reasonably certain that meteorites were formed in the originally molten interior of small planet-like bodies which solidified, slowly cooled under pressure, and later broke up; the interesting problems relate to the probable dates of solidification and break-up. For the former the lead isotope method is more reliable than the uranium-thorium-helium method, even though cosmic-ray helium can be distinguished from radiogenic helium by its helium-3 content; radiogenic helium probably diffuses out of the meteorite whereas cosmic-ray helium does not. It is possible to determine the time of exposure to cosmic rays, and therefore to determine the break-up date of the parent planets, from the helium-3 data; for example, the meteorite Carbo was created about 300×10^6 yrs ago, and the age of four other iron meteorites is approximately the same, though less certain. In one case where the helium-3 and tritium contents were measured simultaneously, the age can be established exactly (see Geophys. Abs. 170–19) as 260×10^6 yrs. The good agreement between these figures and an average life-time of meteorite-like objects computed by Öpik gives confidence in these determinations and also explains why older objects have not been observed; it suggests that cosmic ray intensity has not varied greatly since about 300×10^6 yrs ago. Finally the use of the helium-3 method—to determine the mass lost by meteorites in traversing the atmosphere and to explain their holes and cavities—is described.—*D. B. V.*

171–5. Patterson, C[laire] C. Age of meteorites and the earth: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 157–159, 1956.

An accurate age of meteorites is determined by assuming that meteorites represent an array of uranium-lead systems with certain properties, and then computing the age of this array from the observed lead pattern. It is assumed that the meteorites were formed at the same time, that they existed as isolated and closed systems, that they originally contained lead of the same isotopic composition, and that they contain uranium that has the same isotopic composition as that in the earth. Data from three stone and two iron meteorites are thus used and the age of the meteorite array is calculated as $4.55\pm0.07\times10^9$ yrs. The age of the earth is then obtained by demonstrating that the earth's uranium-lead system belongs to the array of meteoritic uranium-lead systems. (See also Geophys. Abs. 167–5.)—*M. C. R.*

171–6. Schumacher, Ernst. Age of meteorites by the Rb^{87}-Sr^{87} method: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 90–96, 1956.

The rubidium-strontium ratio in the Forest City meteorite is 1:3.06. The Pasamonte meteorite consists of two distinct fractions in which the rubidium-strontium ratios are 1:189 and 1:136. Concentrations of strontium-87 range from 6.74 ± 0.02 percent to 7.34 ± 0.02 percent. The strontium-87 concentrations in the Pasamonte and Bustee meteorites are the lowest values found up to now in any material. The value of 6.75 ± 0.02 percent is believed to be a good approximation to primordial abundance of this isotope. The two combinations of the Forest City and Pasamonte results give two sets of equations from which the age can be computed. If it is assumed that the two meteorites have the same age, that the present ratios have not changed except for the radioactive

decay of rubidium-87, and that the two fractions of the Pasamonte meteorite are cogenetic, the ages obtained are 5.02 and 5.33±0.5 billion years, or an average of 5.17±0.05 billion years. The Forest City meteorite has been dated by potassium-argon method; a correction of −9 percent in the half life of rubidium-87 to 5.26×10^{10} yrs is necessary to bring the two ages in agreement.—*M. C. R.*

171–7. Reed, George W., and Turkevich, Anthony. Uranium, helium and the ages of meteorites: Nature, v. 180, no. 4586, p. 594–596, 1957.

Radiogenic helium ages of 11 stone meteorites range from 0.5 to 4.5×10^9 yrs; in 8 of the 11 these ages agree with other radiogenic ages within 15 percent. In calculating ages it was assumed that the average uranium content of chondrites for which no recent determinations have been made is 1.1×10^{-8} g per g, that non-radiogenic helium consists of four helium-4 atoms for each helium-3 atom, that the thorium/uranium and uranium-238/uranium-235 ratios are the same as those found terrestrially, and that the rate of production of helium-3 (grams per year) from cosmic rays is 8.2×10^{-15} cc S. T. P. The ages fall in two groups, one about 1×10^9 yrs and the other 4×10^9 yrs; the two groups may represent accumulation and segregation of all the meteoritic matter (4.5×10^9 yrs) and loss of radiogenic helium by some of the material about 10^9 yrs ago. Cosmic ray ages deduced from helium-3 contents are considerably lower, possible owing to the effect of self shielding in the original meteorite or because the meteorites spent most of their time in regions of cosmic ray intensity lower than that near the earth.—*M. C. R.*

171–8. Reynolds, J[ohn] H., and Lipson, J[oseph] I. Rare gases from the Nuevo Laredo Stone meteorite: Geochim. et Cosmochim. Acta, v. 12, no. 4, p. 330–336, 1957.

The isotopic composition of helium, neon, argon, and xenon from the Nuevo Laredo Stone meteorite has been measured and concentrations of these gases determined. Radiogenic helium–4 and argon–40 are present, also cosmogenic helium, neon, and argon. The xenon found, which may be entirely due to contamination, was of normal isotopic composition, a fact which has a bearing on the time interval between nucleogenesis and formation of meteorites. The potassium-argon age of the meteorite is 3.1 to 3.6×10^9 yrs; this age confirms the fact, already established by lead isotope data (see Geophys. Abs. 162–171) that the stone is ancient, but suggests loss of radiogenic argon. Also, most of the helium–4 has escaped, if the published value of lead concentration is correct. The isotopic compositions of the cosmogenic gases are in general agreement with earlier work but they are present in lower concentrations, particularly helium–3, suggesting that the stone has been severely heated late in its history.—*D. B. V.*

171–9. Hamaguchi, Hiroshi, Reed, George W., and Turkevich, Anthony. Uranium and barium in stone meteorites: Geochim. et Cosmochim. Acta, v. 12, no. 4, p. 337–347, 1957.

The uranium and barium contents of 4 chondrite meteorites and 1 achondrite, a basalt, and a dunite have been determined by neutron activation. The isotopic composition of the uranium in the stone meteorites is the same as that of terrestrial uranium within 10 percent. Uranium content of the chondrites is close to 1.1×10^{-8} grams per gram, of the achondrite about 10 times more. The barium contents are all about 350 times greater than uranium contents. The amount

of uranium found is less than that needed to produce the isotope ratios and absolute amounts of lead measured by Patterson (see Geophys. Abs. 162–171). This discrepancy can be explained either by a variation in these minor constituents within meteorites, by a lead-uranium ratio varying with time; or by error in either the lead or uranium experiments. The lead isotope ratios of the Nuevo Laredo meteorite are so abnormal and discrepancy in absolute amounts so small that it is hard to conceive of a contamination mechanism that would seriously alter the deduced age of 4.55×10^9 yrs, but in the Forest City and Modoc meteorites, the most obvious type of contamination (by terrestrial lead) would practically destroy the usefulness of the lead isotope data for age determinations of those meteorites.—*D. B. V.*

171–10. Reed, George W., and Turkevich, Anthony. The uranium content of two iron meteorites: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 97–99, 1956.

No uranium was detected in the Tamarugal and Thunda meteorites by neutron activation analyses at the Argonne Heavy-water Pile. Previous investigators using fluorimetric and radon counting techniques have indicated that the uranium content of many iron meteorites lies in the range of 20 to 100×10^{-10} grams per gram and have reported 30 to 34 and 55×10^{-10} grams per gram for these two meteorites. (See also Geophys. Abs. 163–163.)—*M. C. R.*

171–11. Hernegger, F., and Wänke, H. Über den Urangehalt der Steinmeteorite und deren "Alter" [On the uranium content of stone meteorites and their "age"]: Zeitschr. Naturforschung, Band 12a, Heft 10, p. 759–762, 1957.

The uranium content of 3 chondrites, determined by neutron activation analyses, is approximately 1×10^{-8} grams uranium per gram. In addition a mean value of 3.5×10^{-6} grams of barium per gram is indicated. For two of the meteorites investigated, determinations of helium content were already available. Assuming a thorium concentration three times as high as the uranium concentration, a helium age of 3.6 to 3.8×10^9 yrs is calculated for these two meteorites.—*D. B. V.*

171–12. Ebert, K. H., König, H., and Wänke, H. Eine neue Methode zur Bestimmung kleinster Uranmengen und ihre Anwendung auf die Urananalyse von Steinmeteoriten [A new method of determining very small amounts of uranium and its application to uranium analysis of stone meteorites]: Zeitschr. Naturforschung, Band 12a, Heft 10, p. 763–765, 1957.

A new method of determining very small amounts of uranium in stone meteorites is described, in which the xenon-133 produced by decomposition of uranium-235 is measured. The uranium contents of three chondrites were determined by this method, together with that of pure uranium oxide irradiated along with them as control. Possible sources of error, such as loss of active xenon or shadow effects during radiations, are discussed.—*D. B. V.*

171–13. Ebert, K. H., and Wänke, H. Über die Einwirkung der Höhenstrahlung auf Eisenmeteorite [On the effect of cosmic radiation on iron meteorites]: Zeitschr. Naturforschung, Band 12a, Heft 10, p. 766–773, 1957.

The helium and neon contents (produced by cosmic ray reactions) were determined for a series of iron meteorites. These reactions were thoroughly studied, particularly the proportion of secondary particles to helium produced. The loss of mass by meteorites while traversing the atmosphere is calculated as about 78 percent of the original mass. Assuming a constant temporal and spatial cosmic radiation of 0.25 particles per cm^2 per sec per sterad, the neon content of one of the meteorites (Mt. Ayliff) indicates that it has been exposed to cosmic radiation for a period of 920 million years.—*D. B. V.*

171–14. Bate, George L., Huizenga, J. R., and Potratz, Herbert A. Thorium content of stone meteorites: Science, v. 126, no. 3274, p. 612–614, 1957.

Thorium concentrations of 4.0 to 4.7 x 10^{-8} g per g are reported for the Beardsley, Forest City and Modoc chondrites, 9.0 x 10^{-8} g per g for the Holbrook meteorite, all significantly lower than values computed by Patterson to account for lead isotope compositions. A wide variation is obtained in two achondrites. Measurements of thorium in meteorites by neutron activation techniques are generally lower than those obtained by conventional methods.—*M. C. R.*

171–15. Gross, Hugo. Die Fortschritte der Radiokarbon-Methode 1952–1956 [The progress of the radiocarbon method 1952–1956]: Eiszeitalter und Gegenwart, Band 8, p. 141–180, 1957.

A review, including discussion of carbon-14 dating in relation to glacial chronology.—*M. C. R.*

171–16. Vinogradov, A. P., Devirts, A. L., Dobkina, E. I., Markova, N. G., and Martishchenko, L. G. Opredeleniye absolyutnogo vozrasta po C^{14} [Determination of absolute age by C^{14}]: Geokhimiya, no. 8, p. 3–9, 1956.

A discussion of the carbon-14 method in dating relatively young geologic material. The carbon dioxide method has been selected for use. Important details which make the final result more reliable are discussed. It is believed that the method can be used for ages as great as 32,000 years.—*S. T. V.*

171–17. Galanopoulos, A. G. Zur Bestimmung des Alters der Santorin-Kaldera [On the determination of the age of the Santorin caldera]: Neues Jahrb. Geologie u. Paläontologie Monatsh., Jahrg. 1957, Heft 9, p. 419–420.

A carbon-14 measurement of a sample of charred wood found with human remains and artifacts under the bottom pumice layer on Santorin (Thera) Island indicates an age of 3,050±150 yrs for the beginning of Santorin caldera, about the end of the Minoan culture. Archeological dating of the artifacts as 1,500 to 1,800 B. C. is thus several hundred years too early.—*D. B. V.*

171–18. Lundqvist, G. C^{14}-analyser i svensk kvartärgeologi 1955–57 [Carbon-14 analyses in Swedish Quarternary geology, 1955–57 (with English summary)]: Sveriges Geol. Undersökning Årsbok 51, no. 8, (Ser. C., no. 577), 25 p., 1957.

A summary of the results of carbon-14 determinations made in the first two years of operation of the Stockholm laboratory. The solid carbon method was used in 1955 but was changed in 1956 to the CO_2 method with proportional counter. Dates have been obtained for interglacial and morainal wood, raised beaches, submarine stumps, pollen-determined "recurrence surfaces" (see Geo-

phys. Abs. 171–19), a Lapp hunting pit, and the opening of the Falun copper mine.—*D. B. V.*

171–19. Lundqvist, Jan. C^{14} dateringar av recurrensytor i Värmland [Carbon-14 dating of recurrence surfaces in Värmland (with English summary)]: Sveriges Geol. Undersökning Årsbok 51, no. 5, (Ser. C, no. 554), 22 p., 1957.

Carbon-14 determinations have been made to check some pollen analysis determinations of the age of "recurrence surfaces" (horizons in peat and mire deposits showing changes to moister and (or) colder climate) in Värmland, western Sweden. Analysis of the results show that the pollen zones are not synchronous over the country but become younger toward the west. The shift is probably not as regular as these first few data suggest.—*D. B. V.*

171–20. Wright, H. E., Jr. The late-glacial chronology of Europe.—A discussion: Am. Jour. Sci., v. 255, no. 7, p. 447–460, 1957.

New techniques in pollen analysis plus the introduction of radiocarbon dating have increased the understanding of glacial chronology of Europe during the Late-Glacial phase of the Weichsel or Würm glaciation. Correlation of the Alleröd interval, a key pollen horizon over a broad area from glacial regions south to the Alps, is supported by radiocarbon dating and by the occurrence of volcanic ash within the interval.

Correlation of the Bölling, an earlier warm fluctuation recognized in Denmark and adjacent areas, with morainic sequence in the Alps is not firm because radiocarbon dating has not been widely applied in the Alpine region. The application of radiocarbon dating techniques is also expected to make firm the correlation of earlier stages between the Alps and the Scandinavian ice margin not aided by pollen analyses.—*V. S. N.*

171–21. Gill, Edmund D. Report of the A. N. Z. A. A. S. Committee for the Investigation of Quaternary Strandline Changes: Australian Jour. Sci., v. 20, no. 1, p. 5–9, 1957.

Quaternary studies have benefited greatly from the recent studies integrating radiocarbon data and paleotemperature curves (see Geophys. Abs. 165–8 and 168–205). Some radiocarbon dates are quoted in the section dealing with Victoria (submerged eucalyptus stump, 8,780±200 years and 8,300±210 years in separate measurements; kitchen middens from the 25-ft shoreline, 1,177±175 and 1,855±85 years, respectively; a higher sea level at Melbourne, 4,820±200 years, and a dead emerged coral reef near Brisbane, 3,710±250 years, are evidence of emergence at the time of the postglacial maximum) and in the section on South Australia (the postglacial 10-ft terrace, between 4,250 and 6,020 years). A worldwide series of carefully studied and radiocarbon-dated sites is needed to settle the question of postglacial emergence.—*D. B. V.*

171–22. Elson, John A. Lake Agassiz and the Mankato-Valders problem: Science, v. 126, no. 3281, p. 999–1002, 1957.

"This article is a brief review of data on Lake Agassiz in the light of radiocarbon dates; it shows that the Valders ice border probably lay well inside the margin of the Canadian Shield in western Ontario and northern Manitoba and that the Cary-Mankato retreat and readvance were minor compared with the Mankato-Valders marginal fluctuation."—*M. C. R.*

171–23. Bella, Francesco, and Cortesi, Cesare. Attività del Laboratorio dell'Università di Roma per le datazioni con il C^{14} [Activity of the carbon-14 dating laboratory of the University of Rome]: La Ricerca Sci., anno 27, no. 9, p. 2677–2690, 1957.

A description of the work of the radiocarbon dating laboratory of the University of Rome, and list of five dates, all of archeological value.—*D. B. V.*

171–24. Broecker, W. S., and Kulp, J. Laurence. Lamont natural radiocarbon measurements IV: Science, v. 126, no. 3287, p. 1324–1334, 1957.

Carbon-14 age determinations at the Lamont Geological Observatory from October 1955 to March 1957 are reported. The measurements were all made by the carbon dioxide proportional counting method. Samples were geological and archeological materials, ocean bottom cores, and pluvial lake deposits.—*M. C. R.*

171–25. Barendsen, G. W., Deevey, E[dward] S., Jr., and Gralenski, L. J. Yale natural radiocarbon measurements III: Science, v. 126, no. 3279, p. 908–919, 1957.

Results obtained at the Yale laboratory between July 1955 and March 1957 are reported. Since December 1955 these results have been obtained by the carbon dioxide method of de Vries and Barendsen. Both archeological and geologic samples are included. A summary of radiocarbon-calibrated pollen chronology and archeology of northwestern Europe is included.—*M. C. R.*

Brannon, H. R., Jr., Daughtry, A. C., Perry, D., Whitaker, W. W., and Williams, M. Radiocarbon evidence on the dilution of atmospheric and oceanic carbon by carbon from fossil fuels. See Geophys. Abs. 171–217.

171–26. Damon, Paul E., and Kulp, J. Laurence. Determination of radiogenic helium in zircon by stable isotope dilution technique: Am. Geophys. Union Trans., v. 38, no. 6, p. 945–953, 1957.

Standard zircon samples studied earlier by Hurley, Larsen, and Gottfried (1955) have been analyzed for helium by an isotopic dilution technique using helium-3 as a spike yielding an accuracy of about ±3 percent. The quantity of helium obtained is about 15 percent higher than that obtained by earlier volumetric techniques. Alpha activity determinations agree closely with earlier work. Measurements on non-metamict zircons from Ontario, Ceylon, and Oklahoma suggest that helium retentivity in excess of 80 percent is not unusual. Metamict zircons on the other hand may have retained only one percent of radiogenic helium. Total irradiation is not the only factor in determining the quantity of helium retained. A helium age method is still possible under proper conditions.—*Authors' abstract*

171–27. Tilton, G[eorge] R., and Nicolaysen, L. O. The use of monazites for age determinations: Geochim. et Cosmochim. Acta, v. 11, no. 1/2, p. 28–40, 1957.

Two of four isotopically controlled age determinations on monazites show gross discrepancies in their individual isotopic age. Acid-washing experiments on the powdered samples seem to indicate the trend of recent alterations affecting the uranium, thorium, and lead contents, and correlate strikingly with certain features of the age pattern. Interesting differences in the radiogenic

lead-207 : lead-206 ratios of the acid-soluble leads cannot be interpreted with any degree of certainty. Marked differences were noted in the solubilities of the primary and radiogenic leads. It is apparent that monazites often exhibit fractionation of uranium, thorium, and lead. Very little is understood regarding the mechanisms by which these fractionations occur, and it is necessary to assemble complete age data on a monazite in order to detect fractionation.—*D. B. V.*

171–28. Aldrich, L. T., Davis, G. L., Tilton, G[eorge] R., Wetherill, G[eorge] W., and Jeffrey, P. M. Evaluation of mineral age measurements. I: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 147–150, 1956.

Lead-uranium and lead-thorium ages for the Brown Derby pegmatite and the Quartz Creek granite are very discordant. The rubidium-strontium ages average 1,740 million years with a mean deviation of 80 million years. Potassium-argon ages of six micas average 1,400 million years with a mean deviation of 40 million years, but feldspar ages are considerably lower. Data on potassium-argon and rubidium-strontium ages of minerals from four West Australia pegmatites are also cited. These indicate that rubidium-strontium ages on mica and feldspar plus potassium-argon ages of mica give a fairly complete picture of the age pattern in much the same way that the lead-uranium age pattern does for a uranium mineral.—*M. C. R.*

171–29. Tilton, George R. Acid washing experiments: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 79–84, 1956.

Discrepancies between uranium-238 : lead-206 and uranium-235 : lead-207 ages are commonly assumed to have resulted from loss of lead when the ages are too low or from loss of uranium when the ages seem to be too high. Results of acid wash experiments in which powdered samples previously used for age determinations were washed in hydrochloric acid (and in one case in aqua regia) and the isotopic composition of the lead removed compared with that in the original sample, suggest that erroneous ages are accompanied by the excess of solubility of both parent and daughter. (See also Geophys. Abs. 165–9.)—*M. C. R.*

171–30. Wickman, Frans E. Leakage of uranium and lead and the measurement of geological time: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 62–67, 1956.

An attempt to derive a simple theory about how the presence of original lead and the leaching of uranium and lead affect age determinations. It is assumed that the original lead in all minerals formed at a given time has the same isotopic composition; that no lead or radioactive elements are added to the radioactive minerals and that the chemical processes will be pure leaching processes; that the leaching will not produce any isotope separations and that all minerals in a deposit are leached during the same period of time. Under these conditions it is shown that if the leaching period is short the real age, the leaching age, and the original lead values may be obtained, at least in principle, from four samples with different uranium-lead composition, and that if the difference between fractions of lead and uranium leached per unit time can be approximated by a constant or a one-parameter function, then the original

lead values and the leaching and true age can be obtained from five different samples.—*M. C. R.*

171–31. Russell, R. D. Interpretation of lead isotope abundances: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 68–78, 1956.

To explain differences in lead isotope abundances a history is proposed in which the lead originates in the mantle and is added to the crust at times of orogeny. "Ordinary" leads result if the lead is incorporated directly into minerals. "Anomalous" leads result when the lead is incorporated into rocks having uranium-lead and thorium-lead ratios much larger than the mantle and subsequently forms a lead mineral. Leads isotopically indistinguishable from ordinary leads are formed when lead is incorporated in crustal rocks in which the uranium-lead and thorium-lead ratios are similar or lower than those in the mantle and subsequently forms a lead mineral. The Joplin-Tri-State, Sudbury, and Broken Hill deposits are discussed in terms of the suggested history.—*M. C. R.*

171–32. Lyons, J. B., Jaffe, H[oward] W., Gottfried, D[avid], and Waring, C[laude] L. Lead-alpha ages of some New Hampshire granites: Am. Jour. Sci., v. 255, no. 8, p. 527–546, 1957.

Age determinations by the Larsen method (lead-alpha) on four plutonic series in New Hampshire give the following results in millions of years: Highlandcroft 385±27, Oliverian 311±26, New Hampshire 296±29, and White Mountain 186±14. Middle Devonian granites of Maine and New Brunswick have a mean age of 315±11 million years, and plutonic rocks of southeastern New Hampshire and southwestern Maine have an age of 294±12 million years. These data with geologic data indicate five Paleozoic plutonic series in New England: Late Ordovician (Taconic) Highlandcroft and equivalents, 360 to 390 million years; Middle Devonian (Acadian) Oliverian, New Hampshire, and equivalents, 290–310 million years; pre-Pennsylvanian (Mississippian?) alkalic granites of eastern Massachusetts 260 million years; post-Middle Pennsylvanian calc-alkalic granites of Rhode Island, 230 million years; and Late Permian (?) alkalic White Mountain series, 180–190 million years.—*V. S. N.*

171–33. Quinn, A. W., Jaffe, H[oward] W., Smith, W. L., and Waring, C[laude] L. Lead-alpha ages of Rhode Island granitic rocks compared to their geologic ages: Am. Jour. Sci., v. 255, no. 8, p. 547–560, 1957.

Lead-alpha age determinations on zircon and monazite from the Scituate granite gneiss and the Esmond granite, the Cowesett and the Quincy granite, and the Westerly and Narragansette granites gave mean ages of 306±18 million years, 270±7 million years, and 234±23 million years, respectively for the three groups. These ages are in agreement with geologic evidence and within the accepted age limits of the geologic time scale for the Devonian, Mississippian, and Pennsylvanian periods respectively.—*V. S. N.*

171–34. Hée, A[rlette], Coche, A., Jarovoy, M[ichel], and Kraemer, R. Détermination de l'âge absolu de deux granites de la chaine des Vosges [Determination of the absolute age of two Vosges granites]: Annales Géophysique, tome 13, no. 2, p. 135–152, 1957.

A detailed description is given of the techniques involved in age determination of zircons from α radioactivity and radiogenic lead content. The measured ages of the Natzwiller and Andlau granites from the Vosges are 300±20 million years and 240±25 million years, respectively.—*P. E. B.*

171–35. Deutsch, S[arah], Kipfer, P., and Picciotto, E. Pleochroic haloes and the artificial coloration of biotite by α-particles: Nuovo Cimento, v. 6, no. 4, p. 796–810, 1957.

Study of pleochroic haloes artificially produced in biotites from 11 granites shows that commencement of measurable coloration is provoked by a dose of 10^{13} alpha particles per sq cm; optical density Δd increases less and less until it reaches a plateau in the curve for doses of the order of 10^{15} alpha particles per sq cm. The inversion stage is not reached for doses less than 1.4×10^{15} alpha particles per sq cm. The sensitivity to coloration of a biotite may be defined by two parameters, Δd_{max} (value of Δd corresponding to the saturation plateau) and ρ, characteristic of each biotite, representing the fraction formed per α of the total number of color centers. Comparison with natural haloes indicates at least qualitative correspondence between sensitivities of biotite to experimental and natural radiation. It is not yet possible to utilize this work on artificial coloration to determine absolute age of haloes; for relative determinations, sensitivity differences must be taken into account. (See also Geophys. Abs. 169–22).—*D. B. V.*

171–36. Besairie, Henri. La période cambrienne à Madagascar [The Cambrian period in Madagascar]: Internat. Geol. Cong., 20th, Mexico 1956, Symposium El Systema Cámbrico, su Paleogeografía y el Problema de su Base, pt. 1, p. 341–342, 1956.

On the basis of recent age determinations, sedimentary rocks of Cambrian age (as well as Infracambrian through Silurian) are lacking in Madagascar, but there is evidence of strong plutonic igneous activity in the final stages of that period: uraninite from Bemasoandro is 480±15 million years old, thorianite from Betioka, 490±20 million years, and thorianite from Sofia, 480±20 million years.—*D. B. V.*

171–37. Carr, D[onald] R., Damon, P[aul] E., Broecker, W. S., and Kulp, J. Laurence. The potassium-argon age method: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 109–113, 1956.

The potassium-argon method of age determination has been established in a broad way but precise measurements depend on definition of the retentivity of argon in different minerals.—*M. C. R.*

171–38. Wetherill, G[eorge] W. Radioactivity of potassium and geologic time: Science, v. 126, no. 3273, p. 545–549, 1957.

The chief difficulties in application of the potassium-argon method of age determination have been the uncertainties in the value of the specific gamma activity and in the fraction of argon that has been retained by the mineral during the time since its formation. Comparisons of potassium-argon ages with ages obtained by other methods indicate that the specific gamma activity is greater than 3.2 gammas per gram per sec and that feldspars have lost as much as half their argon although mica seems to retain nearly all its argon.

The specific gamma activity was experimentally measured by use of thallium-activated sodium iodide scintillation spectrometer with cobalt-60 and sodium-24 as standards, as 3.39±0.12 gammas per gram per sec. The measurements on geologic materials may be used to evaluate the extent to which minerals have been able to retain radiogenic argon during geologic time, by using this value of the specific activity and assuming that electron capture directly to the ground state is negligible. It is found that the retentivity of feldspar is almost always low but in most samples of mica it is greater than 90 percent.—*M. C. R.*

171–39. Reynolds, J[ohn] H. K-A dating: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 135–146, 1956.

A high sensitivity mass spectrometer suitable for isotope abundance measurements of small rare gas samples, developed at Berkeley, consists of a small 4½-inch radius glass, 60° mass spectrometer that can be baked out in its entirety and which is pumped through all-metal vacuum valves of the type developed by Alpert and co-workers at the Westinghouse Research Laboratory. This mass spectrometer has been highly successful in potassium-argon studies. The first data reported are for granitic rocks from the Sierra Nevada batholith, and from the Yellowknife Continental Nucleus in Canada, the Forest City meteorite, and sylvite from Canada. The discrepancies between argon-40: potassium-40 ratios in micas and feldspars in the same rock is attributed to argon leakage from the feldspar.—*M. C. R.*

171–40. Wasserburg, G. J., and Hayden, R. J. A^{40}-K^{40} dating: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 131–134, 1956.

Differences in argon-40: potassium-40 ratios in micas and feldspars from the same rock may be grossly explained by a rather regular loss of argon. A branching ratio of 0.085 produces good agreement between argon-40: potassium-40 and lead-uranium ages of certain feldspars. The ratio of 0.085 is taken as an "empirical calibration factor which corrects for the regular loss of argon in the feldspars investigated". Argon-40: potassium-40 ratios of some authigenic sedimentary minerals fall into proper sequence as determined by stratigraphic age though the ages are as much as 20 percent higher than the values assigned by Holmes. The agreement cannot be interpreted as proof of the method but the data do indicate a possibility of measuring absolute stratigraphic time by the argon-40: potassium-40 method. (See also Geophys. Abs. 161–132.)—*M. C. R.*

171–41. Gentner, W., and Kley, W. Argonbestimmungen an Kaliummineralien—IV. Die Frage der Argonverluste in Kalifeldspäten und Glimmermineralien [Argon determinations in potassium minerals.—IV. The question of argon loss in potassium feldspars and mica minerals]: Geochim. et Cosmochim. Acta, v. 12, no. 4, p. 323–329, 1957.

The ages of several feldspars and micas have been determined by the potassium-argon method. The argon content of feldspar from pegmatite from Hechtsberg in the Black Forest of Germany (about 250 million years old) is about 5 percent less than that of mica from the same rock, and a similar result is found for pegmatite from Hobol in southern Norway (about 960 million years old). The loss of argon in feldspar is attributed to metamorphic effects observed under the microscope. Investigation of the relationship of argon loss in feld-

spars (from Varuträsk, Sweden) to grain size showed that such loss appeared when the mineral was ground to less than 100μ; further pulverization to 5–10μ produced losses of 30 to 50 percent.—*D. B. V.*

171–42. Gerling, E. K., Yashchenko, M. L., and Yermolin, G. M. Argonovyy metod opredeleniya vozrasta i yego primeneniye [The argon method of age determination and its application]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Byull., vypusk 2, p. 8–27, 1957.

The argon ages of 19 Paleozoic and Mesozoic rocks and minerals from various parts of the U. S. S. R. and of 70 Karelian intrusives representing 4 Precambrian igneous cycles have been calculated on the basis of a new determination of the *K*-capture constant of potassium-40 (6.02×10^{-11} yrs^{-1}). It is concluded that micas are most suitable for argon age determinations because the argon can be isolated only by destroying the crystal lattice by heating to high temperatures. The ages obtained for the younger minerals and rocks agree well with those obtained by the helium and lead methods and with the geological evidence. Determinations made on microcline perthites, microcline granites, and antiperthites in the older rocks are too low; significant loss of radiogenic argon is indicated, but ages obtained from micas agree well with lead ages.—*D. B. V.*

171–43. Gerling, E. K., and Morozova, I. M. Opredeleniye energii akivatsii vydeleniya argona iz slyud [Determination of the activation energy of argon isolated from micas]: Geokhimiya, no. 4, p. 304–311, 1957.

The activation energy of the argon isolated from minerals may serve as a criterion for the retention of radiogenic argon; the higher the activation energy, the less the probability of argon loss. The activation energy has been determined for argon from muscovite, biotite, and phlogopite micas as 85,000, 57,000, and 67,000 cal per gram-atom of argon respectively; these are comparable to the bonding energy of the most stable chemical compounds. Therefore micas are undoubtedly suitable for argon age determinations. Muscovite from Ulyaleg in Karelia contains no occluded argon, all of it being of radiogenic origin from potassium-40. The percentage of argon isolated from secondary positions in the minerals varies for the different micas from 60 to 75 percent; in each sample it remains within limits of ±6 percent over a rather wide temperature range except in phlogopite, in which the amount of argon decreases from 78 percent at low temperatures to 34 percent at 843° and above.—*D. B. V.*

171–44. Beveridge, A. J., and Folinsbee, R. E. Dating Cordilleran orogenies: Royal Soc. Canada Trans., v. 50, ser. 3, sec. 4, p. 19–43, 1956.

The time relation between the Sierra granites, the Boulder batholith, and the Crowsnest volcanic rocks was determined by potassium-argon dating of orthoclase feldspars. The Crowsnest volcanic rock is Middle Cretaceous according to the paleontologically controlled time scale. The potassium-argon age is 96 million years in good agreement with Holmes' (1948) absolute time scale. Potassium-argon ages of samples from the Sierra Nevada batholith are 68, 72, and 88 million years; the age determination from the Boulder batholith (Montana) is 71 million years. An Upper Cetaceous age for the Boulder batholith and at least part of the Sierra Nevada batholith is suggested. Lead-alpha determinations on zircon from the Nelson batholith, British Columbia, indicate an age of 105 million years, in exact agreement with the average lead-alpha

ages of the Southern California, Sierra Nevada, and the Idaho batholiths. Thus, the geochronological data suggest a main period of Cordilleran batholitic emplacement in Middle Cretaceous time, 100 million years ago, and a late phase of magmatic intrusion in early Laramide time, 70 million years ago.

A comparison of heavy mineral residues from the Cretaceous sedimentary section with those from the Cordilleran intrusive rocks suggests that during Early Cretaceous time granitic intrusives were emplaced and unroofed in the Cordilleran area. It is possible that the Nelson batholith was one of these early plutons.—*V. S. N.*

171–45. Afanas'yev, G. D. O kaynozoyskom magmatisme Kavkaza i o nekotorykh itogakh opredeleniya absolyutnogo vozrasta kavkazkikh porod K-Ar metodom [On the Cenozoic igneous activity of the Caucasus and some results of absolute age determinations on Caucasus rocks by the potassium–argon method] : Akad. Nauk SSSR Izv. Ser. geol., no. 6, p. 30–54, 1957.

The first half of this paper is a petrographic study of the Cenozoic igneous complex of the Caucasus; the second half presents the results of argon age determinations on 16 of these and associated rocks and on 25 other rocks and minerals from Caucasian massifs ranging in age from Silurian-Devonian to Tertiary. Use of petrologic-geologic studies in conjunction with argon age investigations may avoid possible errors due to argon loss.—*D. B. V.*

171–46. Holland, Henrich D. Radiation damage and age measurement in zircons: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 85–89, 1956.

Age measurements based on radiation damage in zircons have been determined for several specimens and are found to be either equal to or lower than those found by other techniques. Differences between the ages measured by radiation damage and the probable true age of the samples are thought to be due either to inhomogenity in the distribution of the radioelements in the samples studied, or to thermal annealing of radiation damage during the geologic history of the sample. It may be possible that all previously produced radiation damage is removed during metamorphism and so the age measured today may correspond to the time elapsed since cessation of the last thermal nealing. Geologic evidence and one isotopic analysis suggest that some of the igneous rocks of the Adirondack Province are of Grenville age (1,000±100 million years). Age measurements by the radiation damage and lead-alpha methods indicate lower ages and suggest a possibility that the Grenville rocks were strongly metamorphosed during late Precambrian time and that the anomalously low ages found by the radiation damage method are related to this period of metamorphism.—*M. C. R.*

171–47. Herzog, Leonard F. Rb-Sr and K-Ca analyses and ages: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 114–130, 1956.

This is a summary of studies at the Massachusetts Institute of Technology on the following subjects: rubidium, strontium, potassium, and calcium content of meteorites; half-life of rubidium-87; variation with time of strontium-87; strontium and rubidium content of geologic standards; comparison of isotope dilution and optical spectrographic analyses; rubidium-strontium methods of

age determination using lepidolites, biotites and other minerals; correlation of rock units by rubidium-strontium analyses; isotope abundance of potassium-40; potassium-calcium dating studies; potassium-argon dating; and potassium-argon-calcium branching ratio.—*M. C. R.*

171–48. Wetherill, G[eorge] W., Tilton, G[eorge] R., Davis, G. L., and Aldrich, L. T. Evaluation of mineral age measurements. II: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 151–156, 1956.

A series of comparisons between potassium-argon, rubidium-strontium, and concordant uranium-lead ages of minerals from the Bob Ingersoll pegmatite at Keystone, South Dakota, the Fission Mine at Wilberforce, Ontario, the Bikita pegmatite of Southern Rhodesia and the Viking Lake pegmatite of Saskatchewan, all show that potassium-argon ages on mica agree well with concordant uranium-lead ages; that potassium-argon ages on feldspars seem too low, presumably because of argon loss; and that the rubidium-strontium ages seem consistently about 25 percent higher than concordant uranium-lead ages though good agreement between the two ages can be obtained if a half-life of 50×10^9 yrs is used instead of 63×10^9 yrs. Preliminary work on comparisons of rubidium-strontium and potassium-argon ages of minerals separated from granitic rocks indicate the same general effect.—*M. C. R.*

171–49. Schürmann, H. M. E., Bot, A. C. W. C., Steensma, J. J. S., Suringa, R., Deutsch, Sarah, Kley, W., Schmidlin, P., Kiessling, J., and Mürtz, H. J. Third preliminary note on age determinations of magmatic rocks by means of radioactivity: Geologie en Mijnbouw, 19e jaarg., no. 10, p. 398–413, 1957.

Recheck of the surprisingly high age of galena from the Lausitz granite of Europe ($600\pm60\times10^6$ yrs) confirms former measurements; the galena from the Billiton tin granite of Indonesia (from the same province as the Singkep monazite) is $105\pm50\times10^6$ yrs; and galena from Nigerian granite gives an age of $660\pm60\times10^6$ yrs (this is not very precise because of strong contamination of the sample). The chemical analyses, extraction experiments, separation of the riebeckite granite of Gebel Gharib, Egypt, and description of its minerals to be investigated are discussed in some detail. The age of the pleochroic haloes in biotite from the Lausitz granite is approximately $280\pm150\times10^6$ yrs; this is a minimum age, representing the age of the mineral that crystallized last or the age of the last rise in temperature. The results to date of the whole age determination program being carried on by Schürmann and the others are tabulated (feldspars from two places in Egypt; monazite and galena from Nigeria; feldspar, galena and monazite from Indonesia; and feldspar, zircons, monazite, 2 biotites, and galena from the Lausitz granite). (See also Geophys. Abs. 163–132 and 167–19.)—*D. B. V.*

EARTH CURRENTS

171–50. Ádám, A. Ein neues tellurisches Mess-Instrument [A new telluric measuring instrument]: Sopron Müszaki Egyetemi Karok Bányamérnöki és Földmérömérnöki Karok Közleményei, v. 19, p. 115–121, 1956.

A description of the telluric current measuring equipment at the Geophysical Research Laboratory of the Hungarian Academy of Sciences at Sopron; with photographs and schematic diagrams.—*D. B. V.*

171–51. Kántás, K. Results of the simultaneous measurements of telluric currents between Peking (China) and Sopron (Hungary) executed from 9th to 14th January 1956: Sopron Müszaki Egyetemi Karok Bányamérnöki és Földmérömérnöki Karok Közleményei, v. 19, p. 107–114, 1956.

Presents and analyzes the results of simultaneous telluric current measurements made during the week of January 9–14, 1956, in Peking and Sopron. Vector diagrams constructed for 1 min intervals for the records of January 14th show that in Sopron the vector of field intensity was revolving, whereas in Peking it was nearly constant in a north to northeast direction. The change in average levels in an interval of 10 min was analyzed by means of two different statistical methods; it was found that with a few exceptions the change in level occurred in identical directions for the two stations, and sometimes the resemblance was quantitative as well. Frequency relations, studied by means of simple scaling of frequencies, were found to agree well in detail.—*D. B. V.*

EARTHQUAKES AND EARTHQUAKE WAVES

171–52. Ambroggi, R., and de Gélis, E. Effet du tremblement de terre d'Orléansville sur la nappe aquifère du Souss [Effect of the Orléansville earthquake on the ground water layer of the Souss]: Service géol. Maroc Notes et Mém., tome 11, no. 123, p. 175–176, 1955.

Oscillations of water level in a well in the Souss valley, Morocco on September 9, 1954 at $1^h30 \pm 10^m$ (G. m. t.) is attributed to the Orléansville earthquake which occurred in Algeria a few minutes earlier.—*D. B. V.*

171–53. Krestinkov, V. N. Seysmichnost' i geologicheskoye stroyeniye na primere severnogo Tyan'-Shanya [Seismicity and geologic structure of the northern Tien Shan]: Priroda, no. 8, p. 25–34, 1957.

A review of the seismological investigations in the northern Tien Shan, including earthquake studies and deep seismic sounding by Gamburtsev and coworkers, and geologic investigations. Results of the seismic exploration have fully confirmed the geological conclusions on the deep structure of the area. Geological and seismological data have been successfully used by Vvedenskaya and Rozova to evaluate the seismic danger to industrial buildings to be erected in this area.—*S. T. V.*

171–54. Kupsch, W. O. Rocking Regina: Alberta Soc. Petroleum Geologists Jour., v. 5, no. 9, p. 222–223, 1957.

The intensity (9 on the Rossi-Forel scal) of the earthquake of May 15, 1909, the epicenter of which was in front of the Missouri Coteau near Regina, Saskatchewan, Canada, is a strong argument for tectonic faulting in this area.—*V. S. N.*

171–55. Jensen, Henry. Jordskaelvet ud for Stevns den 4, Juni 1954 [The earthquake off Stevns on June 4, 1954]: Denmark Geod. Inst. Meddel. no. 29, 9 p., 1954.

The earthquake felt in eastern Denmark on June 4, 1954 was not very strong, barely over 4 on the modified Mercalli scale, but a rare event in this area. The first *P*-waves were registered at Copenhagen at $21^h03^m25^s$ G. m. t.; the $S-P$ interval of 4.1 sec indicated an epicentral distance of 36 km. The epicenter was located at lat 55°22′ N, long 12°35′ E, off Stevns Klint on the east coast of Sjaelland, approximately the same as the focus of the earthquakes of October 31–November 1, 1930. The focal depth, however, was about 10 km, instead of 60 km as in the 1930 shocks. The isoseismal map shows a definite structural control, a NW-SE elongation corresponding closely to the trend of uplift of the Danian known from geological mapping.—*D. B. V.*

171–56. Panasenko, G. D. Seysmichnost' kol'skogo Poluostrova i Severnoy Karelii [Seismicity of the Kola Peninsula and northern Karelia]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 8, p. 969–978, 1957.

Twenty-four earthquakes which have occurred since 1728 in the Kola Peninsula, Finland, and northern Karelia are listed with short notes on the time of the shocks, intensity, and the resulting destruction. The most active zone is the narrow valley separating the Kola Peninsula from the Scandinavian Peninsula.—*S. T. V.*

171–57. Galanopoulos, A. G. Earthquake activity in the Greek area from 1950 to 1953 [in Greek with English summary]: Akad. Athenon Praktika, v. 30, p. 38–49, 1955.

Strain-rebound increments were calculated for earthquakes of magnitude 5 or greater during 1950 to 1953. The rate of strain relief was the same on both sides of the Aegean intermediate mass.—*M. C. R.*

171–58. Galanopoulos, A. G. Strain relief at the same rate on both sides of the Aegean mass [in Greek with English summary]: Akad. Athenon Praktika, v. 30, p. 49–57, 1955.

Strain relief at the same rate on both sides of the Aegean intermediate mass can be explained by "elective" isostatic compensation of the mobile fault blocks on both sides of the passive mass. Shift of epicenters on Crete during some active periods may be accounted for by the gradual sinking of the south side and rising of the north side.—*M. C. R.*

171–59. Simon, Béla. A Magyar földrengéskutatás 50 éve [Fifty years of Hungarian seismological investigations]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 6, szám 1–2, p. 69–72, 1957.

A historical review of seismological research in Hungary, from the first earthquake catalog published in 1783 to the current activity of the national seismological institute.—*D. B. V.*

171–60. Zátopek, A[lois]. Zu einigen Problemen der Erdkrustendynamik im Karpatengebiet [On some problems of the dynamics of the earth's crust in the Carpathian region]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 6, szám 1–2, p. 105–115, 1957.

Investigation of the seismicity of the Carpathian region would help to clarify a number of problems, here outlined, of crustal dynamics. The macroseismic relations between the Alps, Bohemian Massif, and western Carpathians suggest

the presence under the latter either of a formation that absorbs earthquake energy or an inclined discontinuity that reflects seismic waves. The irregular distribution of macroseismic intensity in the area in the period 1923–38 suggests a structural control, but not a simple one. Calculation of magnitudes would throw light on the seismicity of Central Europe in general and of the relation between the Carpathian area and surrounding regions in particular. More exact determination of foci would aid studies of initial mechanism of earthquakes, and study of the weak shocks preceding main shocks would increase understanding of focal mechanisms. The earthquakes of the outer border of the southeastern Carpathians, with foci in the subcrust at about 150 km, resemble those of the Hindu Kush and are particularly worthy of attention, especially with regard to their location at the sharpest bend of the Carpathian arc and their relations with strong earthquakes of the Inner Carpathians that originate in the crust.—*D. B. V.*

171–61. Bisztricsány, Ede, and Csomor, Dezsö. Az 1956, Január 12–i földrengés mikroszeizmikus adatainak feldolgozása és a föld kérgének felépitése a Magyar-medencében [Analysis of microseismic data on the earthquake of January 12, 1956, and crustal structure in the Hungarian Basin]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 6, szám 1–2, p. 37–45, 1957.

Analysis of the records of the earthquake near Dunaharaszti, Hungary, on January 12, 1956 shows that the Conrad discontinuity is at a depth of 20.2 km under the sedimentary rocks of the Hungarian basin, and the Mohorovičić is at a depth of 33 km. Computed *P*-wave velocities agree well with data from the Helgoland and Haslach explosions (5.49 kmps in the granitic layer, 6.98 kmps in the gabbroic, and 8.18 kmps below the crust). The focus of the earthquake, at 3.31 km, was at the bottom of the carbonate basin sediments rather than in the crust proper.—*D. B. V.*

171–62. Rozova, E. A., and Green, V. P. Raspolozheniye epitsentrov zemletryaseniy, proisshedshikh na territorii Kirgizii [Distribution of the epicenters of earthquakes which occurred in the Kirgiz SSR]: Akad. Nauk Kirgiz SSR, otdel geofiz., 40 p., 1954.

Sixty earthquakes that have occurred in the Kirghiz S. S. R., mostly since 1820 (one in 1620), are briefly described. For each earthquake the intensity, the position of the epicenter and some information characterizing the earthquakes are given. Methods of determining epicenters and the errors involved are analyzed. A scale of intensity, which gives the greatest acceleration corresponding to each class of earthquake, is included. Maps of earthquake epicenters in Central Asia for each year are also given.—*S. T. V.*

171–63. Rey Pastor, Alfonso. Estudio morfo-tectonico de la Falla del Guadalquivir [Morpho-tectonic study of the Guadalquivir fault]: Rev. Geofisica, año 14, no. 54, p. 101–137, 1955.

The most seismically active portion of the Guadalquivir valley is the area around Linares-Bailen where, as recently as 1951, 80 earthquakes occurred of intensities as great as VIII (see Geophys. Abs. 10231). A detailed tectonic analysis is presented. Magnetic surveys confirm the tectonic interpretations gravity anomalies in the region of Linares-Andujar-Jaen are interpreted as produced by collapse of vast caverns. Results are presented as a map of the region on which the epicenters of earthquakes, isoseismal lines, and probable faults are shown.—*S. T. V.*

171–64. Stark, Hans. Entstehung und Ursache einer Spaltenzone in den Lockerablagerungen des Menderestales während des Erdbebens vom 16.7.1955 [Formation and cause of a fissure zone in the unconsolidated deposits of the Menderes valley during the earthquake of July 16, 1955]: Geol. Jahrb., Band 72, p. 495–500, 1957.

A feather-like fissure system diagonally crossing the Menderes valley in Turkey and produced by the earthquake of July 16, 1955, represents a zone of abcission along which blocks tended to move downslope during the shocks; the direction and intensity of the fissures thus depends on local topographic inhomogeneities. In comparison, a long clean-cut fissure in unconsolidated sediments in the Kelkit graben is the direct trace of a fault in the bedrock.—*D. B. V.*

171–65. MacCarthy, Gerald R. An annotated list of North Carolina earthquakes: Elisha Mitchell Sci. Soc. Jour., v. 73, no. 1, p. 84–100, 1957.

A list is given of all earthquakes felt in North Carolina from 1774 through 1956, whether or not they originated within the state. Special attention is given to minor and lesser known shocks which have received little attention in the literature. Where possible the intensities are given.—*V. S. N.*

171–66. Tocher, Don and others. The Dixie Valley-Fairview Peak earthquakes of December 16, 1954: Seismol. Soc. America Bull., v. 47, no. 4, p. 299–396, 1957.

Tocher, Don. Introduction, p. 299–300.
Romney, Carl. Seismic waves, p. 301–319.
Whitten, C. A. Geodetic measurements, p. 321–325.
Cloud, William K. Intensity distribution and strong-motion seismograph results, p. 327–334.
Steinbrugge, K[arl] V., and Moran, D[onald] F. Engineering aspects, p. 335–348.
Reil, Orvis E. Damage to Nevada highways, p. 349–352.
Slemmons, David B. Geological effects, p. 353–375.
Larson, E. R. Minor features of the Fairview Fault, p. 377–386.
Zones, C. P. Changes in hydrologic conditions, p. 387–396.

The report covers the seismic results, geodetic measurements, engineering aspects and damage, geologic aspects, and changes in hydrologic conditions. The two large shocks had magnitudes, according to Pasadena, of 7.1 and 6.8. The motion at the focus for the Fairview Peak earthquake, as determined from Byerly's method, agreed almost exactly with the geodetic measurements. The fault displacements were mainly along normal faults of the Basin-Range type. The maximum strike-slip component was 12 feet (right lateral) at Fairview Peak, and the maximum vertical-slip component was about 12 feet at Bell Flat. Ground water levels have changed locally by tens of feet or less since the earthquakes.—*P. E. B.*

171–67. Bruet, E. Les tremblements de terre d'origine volcanique [Earthquakes of volcanic origin]: Le Monde Souterrain, 21e année, no. 951, p. 271–274, 1956.

A review of earthquakes in relation to volcanic activity.—*M. C. R.*

171–68. Hiller, Wilhem. Über die Mechanik und Dynamik der Erdbeben [On the mechanics and dynamics of earthquakes]: Geol. Rundschau, Band 46, Heft 1, p. 39–50, 1957.

Two cases are cited to illustrate the dynamic relationships between structure and earthquakes. One is on a small scale—the series of earthquakes in southwestern Germany in 1933–36, obviously related to Alpine folding. The second involves a quarter of the earth's surface—from November 1955 to February 1956 practically all seismic activity was concentrated in the Pacific area. Here also there presumably was some connection between the forces in play. If such be the case, then the fluctuations in stresses and strains cannot be limited to a relatively thin outer band (maximum 700 km) of the earth; it must be assumed that the true sources of energy and causes of earthquakes, and therefore of tectonic phenomena to a large degree at least, lie deeper in the interior, perhaps even in the core. Geomagnetic investigations have already been turning toward currents in this deep interior for the explanation of secular variations.—*D. B. V.*

171–69. Aki, Keiiti. Thermal process near the earth's crust: Zisin, v. 7, no. 2, p. 65–76, 1955; Jour. Physics of the Earth, v. 4, no. 2, p. 53–62, 1956.

Matuzawa (Geophys. Abs. 162–125 and 165–39) has proposed a mechanism for earthquake occurrences in which a solid-liquid phase transformation supplies strain energy to the crust. The amount of heat energy required can be supplied only by convection currents below the crust. If such a current has a linear dimension of 100 km, the viscosity of the material must be 10^{17} poise, its maximum current velocity 50 m per yr, and it exerts a tangential stress of the order of 10^7 dynes per sq cm along the lower surface of the crust.—*M. C. R.*

171–70. Tanabashi, Ryō. Ultimate resistance of building structures to destructive earthquakes [in Japanese with English abstract]: Kyoto Univ. Disaster Prevention Research Inst. Bull., 5th Anniversary Memorial issue, p. 106–115, 1956.

A review of Tanabashi's work on the dynamic behavior of structures during earthquakes.—*M. C. R.*

171–71. Hatanaka, Motohiro. On the earthquake resistant properties of arch dams [in Japanese with English abstract]: Kyoto Univ. Disaster Prevention Research Inst. Bull., 5th Anniversary Memorial issue, p. 125–134, 1956.

A discussion of the determination of the period of free vibration and mode of vibration of arch dams, and of the distribution of the seismic coefficient of an arch dam.—*M. C. R.*

171–72. Kobori, Takuji. Quake resistant and nonlinear problems of the structural vibrations to violent earthquakes [in Japanese with English abstract]: Kyoto Univ. Disaster Prevention Research Inst. Bull., 5th Anniversary Memorial issue, p. 116–124, 1956.

A discussion of the earthquake resistance of buildings. The point is made that analysis of linear vibrations is not adequate because some slight destruction is almost inevitable in buildings subjected to a violent earthquake.—*M. C. R.*

171–73. Ozawa, Izuo. On the observation of crustal deformation at Ōsakayama [in Japanese with English abstract]: Kyoto Univ. Disaster Prevention Research Inst. Bull., 5th Anniversary Memorial issue, p. 14–19, 1956.

Linear strain and tilting of the ground has been observed at Ōsakayama since 1947. When periodic variations are eliminated, remarkable changes in linear strain are observed before and after the Yoshino earthquake of July 18, 1952.—*M. C. R.*

171–74. Ooba, Syohachi. Study of the relation between the subsoil conditions and the distribution of damage percentage of wooden dwelling houses in the province of Tōtōmi in the case of the Tōnamkai earthquake of December 7, 1944 [in Japanese with English summary] : Tokyo Univ. Earthquake Research Inst. Bull., v. 35, p. 1, p. 201–295, 1957.

This gives the results of statistical analysis of the distribution of houses totally collapsed in Tōtōmi province, Japan, in the Tōnankai earthquake. Markedly higher damage occurred on clayier marsh deposits along river courses of low gradient, decidedly slight damage on the diluvial plateau with a gravel layer or along river courses of steeper grade with gravel beds, intermediate damage in coastal sand-dune areas, and negligible damage on rocky foundations. Mean percentages of damage were 26.1 for clay, 1.4 for gravel, 3.5 for sand, and 0.2 for diluvial plus rocky foundations. The seismic activity of the area in historic times and characteristic features of the damaged houses are also described in some detail.—*D. B. V.*

171–75. Coulomb, Jean. La détermination de l'épicentre d'un séisme à l'aide des couples de stations ayant enregistré l'onde *P* à la même heure [The determination of the epicenter of an earthquake by means of pairs of stations recording the *P* wave at the same time] : Acad. Sci. Paris Comptes Rendus, tome 244, no. 8, p. 1060–1062, 1957.

The only method of determining an epicenter without the aid of traveltime tables involves the use of equal-time pairs. One can seek directly the extremum $\Sigma\ (Aa+Bb+Cc+\sin V\frac{dt}{dt}\delta t)^2-\lambda A^2+B^2+C^2-1)$ (A, B, and C are the direction cosines of the unknown epicenter; a, b, and c the differences between those of the two stations: V=velocity, t=time, λ=Lagrange coefficient). Because δt is small and can be assumed to be 0, the equations for $\delta\lambda$, δA, δB, and δC, the differences from the solution obtained, can be linearized.—*D. B. V.*

171–76. Sultanova, F. F. Otsenka pogreshnostey opredeleniya polozheniya ochagov zemletryaseniy pri primenenii poley vremen [An evaluation of errors in the determination of the foci of earthquakes when using the method of time-fields] : Akad. Nauk Azerbaydzhan. SSR Doklady, tom 13, no. 5, p. 487–491, 1957.

To locate the focus of an earthquake it is necessary to know the geologic profile of the region and the distribution of velocities. Computation of these data, by Riznichenko's "method of time-fields" does not affect the accuracy of determinations of the position of the epicenter, but does result in a rather important error in the depth of the hypocenter.—*S. T. V.*

171–77. Andreyev, S. S., and Shebalin, N. V. O primenenii korotkoperiodnykh seysmografov dlya vydeleniya obmennykh voln na zapisyakh ydalennykh zemletryaceniy [On the use of short-period seismographs for distinguishing converted waves on the records of distant earthquakes] : Akad. Nauk SSSR Izv. Ser. geofiz., no. 7, p. 931–933, 1957.

Converted waves (such as PS_1 and PS_2) produced at deep discontinuities in the crust can be distinguished on the seismograms of distant earthquakes obtained with short-period seismographs with suitably chosen characteristics. Depth to the discontinuities can be calculated from the records of one station. Examples are given from records of the Stepanovsk and Sverdlovsk seismological stations.—*D. B. V.*

171–78. Kondorskaya, N. V. Po povodu regional'nykh osobenostey vremen probega seysmicheskikh voln [Concerning regional peculiarities of travel times of seismic waves]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 7, p. 895–913, 1957.

The study of records of strong earthquakes in the Far East (Kurile-Kamchatka region and southeastern Hokkaido), central Asia, and Turkey has revealed that the observed travel times to various stations throughout the U. S. S. R. are longer than those determined from the Jeffreys-Bullen seismological tables. Corrections computed on the basis of statistically determined average time intervals allow more accurate determination of epicenters. Graphs present curves for *S* and *P* and in some cases, *sS*, *Pp*, and *Sp* waves for earthquakes from the different regions as registered in different parts of Russia, as computed from the tables, and as corrected. Confusion between the *S* and *sS* wave onsets may cause an error up to 2° in location of the epicenter.—*D. B. V., S. T. V.*

171–79. Vaněk, Jiří, and Zátopek, Alois. Magnitudenbestimmung aus den Wellen P, PP, and S für die Erdbebenwarte Prag [Determination of magnitude from P, PP, and S waves for the seismological station at Praha]: Československé Akad. Věd Geofys. Ústav Práce Geophys. Sborník, no. 26, p. 91–120, 1955.

Constant terms in the Gutenberg-Richter magnitude equation have been determined by using the components *PH*, *PV*, *PPH*, and *SH*. Some anomalies in the structure of the crust are indicated by differences in the constants for different distance—for instance, the discontinuity between the eastern Mediterranean region and the Asia Minor at $\Delta=20°$.—*S. T. V.*

171–80. Tomoda, Yoshibumi. Statistical description of the time interval distribution of earthquakes and on its relations to the distribution of maximum amplitude: [in Japanese with English summary]: Zisin, v. 7, no. 3, p. 156–169, 1955.

A statistical investigation shows that the frequency distributions of the time interval between consecutive earthquakes and the distribution of maximum trace amplitudes of earthquake motions follow the same law but are statistically independent quantities.—*M. C. R.*

171–81. Tsuboi, Chuji. Determination of the Gutenberg-Richter magnitude of earthquakes occurring in and near Japan [in Japanese with English abstract]: Zisin, v. 7, no. 3, p. 187–193, 1955.

The following formula has been found useful for calculating the Gutenberg-Richter magnitude of an earthquake occurring in or near Japan from seis-

mometrical data obtained at Japanese stations: $M=+1.73 \log \Delta+\log \Delta-0.83$, where Δ is the maximum displacement amplitude of the ground due to that earthquake (measured in microns) observed at an epicentral distance (measured in km) and log is the common logarithm.—*Author's abstract*

171–82. Tsuboi, Chuji. Earthquake energy, earthquake volume, aftershock area, and strength of the earth's crust. Jour. Physics of the Earth, v. 4, no. 2, p. 63–66, 1956 and Zisin, v. 9, no. 2, p. 76–80, 1956.

The energy of an earthquake depends largely on the volume within which it has been stored. A formula $E=1/2\ e\varpi^2\ V$ is proposed where e and ϖ are the effective elastic constant and ultimate strain, and V, the earthquake volume, is $d\times 3d\times 3d$ where d is the thickness of the crust. If $e=5\times10^{11}$ or 10^{12}, $\psi=10^{-4}$ or 2×10^{-4}, and $d=4\times10^6$ or 5×10^6, E is 1.4×10^{24} or 2.3×10^{25}. Gutenberg and Richter's 1955 formula gives $E=5.0\times10^{24}$ for magnitude of 8.6. The area of aftershock occurrences (A) is related to the magnitude of the main shock and through the magnitude formula to the energy so that $E=6\times10^2\ A^{1.5}$.—*M. C. R.*

171–83. Hosoyama, Kennosuke. On secular observations of tilting motion of the ground [in Japanese with English abstract]: Kyoto Univ. Disaster Prevention Research Inst. Bull., 5th Anniversary Memorial issue, p. 20–27, 1956.

A discussion of the reliability of observtions of crustal strain prior to earthquakes, based on tilting motion associated with the Daishoji-Oki (March 7, 1952) and Yoshino (July 18, 1952) earthquakes.—*M. C. R.*

171–84. Sassa, Kenzo. Some problems on the forecasting of the earthquake (II). On the observation of the crustal strain accompanied by the earthquake [in Japanese with English abstract]: Kyoto Univ. Disaster Prevention Research Inst. Bull., 5th Anniversary Memorial issue, p. 3–7, 1956.

Long-term crustal strain prior to a great earthquake is estimated to be of the order of 10^{-6} per year and of 10^{-7} within 100 km of the focus just before the earthquake. Observations of such small strains must be made more than 30 m underground by a variety of tiltmeters and extensometers.—*M. C. R.*

171–85. Nishimura, Eiichi. On change of state of the materials in the earth's crust with relation to seismic activity [in Japanese with English abstract]: Kyoto Univ. Disaster Prevention Research Inst. Bull., 5th Anniversary Memorial issue, p. 8–13, 1956.

A discussion of the possibility of predicting earthquakes by observation of changes in the crust. Tiltmeter observations at Makimine are cited as an example.—*M. C. R.*

171–86. Ruprechtová, Libuše. Mistni hodochrony vln *PP* a *SS* pro stanici Praha [Regional traveltime curves of *PP* and *SS* waves for the Praha station]: Československé Akad. Věd Geofys. Ústav Práce, Geofys. Sborník, no. 27, p. 121–134, 1955.

Traveltime curves of *PP* and *SS* based on observations at Praha from 1930 to 1948 are in good agreement with those of Bullen but differ from those of Båth, based on data at Uppsala, and Mokrovič for Zagreb, probably because of local structural differences.—*S. T. V.*

171–87. Aki, Keiiti. Correlogram analysis of seismograms: Zisin, v. 8, no. 2, p. 99–107, 1955; Correlogram analysis of seismograms by means of a simple automatic computer: Jour. Physics of the Earth, v. 4, no. 2, p. 71–79, 1956.

An automatic relay computer for calculating autocorrelation coefficients has been used in the analysis of about 100 near earthquakes recorded in Tokyo and at Mizusawa. The predominant period of waves depends on crustal structure of the wave path and magnitude in the shocks studied. Where the crustal structure is simple, the predominant period is short at the beginning and increases to a steady value in the coda; if the crustal structure is complex the difference is not marked. Period increases with increasing magnitude.—*M. C. R.*

171–88. Bycroft, G. N. The magnification caused by partial resonance of the foundation of a ground vibration detector: Am. Geophys. Union Trans., v. 38, no. 6, p. 928–930, 1957.

This note is intended to indicate the values of magnification and phase shift arising in a ground vibration detector due to partial resonance of the instrument on the ground. Results from a previous paper by the author are used to derive curves of magnification and phase shift. It is shown, by an example, that a typical geophone will give results grossly in error when the frequencies of the measured vibrations are high.—*Author's abstract*

EARTH TIDES

171–89. Tomaschek, R[udolf]. Die Flut der festen Erde [The tide of the solid earth]: Umschau, Jahrg. 57, Heft 21, p. 647–650, 1957.

A review of the causes and measurements of, and the effect of ocean tides, meteorological conditions, geologic structure, and seasonal temperature changes on earth tides.—*D. B. V.*

171–90. Tomaschek, Rudolf. Measurements of tidal gravity and load deformamations on Unst (Shetlands): Geofisica Pura e Appl., v. 37, p. 55–78, 1957.

The tidal gravimetric factor due to the elastic yielding of the earth, determined from gravimetric measurements made on Unst, one of the Shetland Islands, over a period of one month is found to be $G=1.205\pm3$ (corrected value). The effects on the results of applying different methods of harmonic analysis, and the effects of ambient temperature and pressure and of sea tides, are discussed. No significant difference in G for semidiurnal and diurnal tides remains after the necessary corrections have been made. The amplitude of the semidiurnal load depression is about 2 cm and it is shown that more distant North Atlantic tides have a greater effect than tides in the Shetlands region. The mean rigidity of the part of the earth's crust yielding to maritime load differences in this region is calculated as approximately 4.3×10^9 cgs units.—*D. B. V.*

171–91. Lassovszky, Károly. A föld deformációs együtthatójának meghatározása graviméterészlésekből [Determination of the deformation coefficient of the earth from gravimeter observations (with German summary)]: Magyar Állami Eötvös Lóránd Geofiz. Intézet Geofiz. Közlemények, kötet 5, szám 1, p. 18–26, 1956.

This paper describes a method of determining the deformation coefficient of the earth (d) independent of instrumental drift. The first step is elimination of jumps in the instrument drift by means of a provisional drift curve, obtained by subtracting from the observed values the values of the theoretical luni-solar effect for the same times; from this curve the jumps and their magnitude are easily determined. The second step is determination of the instrumental drift, by plotting the drift value for each point of time in which the luni-solar effect is zero; the smooth curve connecting these points is the drift curve.

From the values corrected for drift is obtained a curve comparable to the luni-solar curve but of greater amplitude. The amplitude ratio of the two curves gives the coefficient d, if all observed values are divided by the corresponding theoretical value. In calculating the mean value, the numerical values of the theoretical data are assumed to be the gravity of the individual values.—*D. B. V.*

ELASTICITY

171–92. Verma, Ghasi Ram. On the stresses produced by impulsive displacements applied to the inner surface of a spherical cavity: Geofisica Pura e Appl., v. 37, p. 16–20, 1957.

Equations are derived for the displacements and stresses produced in an infinite elastic solid by impulsive radial and impulsive twisting displacements applied to the inner surface of a spherical cavity.—*D. B. V.*

171–93. Robinson, A. Wave propagation in a heterogeneous elastic medium: Jour. Math. and Physics, v. 36, no. 3, p. 210–222, 1957.

Wave propagation in a heterogeneous elastic medium is investigated directly, without recourse to equivalent homogeneous layering. The wave is assumed to have a discontinuity across a wave front, and the system of differential equations satisfied by this discontinuity along the rays is analyzed with the aid of a determinantal characteristic condition. The rays satisfy Fermat's principle for velocities $C_p=\sqrt{(\lambda+2\mu)/\rho}$ and $C_s=\sqrt{\mu/\rho}$. The study shows that a sharp longitudinal wave cannot be created by gradual transformation from a sharp transverse wave and that a sharp transverse wave cannot be generated by a longitudinal wave. On the whole the conclusions are consistent with but more precise than those given by Jeffreys in an earlier report.—*R. G. H.*

171–94. Takeuchi Hitoshi, and Kobayashi, Naota. Wave generations in a superficial layer resting on a semi-infinite lower layer: Jour. Physics of the Earth, v. 4, no. 1, p. 21–30, 1956.

Movement at a point as a result of waves generated by a line source of *SH* type is composed of pulses that represent disturbances arriving at the theoretical times of reflected and refracted waves. Superposition of these component waves at points far from the origin results in theoretical movement similar to that predicted by the normal mode solution. Thus simple aperiodic motion near the origin is changed to complex periodic motion.—*M. C. R.*

171–95. Kobayashi, Natoa, and Takeuchi, Hitoshi. Propagation of tremors over the surface of an elastic solid: Jour. Physics of the Earth, v. 3, no. 1, p. 17–22, 1955.

Wave phenomena at the surface of a semi-infinite elastic solid subjected to an external tangential force acting paralell to the x-axis (SV) are almost the same

as those resulting from a dilatational origin. If the external force acts parallel to the z-axis, neither P nor Rayleigh waves are obtained.—*M. C. R.*

171–96. Takeuchi, Hitoshi, and Kobayashi, Naota. Propagation of tremors over the surface of an elastic solid: Jour. Physics of the Earth, v. 2, no. 1, p. 27–31, 1954.

Wave phenomena which are seen along the surface of a semi-infinite elastic solid when subjected to an impulsive line force in the direction normal to its surface have been studied. The results obtained are as follows. (1) Immediately after the impulsive force is removed, the vertical displacement is downward in the neighborhood of the origin, and it is upward outside that downward domain. (2) In the downward (upward) domain, the horizontal displacement is toward (away) from the origin. (3) The surface deformations thus produced are propagated with the velocity of a Rayleigh wave without conspicuous changes in form. (4) The wave length of the Rayleigh wave is proportional to the time of duration of the impulse, and is of the same order of extent as that of the downward domain at the moment when the force is removed.—*Authors' abstract*

171–97. Satō, Ryōsuke. On the propagation of tremors along the interface of water and solid produced by a point source in a solid. Pt. 2 [in Japanese with English abstract]: Zisin, v. 7, no. 2, p. 77–88, 1955.

A dilatational point source is assumed and displacements at different epicentral distances obtained. The waves propagated along the interface are: a P-wave in the solid and a Rayleigh whose velocity is slightly smaller than that of sound in water, and a compressional wave in water and S-wave in the solid. At large epicentral distances the maximum vertical displacements are smaller than the horizontal except in the S-wave.—*M. C. R.*

171–98. Riznichenko, Yu. V. O raskhozhdnii i pogloshchenii seysmicheskikh voln [The propagation and absorption of seismic waves]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 35 (162), p. 9–41, 1956.

The best formula to describe the changes of amplitude of propagating through different media with boundary conditions that strongly affect the behavior of the waves is $A=C\,r^{-n}e^{-\alpha r}$, where A is the amplitude of the wave at a point at distance r from the source of disturbance, n is a constant determining the spreading of the wave front which causes a decrease of the stream of the energy passing through a unit volume, and $e^{-\alpha r}$ shows the decrease of amplitude because of incomplete elasticity of the medium. The values of the coefficients n and α are different for different media and boundary conditions. For a plane wave in a perfectly elastic medium n and α are zero. For a plane wave propagating through a homogeneous but not perfectly elastic medium n is zero, but α depends on the damping property of the medium. More than 25 cases of different waves are discussed and the solution given with the principle characteristics of the resulting wave pattern and the limits of applicability of the suggested method of solution.—*S. T. V.*

171–99. Pěč, Karel. Les ondes du type de Rayleigh dans une couche interne (première partie) [The waves of the Rayleigh type in an internal layer (first part)]: Československé Akad. Věd Geofys. Ústav Práce, Geofys. Sborník, no. 24, p. 69–78, 1955.

A discussion of the propagation of Rayleigh type waves along a thin stratum between two semispaces, all of which are assumed to be homogeneous, isotropic,

and perfectly elastic. The coupling along the boundaries is assumed to be rigid so that the components of displacement and stress remain continuous. The velocity of the Rayleigh wave can be determined as function of its wave length. Special cases of the general problem are also analyzed and lead to the known Stoneley and Sezawa waves.—*S. T. V.*

171–100. Satō, Yasuo. Study on surface waves XIII. Nomograph for the phase velocity of Love-waves in doubly stratified medium: Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 1, p. 1–6, 1957.

A nomograph has been constructed for determination of velocity of Love waves for the case of two layers for use in calculation of their dispersion curves. A complete nomograph cannot be constructed because the characteristic equation is very complicated; an approximate value of frequency corresponding to some given velocity value is found by trial and error. The precision, however, seems to be satisfactory for practical work, and the time required to obtain dispersion curves is reduced to about one tenth or one fifth that of the ordinary method.—*D. B. V.*

171–101. Press, Frank, and Healy, John. Absorption of Rayleigh waves in low-loss media: Jour. Applied Physics, v. 28, no. 11, p. 1323–1325, 1957.

Many materials are characterized by internal dissipation parameter $1/Q << 1$. An expression is derived for such media relating the Rayleigh wave absorption coefficient to compressional and shear wave absorption coefficients with the elastic velocities as parameters. Ultrasonic experiments are described in which the three absorption coefficients are measured in thin Plexiglas sheets. The theoretically derived expression satisfactorily relates the observed absorption coefficients.—*M. C. R.*

171–102. Knopoff, L., Fredricks, R. W., Gangi, A. F., and Porter, L. D. Surface amplitudes of reflected body waves: Geophysics, v. 22, no. 4, p. 842–847, 1957.

The motion at a free surface does not directly describe incident body wave motion because of *P–SV* interaction at reflecting surfaces. Corrections to be applied to surface motion data to produce the actual body wave amplitudes are computed for incident plane waves.—*R. G. H.*

171–103. Ivakin, B. N. Golovnyye prokhodyashchiye i drugiye volny v sluchaye tonkogo tverdogo sloya v zhidkosti [Head waves, normal waves, and other waves in a thin rigid layer in a fluid]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 35 (162), p. 88–115, 1956.

Propagation of elastic impulses in a liquid medium containing a rigid plane layer of high seismic velocity was investigated by model experiments, using the ultrasonic impulse seismoscope. The presence of the head wave *PPP* and of the converted *PSP* wave, both of which exhibit resonance phenomena, was established. The amplitude of *PPP* varies with the thickness of the rigid layer; the variation is not linear but has a maximum controlled by the ratio of the thicknes of the rigid layer to the length of the wave *P*. At most *PPP* at the initial point has an amplitude of only 3 percent of the amplitude of the incoming wave *P*. The anomalous dispersion of the converted wave *PSP* decreases with the increase of the thickness of the rigid layer; at the maximum point the amplitude

of *PSP* is about 25 percent of that of *P*. The amount of wave energy passing through the layer ("transparency" of the layer) is affected by the material. If a quasi-spherical wave falls on a rigid layer as the angle of incidence increases, the amount of the total wave energy passing through the layer decreases. For still greater angles of the waves, which do not follow the rules of geometric optics but appear to be analogous to Rayleigh surface waves, were observed.—*S. T. V.*

171–104. Carabelli, E., and Folicaldi, R. Seismic model experiment on thin layers: Geophys. Prosp., v. 5, no. 3, p. 317–328, 1957.

Model experiments were made to determine whether the presence of thin reflecting layers (thickness much smaller than a wavelength) could be observed as a separate event. The records show that reflections of large amplitudes are present even for the case of moderate acoustical impedance ratios between the thin layer and the surrounding medium.—*I. Z.*

171–105. Kosminskaya, I. P. Analiz zon intereferentsii seysmicheskikh voln [Analysis of the zones of interference of seismic waves]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 35 (162), p. 116–145, 1956.

The applicability of methods, successfully used for the separation of the compound harmonic vibrations, to the analysis of interfering seismic waves is discussed. Such interference results from the superposition of several quasi-sinusoidal impulses. Comparison of the results of theoretical computations with graphical constructions for two refracted waves proves the expediency of such a procedure. Thus formulas derived in the studies of harmonic waves for the length of the zones of interference, for apparent velocities, and the ratio of amplitudes can be used for seismic impulse waves. On the basis of criteria of interference zones of interfering waves on seismograms can be determined, and the presence of compound waves established even though the waves seem to be simple.—*S. T. V.*

171–106. Fedotov, S. A. Priblizhennyy sposob rashcheta dinamicheskikh godografov voln, prelomlennykh na krivolineynykh gravitsakh [Approximate determination of dynamic traveltime curves of waves refracted on curvilinear boundaries]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 35 (162), p. 42–50, 1956.

Dynamic traveltime curves are those that give direction and absolute value of the amplitude as well as time of arrival at any point. The shape of the curve gives an indication of the dynamic changes undergone by the wave in the process of refraction. Such traveltime curves, especially of waves refracted on curvilinear boundaries, can be evaluated by a method based on substitution of straight linear segments for the successive elements of the curvilinear boundary. Formulas are given. Computed results can be verified by comparison with data obtained from model experiments.—*S. T. V.*

171–107. Berzon, I. S. O nekotorykh dinamicheskikh osobennostyakh voln, rasprostranyayushchikhsya v vertikal'no-sloistykh sredakh [On certain dynamic peculiarities of waves propagating in a vertically stratified medium]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 35 (162), p. 51–87, 1956.

It has been observed in seismic prospecting that when a seismic wave crosses a boundary between vertically stratified media, there are important changes in

its dynamic characteristics. Detailed consideration suggests that these changes can be used to study vertically stratified formations and that they will give a better indication of the position of the boundary surface than can be obtained from study of traveltime curves. Thin strata can be clearly detected on the curve of dynamic changes. The resolving power of the new method can be increased by use of higher frequency waves. If the vertically stratified medium is covered with an overburden the resolving capacity of the method is determined not only by the frequency of the waves but also by the ratio of the velocities in the overburden and the contacting strata.—*S. T. V.*

171–108. Yepinat'yeva, A. M. Ob otrazhennykh volnakh, voznikayushchikh pri uglakh padeniya, bol'shikh predel'nogo [On reflected waves produced at angles of incidence greater than the critical angle]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 709–727, 1957.

Experiments show that in some real media, longitudinal reflected waves may appear in seismograms even when their angle of incidence is equal to or greater than the critical angle and that the amplitude of such waves may be greater than that of refracted waves. A sharp change of the coefficient of reflection as a function of angle of incidence could cause a sharp change in amplitude and in form of the reflection record with a change of distance from shot point. At some distances the suddenly increased amplitudes could be mistaken for the arrival of new waves. These experimental results, which agree well with theoretical calculations, necessitate revision of previous concepts of amplitude relations between reflected and refracted waves; further experimental and theoretical study of the question is recommended.—*D. B. V.*

171–109. Hardtwig, E[rwin]. Näherungsformeln für die bei der Reflexion und Brechung elastischer Wellen an Unstetigkeitsflächen auftretenden Reflexions- und Transmissionskoefficienten [Approximation formulas for the reflection and transmission coefficients appearing in the reflection and refraction of elastic waves at discontinuities]: Geofisica Pura e Appl., v. 37, p. 1–15, 1957.

Approximation formulas are derived for the otherwise very complicated reflection and transmission coefficients that enter into calculations of the partition of energy among the four secondary waves (reflected and refracted compressional, and reflected and refracted shear waves) developed when a compressional wave is incident on a plane boundary between two elastic mediums. With these simplified formulas, calculations are substantially more rapid and only a few percent of accuracy are lost.—*D. B. V.*

171–110. Murphy, William O., Jr., Berg, Joseph W., Jr., and Cook, Kenneth L. Seismic velocity study of synthetic cores: Geophysics, v. 22, no. 4, p. 813–820, 1957.

The velocity of a longitudinal elastic wave through rock at room temperature and at atmospheric pressure depends upon the nature of the rock frame, the porosity of the rock, and the nature of the pore-filling fluid. In the present investigation longitudinal elastic wave velocities were measured for sixty synthetic cores. The rock frame consisted of sorted quartz sand grains and cement, the percentage of cement varying from ten to fifty percent. The core porosities varied from 8.8 percent to 22 percent. The velocities were measured for dry air-filled cores and for cores saturated with various liquids. These pore-filling liquids were distilled water, ethyl alcohol, benzene, carbon tetra-

chloride and chloroform. The measured velocities ranged from 2,360 feet per second to 14,710 feet per second. The wave velocity in liquid-filled cores of 10 percent porosity was approximately twice the velocity for cores of 20 percent porosity, the same type of cement being used in both instances. For any given core, flooded with fluids of wave velocities ranging from 3,000 to 5,000 feet per second, the maximum observed variation in core velocity was around 20 percent. The experimental data fitted the empirical linear equation $V_t = kV_f + C$, where V_t = velocity of longitudinal elastic waves passing through the flooded core; and V_f = velocity of longitudinal elastic waves in passing through the saturating fluid.

The constant k depends upon the porosity of the rock and the type of cement used. The constant, C, depends upon the nature of the rock frame.—*Authors' abstract*

171–111. Sutton, George H., Berckhemer, Hans, and Nafe, John E. Physical analysis of deep sea sediments: Geophysics, v. 22, no. 4, p. 779–812, 1957.

A sonic pulse system, similar to that used at Lamont Geological Observatory for seismic model experiments, was used aboard the Research Vessel *VEMA* during the summer of 1954 to determine high frequency seismic velocities in fresh deep sea sediment cores. Velocity profiles were obtained from 26 cores covering a wide range of lithologies and ages (Recent to Miocene). Density, porosity, median grain size, sorting, carbonate content, and salt content were also measured.

The compressional wave velocity in the ocean-bottom unconsolidated sediments studied is well represented by the equation: $v' = 2.093 - (.0414 \pm .0060)\ \varphi + (.00135 \pm .00038)\ \gamma - (.44 \pm .15)\ \eta$ where v'=compressional wave velocity in km per sec, φ=median grain size in phi units, γ=percentage of HCl soluble material, and η=porosity. Many measurements gave velocities less than the velocity of sound in sea water. Most of the low carbonate samples followed a velocity-porosity relation given by the Wood (1941) equation. The regression coefficient, $-.44\eta$, agrees well with the average slope of the Wood equation over the observed porosity range. High carbonate and large median grain size samples gave velocities above that predicted by the Wood equation. These higher velocities are explained as the combined result of shear strength and low effective porosity in the samples. The highest velocities were found in slowly deposited sediments.

The degrees of sorting of the sediments had no observable effect on the seismic velocities except that unexplained variations were greater for more poorly sorted materials. No correlation between velocity and age was evident in the sediments studied.

The effect of temperature, between 40 and 80° F. on compressional velocity in sediments may be explained by changes in elastic properties of the water fraction alone. The effect of compaction in the upper 15 or 20 feet of homogeneous sediments produced a change in seismic velocity not greater than 1 or 2 percent.

Attenuation was greater in the course-grained high-velocity sediments than in sediments of smaller grain size.—*Authors' abstract*

171–112. Krinari, A. I., and Zubkov, V. L. K kharakteristike uprugikh svoistv gornykh porod Paleozoya Tatarii [The characteristic elastic properties of the Paleozoic rocks of the Tartar Autonomous SSR]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 813–817, 1957.

The elastic properties of core specimens from different horizons in exploratory drill holes in the Tartar Autonomous Republic were measured using the quantity $\epsilon=\sqrt{h/H}$, where h is the height of rebound of a steel ball from the polished surface of the specimen, and H the height from which the ball falls. The results tabulated and analyzed, provide information on the relation of the elastic velocities (in m per sec) of the various formations of the sedimentary cover and metamorphic basement in the region to their composition, age, depth, details of sedimentation, and degree of metamorphism, which should provide the basis for more accurate interpretation of seismic surveys.—*S. T. V.*

ELECTRICAL EXPLORATION

171–113. Bhattacharyya, Bimal Krishna. Propagation of an electric pulse through a homogeneous and isotropic medium: Geophysics, v. 22, no. 4, p. 905–921, 1957.

Step function electric impulses with sharp edges and moderately fast repetition rate have a large high-frequency content. Studies of propagation of such pulses through media of low conductivity: permittivity ratio, σ/ϵ, therefore require consideration of displacement currents. Expressions for radial, e_r, and colatitude, $e\theta$ components of the electric field response to a step-function dipole current source are derived with the aid of Laplace transforms of the components of the vertically polarized Hertz vector. The attenuation effects for various values of σ/ϵ are shown graphically. The study shows that σ/ϵ can be obtained directly if the initial and final values of e_r and $e\theta$ are known from practical pulse measurements. As ϵ can be determined experimentally, σ can be readily calculated.—*R. G. H.*

171–114. Krajčovič, Silvester. Studium vplyvu sférického telesa na umelé geoelektrické polia [On the influence of a spherical body upon artificial geoelectric fields]: Československé Akad. Věd Geofys. Ústav Práce, Geofys. Sborník, no. 34, p. 297–326, 1955.

A disturbing body of spherical shape and specific resistivity ρ_2 is assumed to lie in a homogeneous and isotropic conducting semi-infinite medium of specific electric resistivity ρ_1. Theoretical resistivity curves and anomalies produced by the body on the surface of the ground are computed and constructed for both Wenner and Schlumberger arrangements for different values of ρ_2/ρ_1; the radius of the sphere was taken as 0.2 to 0.9 units and the depth of the body's center as 1. Six examples are given of the interpretation of the curves by means of a graphical method. In the concluding section some practical cases are discussed, as well as the field of the application of the constructed curves in geophysical prospecting.—*S. T. V.*

171–115. Novozhilova, M. Ye. Pole polyarizovannoy sfery v prisutstvii kontakta [The field of a polarized sphere near a contact]: Vses. nauchno-issled. inst. razved. geofiz. Voprosy rudnoy geofiz., Sbornik statey 1, p. 114–119, 1957.

The potential field of a polarized sphere lying a depth Z_0 in a medium having a specific resistivity (ρ_1) at a distance (d) from a vertical contact with a medium having a specific resistivity (ρ_2), can be represented by the formula for a vertical dipole: $U_1=\rho/(\xi^2+1)^{3/2}+K_{12}\rho/[2\delta-\zeta)+1]^{3/2}$ and $U_2=(1+K_{12})/\xi^2+1)^{3/2}$ where

U_1 and U_2=potentials of first and second mediums, respectively; ρ=a coefficient depending on moment and depth of the dipole; $K_{12}=(\rho_2-\rho_1)/(\rho_2+\rho_1)$; $\xi=x/Z_0$; $\delta=d/Z_0$; and x=coordinate of point of observation of earth's surface. Graphs are presented showing the potentials for $\rho=-1$, $\rho_1=1$ and $Z_0=1$ for $\delta=0$, 0.1, 0.2, 0.5, 1.0, and 2.0; and for $\rho_2=$ 10, 2, 0.5, 0.1 and 0.—*D. B. V.*

171–116. Kolbenheyer, Tibor. Riešenie okrajovej úlohy odporovej geoelektriky pre sploštený rotačny elipsoid [The solution of the boundary value problem of the electric resistivity method for an oblate ellipsoid of rotation]: Československé Akad. Věd Geofys. Ústav Práce, Geofys. Sborník, no. 33, p. 255–295, 1955.

The first problem discussed is the determination of the field pattern produced by a point source in homogeneous infinite space containing an oblate ellipsoid of different electric conductivity. The point source is situated within or outside the ellipsoid. The potential function can be represented by a series of harmonic functions whose coefficients are determined from the given boundary conditions. By a similar treatment the problem can be solved for the ellipsoid built up of confocal ellipsoidal shells. The problem of the field pattern produced by a dipole under the same conditions is also solved; finally several particular cases, such as a disturbing body in the form of half a lens, are discussed.—*S. T. V.*

171–117. Chetayev, D. N. Analiticheskaya interpretatsiya dannykh pri elektrorazvedke metodom yestestvennogo polya v usloviyakh sloshnogo rel'yefa [Analytical interpretation of data obtained by the self-potential electrical prospecting method in conditions of complex relief]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 794–799, 1957.

A purely analytical method of interpreting spontaneous potential data obtained in regions of complex relief. The method can be applied when the extent of the anomaly is clearly definable and gives not only the position of the ore body but also the direction of polarization determined as the moment of the equivalent dipole. The method suggested is based on the theory of complex variable and is similar to a procedure developed in aerodynamics.—*S. T. V.*

171–118. Semenov, A. S., Novozhilova, M. E., and Veshev, A. V. Menyayushcheyesya yestestvennoye elektricheskoye pole v zemle [The variable spontaneous electric field in the ground]: Vses. nauchno-issled. inst. razved. geofiz. Voprosy rudnoy geofiz., Sbornik statey 1, p. 83–113, 1957.

In addition to the natural electrical fields generated in the earth by the presence of natural conductors such as some ores, coal, or graphite-bearing rocks, variable fields are produced by ground waters percolating in areas of great relief, by diffusion of ions at contacts between salt and fresh waters, by telluric currents, and by lightning. These fields, which vary with time and constitute a serious hindrance to self-potential prospecting work, have been investigated during 1951–55; the results are presented in this paper. Special attention is given to the effect of weather and climatic conditions. Numerous graphs present the result of measurements of variable spontaneous potential at different times of day and year under difficult weather conditions.—*D. B. V.*

171–119. Goudswaard, W. On the effect of the tank wall material in geoelectrical model experiments: Geophys. Prosp., v. 5, no. 3, p. 272–281, 1957.

The effect of the tank walls on apparent resistivity determinations made in model experiments has been investigated for the two extreme cases of insulating and perfectly conducting tank walls. In calculating the effect of the tank walls, the error caused by neglecting all but the first set of images in the nearest walls was less than 1 percent. Experimental results which agreed quite well with the calculations were obtained in a tank 100 cm long, 60 cm wide, and 50 cm deep, filled with sodium chloride. By covering the insulating tank walls with a grid of wires of the proper gage and mesh, it was possible to make the effect of the tank walls negligible at distances of more than about 5 cm from the wall.—*F. F.*

171–120. Cagniard, L[ouis], and Neale, R. N. Technique nouvelle de modèles réduits pour la prospection électrique [New use of small scale models for electrical prospecting]: Geophys. Prosp., v. 5, no. 3, p. 252–271, 1957.

The use of small scale models in the interpretation of results of electric prospecting involves two major difficulties: (1) the dimensions of the models and of the tanks in which the experiment is performed must be of unwieldy large sizes if one wants to be quite free from side effects; (2) the precise geometrical relation, in respect to the model, of the successive points where the interesting data are measured, requires an intricate installation, and is costly in both time and money. The technique which is described in this paper eliminates these difficulties as well as some others. The surface of the ground is represented by the lower face of a thick horizontal plate of plexiglas which is laid at the surface of the liquid filling the tank. This plate is pierced by a great number of small holes whose coordinates have been measured initially with the necessary precision. The electrodes are then introduced into these holes without creating any perturbation in the distribution of the lines of current flow. A solution of copper sulfate is used as the liquid in conjunction with copper electrodes. In this way, a d. c. excitation is possible, combining precision with convenience.—*Authors' abstract*

171–121. Gorelik, A. M. Elektrometricheskiye opredeleniye napravleniya i skorosti podzemnykh vod v odnoy skvazhine [Determination of the direction and velocity of an underground stream by electrometric measurements in one drill hole]; Akad. Nauk SSSR Lab. gidrogeol. problem Trudy, tom 10, p. 193–199, 1951.

The velocity and direction of an underground stream of water can be determined from measurements involving only one drill hole. An electrode is lowered into a drill hole and equipotential lines on the earth's surface are traced around the hole. Where geologic conditions are simple, these equipotential lines form a system of concentric circles centered around the drill hole. Specified amounts of NaCl are loaded into the hole and the equipotential lines again determined several times at equal intervals following the additions of the NaCl; the equipotential lines are deformed, being displaced in the direction of stream flow.—*S. T. V.*

171–122. Abramson, Norman H. Theoretical investigations of the four-electrode crevasse detector: Am. Geophys. Union Trans., v. 38, no. 6, p. 849–856, 1957.

Analyses based on general electromagnetic field equations were undertaken, but these proved tractable only for rather simple cases not extending to the

presence of a cavity. After a study indicated magnetic induction effects to be negligible, analysis of the electrostatic field led to an expression for the potential at any point in a field, with allowance for the presence of a spherical or cylindrical cavity. A numerical solution of the Laplace equation afforded another technique, using the Southwell relaxation method. A third approach was to model the problem in a plane using conducting paper to obtain an analog solution. The analog technique was found to be the most expeditious one, and it is flexible as to the shape of the cavity cross-section. Specimen curves and tables given in the paper are expected to be useful in further studies.—*Author's abstract*

171–123. Kunetz, G[ésa]. Les courants telluriques et leur application à la prospection [Telluric currents and their application to prospecting]: Ciel et Terre, 73e année, no. 6–7, p. 357–386, 1957.

A rather detailed exposition of the telluric current method of prospecting, which is based on the fact that worldwide rapid variations in earth currents are affected by local geologic structures to produce anomalies analogous to those in gravity or magnetic prospecting.—*D. B. V.*

171–124. Kántás, K. Development in the newest geophysical research method in the telluric: Sopron Műszaki Egyetemi Karok Bányamérnöki és Földmérőmérnöki Karok Közleményei, v. 19, p. 93–106, 1956.

An outline of the theory of the telluric method of prospecting and discussion of the limitations of current methods of evaluation. The method of evaluation using total variations is thoroughly examined. Variations of the periods necessary for application of Cagniard's magneto-telluric method are very rare. A new method of determining dip from the vertical component of earth currents is described.—*D. B. V.*

171–125. Veksler, V. I., and Plyusnin, M. I. Nizkochastotnoye elektromagnitnoye issledovaniye okrestnostey skvazshin [Low frequency electromagnetic investigations of drill hole surroundings]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 7, p. 934–939, 1957.

By moving an alternating current loop around a drill hole and measuring the magnetic field inside the hole, it is possible to recognize the probable location of ore, especially if it has good electrical conductivity, because of the elliptical polarization of the field. Both model experiments and a field test of the method in southern Kazakh S. S. R. are described.—*S. T. V.*

171–126. Krajčovič, Silvester. Geofyzikálne merania na vodnej hladine [Geophysical measurements over the surface of water]: Geol. Práce, zprávy 2, p. 90–113, 1954 [1955].

Electrical resistivity measurements were used to determine the thickness of the alluvial deposits at the bottom of the Danube river over a basement of clay and marl. The problem consisted of determining the depth of the water and the thickness of the alluvial layer; the basement was assumed to be of infinite depth. The resistivity curves were interpreted following the procedure suggested by V. N. Dakhnov. Subsequent drilling showed the errors did not exceed 10–15 percent.—*S. T. V.*

171–127. Honma, Ichirō, Obi, Nakamaru, Ono, Yoshihiko, and Sugiyama, Mitsusuke. Electrical prospecting for ground water at western part of

Aichi Prefecture: Geol. Survey Japan Bull., v. 7, no. 12, p. 45–54, 1956.

A resistivity survey was made of the Nōbi Plain in western Aichi Prefecture to locate possible sources of ground water. Resistivity maps indicate that the plain may be divided into three areas: the western, an area of alternating beds of clay and sand showing infiltration of sea water; the central, an area of gravel beds extending to considerable depth; and the eastern, an area of shallow gravel layers underlain by clay layers.—*V. S. N.*

171–128. Honma, Ichirō, and Ono, Yoshihiko. Electrical prospecting for the industrial water supply purposes in Seien District, Shizuoka Prefecture: Geol. Survey Japan Bull., v. 8, no. 2, p. 39–48, 1957.

In a resistivity survey of the Seien plain, western Shizuoka-ken, areas of high resistivity, believed to be caused by gravel beds, were found in the Homatsu area west of the Tenryu River except in the southern part where low resistivities indicate alternating layers of sand and gravel. East of the Tenryu River (Iwata area) only low resistivities, probably caused by alternating sand and gravel beds and by the effects of infiltrating sea waters, were found.—*V. S. N.*

171–129. Hatherton, T. Shallow subsurface prospecting by the electrical resistivity method at Balclutha: New Zealand Jour. Sci. Technology, sec. B, v. 38, no. 8, p. 807–819, 1957.

The electrical resistivity method has been used at Balclutha [New Zealand] to investigate subsurface conditions, in connection with construction of flood-control scheme levees. It has been found possible, using the results of step-traverse surveys, to give a qualitative indication of areas of possible hydraulic-pressure danger. By coupling these step-traverse resistivity measurements with known borehole sections, a correlation has been obtained which enables the depth of overlying silt at any resistivity station to be estimated. It is shown that subsurface conditions in this area are such that the permeabilities of the formations cannot be determined from the resistivity data in this area.—*Author's summary*

171–130. LeFèvre, Colette, Albertinoli, P., Bauer, A., Blum, A., Cagniard, L[ouis], and Fournier, H. Mesures électriques et telluriques sur le grand glacier d'Aletsch [Electrical and telluric measurements on the great Aletsch glacier]: Annales Géophysique, tome 13, no. 1, p. 54–68, 1957.

In order to overcome the effects of electrode resistances of tens to hundreds of megohms in measurements on ice, an electronic amplifier with a 67 megohm input shunt was used in measurements on the Aletsch glacier. The equipment is described in detail. Successful electric and telluric measurements were made. Local electric railways apparently affected the latter measurements. Measured apparent resistivities for the first 5 and 50 meters of ice were 4 and 10 megohm-meters respectively. A combination of electrical and magneto-telluric measurements may prove valuable in delineating the structure of glaciers and ice caps.—*P. E. B.*

ELECTRICAL LOGGING

171–131. Lamont, Norman. Relationships between the mud resistivity, mud filtrate resistivity, and the mud cake resistivity of oil emulsion mud systems: Jour. Petroleum Technology, v. 9, no. 8, p. 51–52, 1957.

Measurements of the resistivities of samples from the mud, mud cake, and mud filtrate should be made whenever possible, for more exact evaluation of electrical logs regardless of the type of drilling fluid used. If only one parameter is known, the relations $R_{mf}=0.876\ (R_m)^{1.075}$ and $R_{mc}=1.306\ (R_m)^{0.88}$ may be used. For approximate results $R_{mf}=0.88\ R_m$ and $R_{mc}=1.31\ R_m$ can be used. These equations, however, may not be valid for temperatures other than 100° F.—*M. C. R.*

171–132. Dumanoir, J L., Tixier, M. P., and Martin, Maurice. Interpretation of the induction-electrical log in fresh mud: Jour. Petroleum Technology, v. 9, no. 7, Transactions section, p. 202–217, 1957.

The induction-electrical log is a combination of standard curves for correlation (16-inch normal and self-potential) and a curve recorded with a focused device having a deep radius of investigation (40-inch induction log). The combination is designed chiefly for surveying of wells drilled with fresh muds. A practical chart is provided for interpretation of the logs in term of saturation.—*M. C. R.*

171–133. Gondouin, M., Tixier, M. P., and Simard, G. L. An experimental study on the influence of the chemical composition of electrolytes on the SP curve: Jour. Petroleum Technology, v. 9, no. 2, Transactions section, p. 58–72, 1957.

In the quantitative interpretation of the *SP* logs, the electrochemical component is generally taken equal to $-K \log R_{mf}/R_w$ where K has the theoretical value corresponding to solutions of pure chloride. This method may be misleading when relatively large quantities of salts other than NaCl are present in formation waters—as in generally the case for law salinites—or in gyp-base muds. In such cases recourse is made in the field to changing the K value or to adding a correction term to the equation on the basis of local experience. An investigation has been made in the laboratory of the influence of HCO_3^-, SO_4^{--}, Ca^{++}, and Mg^{++} on the amplitude of the *SP* deflection, which included in particular determinations of the activity coefficients of Ca^{++} and Mg^{++}. The theory, the experimental techniques and a tentative method for applying the results are described. So far, applications to actual field cases where chemical analyses of waters were available have provided an excellent confirmation of the proposed method. The case of the *SP* in very salty brines is also considered and it is shown that the use of activity data for sodium gives satisfactory results.—*Authors' abstract*

171–134. Winn, R. H. Log interpretation in heterogeneous carbonate reservoirs: Jour. Petroleum Technology, v. 28, no. 9, p. 268–274, 1957.

Log analysis of heterogeneous limestones may be made from neutron, caliper, and focused resistivity surveys when the holes are drilled and surveyed with saline muds. Low logging speeds are essential to provide accurate porosity determinations. The resistivity logging device should be focused in a horizontal plane over as thin an increment of depth as is practicable.

In heterogeneous reservoirs the understanding of the log determinations of porosity and water saturation and the reservoir evaluation requires additional data regarding the capillarity characteristics of the formations and the type of rock matrices encountered. In homogeneous limestones capillarity characteristics may sometimes be inferred from the plot of the log analysis data.—*Author's conclusions*

171–135. Meyer, V. A. Razdeleniye sul'fidov v skvazhinakh putem izmereniya polya iskusstvenno sozdavayemykh gal'vanicheskikh par [Separation of sulfides in drill holes by measuring the artificially produced galvanic couples]: Vses. nauchno-issled. inst. razved, geofiz. Voprosy rudnoy geofiz., Sbornik statey 1, p. 79–82, 1957.

Electrode potential curves obtained when sliding electrodes are used in boreholes traversing sulfide ores show an asymmetrical sharp kink upon entering some sulfide layers. The curve makes a sharp jump at first contact of electrode with ore, then declines smoothly (due to polarization) as the electrode passes across the layer. Similar results are obtained in the laboratory. The effect is attributed to formation of a galvanic couple when the hardness of the sulfide is greater than that of the electrode chosen. By choosing appropriate electrodes, the different sulfide minerals can be distinguished. The field of the galvanic couple (*PGP*) can be logged simultaneously with the electrode potential. Pairs of such curves are reproduced for galena-zinc (no *PGP* effect) and pyrite-zinc (distinct *PGP* effect). The method can be developed further for use with other minerals.—*D. B. V.*

171–136. Nelson, Jack. A report on electric and MG-electric logs in the Fair banks Quadrangle, Sullivan County, Indiana: Compass, v. 34, no. 1, p. 2–5, 1956.

A discussion of the use of electric logs and *MG*-electric logs to interpret the subsurface geology in Fairbanks quadrangle. ["The *MG* log contains a self-potential and one normal resistivity curve instead of the self-potential, lateral, and two normal resistivity curves on an ordinary electric log."] The advantages and disadvantages of each type are described.—*V. S. N.*

EXPLORATION SUMMARIES AND STATISTICS

171–137. Itenberg, S. S. Neftepromyslovaya geofizika dlya geologov [The geophysics of oil fields for geologists]: 2nd ed., 398 p., Moscow, Gosgeoltekhizdat, 1957.

New material in the second edition includes discussion of certain more recent methods of well logging, such as induced potential of radioactivity and thermal logging, and geochemical methods. Emphasis is on the physical basis of the different methods and interpretation of the data.—*S. T. V.*

171–138. Hedström, E. H. In defense of mining geophysics: Geophys. Prosp., v. 5, no. 3, p. 231–238, 1957.

Presidential address at the 12th meeting of the European Association of Exploration Geophysicists, June 5–7, 1957.—*M. C. R.*

171–139. Ryng, S. I. Glubinnoje geologicheskoye stroyeniye territorii Belorussii po dannym geofizicheskikh issledovaniy [The deep geological structure of White Russia's territory as revealed by geophysical investigation]: Akad. Nauk Litovskoy SSR, Geol. i Geog. Inst. Nauchnyye Soobshcheniya, tom 3, p. 49–55, 1956.

Geophysical exploration of the Belorussian S. S. R. began in 1937, and has been increased in volume and comprehensiveness since the last war. Regions promising for oil, gas, and salt have been discovered. It has been established that the salt layer within the limits of the Belorussian part of the Dnepr-

Donets depression is a regional rather than a local phenomenon, and deposits of sodium and potassium salts have been located. All local Paleozoic structures in this area have been discovered by the geophysical methods and some were at depths of as much as 4,000 meters.—*S. T. V.*

171–140. Chronique des Mines d'Outre-Mer et de la Recherche minière. Le pétrole au Gabon [Oil in the Gabon (in French and English)]: Chronique des Mines d'Outre-Mer, 25e année, no. 255, p. 267–273, 1957.

A summary of the petroleum geology of Gabon, French Equatorial Africa, including a résumé of geophysical prospecting. Telluric reconnaissance along the edge of the basement in 1945–1946 proved inadequate, and a seismic survey in the same region in 1949 was difficult to interpret because of interbedded salt layers. After 1952 new electrical and seismic methods were used in the coastal region and led to the discovery of 4,000 to 6,000 m of sediments having low resistivity. Further exploration in detail in 1954–1956 by a gravity survey (10,300 km², one station per km²), seismic reflection (2,100 km of profile on land, 2,150 km on water), and a refraction test survey revealed pools at Ozouri and Pointe Clairette. At the beginning of 1957 each was producing from six wells; expected annual production was 300,000 tons.—*D. B. V.*

171–141. Wolff, Wilhelm. Geophysikalische Beiträge zur Erforschung des tieferen Untergrundes des rheinischen Gebirges [Geophysical contributions to investigation of the basement of the Rhenish Schiefergebirge]: Geol. Rundschau, Band 46, Heft 1, p. 186–196, 1957.

Magnetic measurements show a slight low over the Siegerland arch and its southwestern continuation in Germany which can be attributed, with reservations, to felsic intrusive rocks at depth. Seismic refraction investigations show a higher velocity horizon (6.18 kmps) under the Devonian cover that can be correlated with "granitic" material (about 1.5 km deep under the Siegen-Wieder saddle, 4 km deep under its flanks). Thus the magnetic and seismic data are not mutually exclusive. Recent gravimeter measurements by Schleusener show a positive anomaly of about 4 mgals over the arch, having a Variscan trend (N. 65° E.); this anomaly could be caused either by a deep intrusive body or by a rise in the basement or even by the known sedimentary structure of the region. Seismic reflection surveys and further gravity work—regional over the whole Schiefergebirge, detailed in areas giving interesting reflection results—are necessary to settle the question.—*D. B. V.*

171–142. Scheffer, Viktor. Adatok a Kárpát-medencék regionális geofizikájához [Data on the regional geophysics of the Carpathian Basin (with German summary)]: Maygar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 6, szám 1–2, p. 73–103, 1957.

The major structural elements underlying the Carpathian Basin and its surroundings are described from information obtained from gravity and magnetic surveys and macroseismic observations.—*D. B. V.*

171–143. Kazmi, S. A. A. Role of applied geomagnetism in the exploration of mineral and oil resources of the Country: Pakistan Jour. Sci., v. 9, no. 3, p. 103–107, 1957.

A brief discussion is given of the importance of geophysics, with emphasis on geomagnetism, in the exploration and development of mineral and oil resources of Pakistan. The role of Quetta Magnetic Observatory in exploration is also discussed.—*V. S. N.*

171–144. Semenov, A. S. Metodika geofizicheskikh rabot na mestorozhdeniyakh polimetallicheskikh rud [Geophysical exploration methods for deposits of polymetallic ores]: Vses. nauchno-issled. inst. razved. geofiz. Voprosy rudnoy geofiz., Sbornik statey 1, p. 3–19, 1957.

Geophysical methods should form an integral part of mineral exploration programs. All feasible methods should be employed; the choice depends on the specific circumstances and problems involved in each case. Four stages of exploration are outlined: regional mapping (on 1:1,000,000 or 1:2,500,000 scale) supplemented by gravimetric and vertical magnetic profiles, and particularly aeromagnetic surveys; more detailed exploratory surveys (on a 1:25,000 to 1:200,000 scale); then finer work (on 1:10,000 scale or less); and finally exploratory work in the exploited deposits in which logging methods are particularly useful. The various methods that can be applied in different instances at each of these stages with exploration for polymetallic ores are discussed, with examples from surveys in the Altay Mountains.—*D. B. V.*

GENERAL

171–145. Bonchkovskiy, V. F., and Bubleynikov, F. D. Zemlya yeye figura i fizicheskiye svoystva [The earth, its shape and physical properties]: 252 p., Moscow, Gosudarstvennoye izadatel'stvo tekhniko-teoreticheskoy literatury, 1956.

This textbook, written jointly by a geodesist and a geologist, covers the shape and dimensions of the earth, the velocity of its movements, the measurement of gravity, isostasy, the thermal state of the earth's interior, deformation of the earth, tidal phenomena of the ocean and of the solid earth, internal structure as revealed by seismological observations, and the magnetic and electrical fields of the earth.—*S. T. V.*

171–146. Haughton, S. H. The geophysicist and some geological problems: Royal Soc. South Africa Trans., v. 35, pt. 2, p. 59–69, 1957.

A presidential address. Correlation of Precambrian rocks by age determinations, the nature of the ocean bottom, paleomagnetism, nature of the crust and the possible application of geophysics to problems in the structure of Africa south of the Sahara are discussed.—*M. C. R.*

171–147. Hultqvist, Bengt. The Kiruna Geophysical Observatory, Sweden: Nature, v. 180, no. 4591, p. 828–830, 1957.

A description of the new Kiruna Observatory, formally opened July 2, 1957. Geomagnetic, ionospheric, and seismological instruments are in use at the observvatory.—*M. C. R.*

171–148. Tomoda, Yoshibumi. A simple method for calculating the correlation coefficients: Jour. Physics of the Earth, v. 4, no. 2, p. 67–70, 1956.

In approximate method for calculating the correlation coefficient between two probability variables, the whole range of each variable is divided into two classes and the variable is denoted by +1 or −1 depending on whether it is larger or smaller than the mean value and a new series of variables obtained for which the correlation coeffcient is easy to calculate. Autocorrelation correlograms of seismograms are shown as examples.—*M. C. R.*

GEODESY

171–149. Heiskanen, W. A. The Columbus geoid: Am. Geophys. Union Trans., v. 38, no. 6, p. 841–848, 1957.

This is the first report of results of World-Wide Gravity Project at Ohio State University, the main emphasis of which has been to determine undulations of the geoid and deflection of the vertical from gravity data. The geoid in Europe is not significantly changed from that of Tanni but the geoid in America, in the Atlantic, and in India is changed materially as a result of new data. The gravimetrically computed geoid for the northern hemisphere and for Europe are given. Undulations of the geoid computed astrogeodetically by Bomford and gravimetrically at Ohio differ considerably but the discrepancy can be explained by differences in the values assumed by Bomford at his initial point in Potsdam and those determined gravimetrically.—*M. C. R.*

171–150. Ertel, Hans. Eine Kompatibilitäts-Bedingung der höheren Geodäsie [A compatibility term of higher geodesy]: Deutsch. Akad. Wiss. Berlin Sitzungsber. Kl. Math., Physik u. Technik, Jahrg. 1956, no. 4, 14 p.

The determination of the theoretical figure of the earth, assumed to be a spheroid of rotation with hemispherical symmetry, is based on a force function of the gravity field which includes two potential coefficients. However, since in comparing the normal gravity between pole and equator of the same level surface both of these potential coefficients must satisfy three equations, a compatibility term for the parameters of the figure of the earth and the gravity field is to be fulfilled. The theorem of Clairaut determines the first approximation of this compatibility term with a deviation of the order of 10^{-5}. But present geodetic-geophysical data are better adjusted by the strong form of the compatibility term with an accuracy of the order of 10^{-6}.—*Author's summary, D. B. V.*

171–151. Renner, János. A függővonalalhajlások regionális jellege [Regional character of deviations of the vertical]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 6, szám 1–2, p. 61–67, 1957.

Deflections of the vertical measured astro-geodetically (corrected for topographic effects) are compared with gravimetric anomalies for Hungary. Three sketch maps show the Faye, Bouguer, and isostatic anomalies, each with 17 Laplace points showing the horizontal components in proportion to deviations of the vertical. The horizontal components in all three maps are directed toward the larger gravity maximums, confirming the anomalies determined by gravimetric and torsion balance measurements and suggesting that the maximums probably are caused by rather large masses lying at great depth.—*D. B. V.*

171–152. Bonchkovskiy, V. F., and Karmaleyeva, P. M. Pervyye resul'taty rahoty azimutal'noy naklonomernoy ustanovki [Preliminary results

of the operation of an azimuthal installation for measurement of inclination]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 8, p. 1060–1065, 1957.

The inclination of a certain area as a result of earthquakes or as a forewarning of a coming shock, is usually determined by measurements at one or several inclinometers installed in a circle on a little platform around a center point. If instruments are uniformly distributed around the periphery and the platform is tilted through an angle α in a given direction, but is not deformed, then the sum of the readings of all inclinometers must be zero. If this sum is not zero, then it must be concluded that the supporting platform has been distorted, and a "conventional zero line" must be selected for which this condition is fulfilled.—*S. T. V.*

GEOTECTONICS

171–153. Hiersemann, Lothar. Über die Bedeutung der Rheologie für geophysikalisch-geologisch Theorien [On the significance of rheology for geophysical-geological theories]: Geol. Rundschau, Band 46, Heft 1, p. 69–86, 1957.

According to the definition of rheology as the science dealing with the behavior of matter under the influence of shape-changing forces, the physical-mathematical possibilities for description of the rheological behavior of geologic bodies, such as rocks and even larger units of the earth's crust, are demonstrated. Together with the general facts on the structure and dynamics of the crust these provide a basis for evaluating modern orogenic hypotheses. The rheological assumptions of the contraction and convection current hypotheses are gone into more closely, leading to the conclusion that in the present state of knowledge it is not possible to decide between the two.—*Author's summary, D. B. V.*

171–154. Scheidegger, A[drian] E. On a new theory of mountain-building: Canadian Jour. Physics, v. 35, no. 12, p. 1380–1386, 1957.

Investigation of the forces that might cause continental drifting, if it does take place, leads to a new theory of mountain building. According to present evidence, continental drift, and consequently mountain building, might be explained by the assumption of a random drag force with a correlation time of 150 million years. It is possible, though not altogether likely, that this drag force might be the result of very large (radius 6,000 km) random convection currents, whose duration would have to be of the order of 150 million years. The assumption of a random drag force does not necessarily contradict ideas maintaining that continental growth also took place, as the two effects might be superposed upon one another.—*D. B. V.*

171–155. Bucher, Walter H. The problem of orogenesis in the light of new field and experimental evidence: Alberta Soc. Petroleum Geologists Jour., v. 5, no. 7, p. 138–139, 1957.

This paper was given as a lecture and is essentially the same as the previously published "Role of gravity in orogenesis" (Geophys. Abs. 167–119.)—*V. S. N.*

171–156. Gidon, Paul. L'ordre de succession des phénomènes orogéniques et ses conséquences [The order of succession of orogenic phenomena and its consequences]: Soc. géol. France Bull., tome 7, fasc. 1–3, p. 125–136, 1957.

In some parts of the Alps, in the Pyrenees, and possibly in the Andes, it can be demonstrated that uplift has preceded folding. This sequence fits in with gravity-sliding orogenic theories and contradicts those invoking compressive forces. The consequences of this reasoning are explored in some detail. In general, it is argued that subsidence of geosynclines can be brought about without compression by convection currents; cessation of convective movement would allow isostatic uplift, creating sialic intumescences on which gravity tectonics would develop.—*D. B. V.*

171–157. Vening Meinesz, F. A. The geophysical history of a geosyncline: K. Nederland. Akad. Wetensch. Proc., ser. B, v. 60, no. 2, p. 126–140, 1957.

Lateral compression in the crust must lead to plastic downbuckling of the crust when the elastic limit is exceeded. A sialic root will be pressed down into the subcrustal material while at the surface a geosyncline is formed in which sediments are deposited. If compression continues, these sediments will be folded and over-thrust. When the crustal compression vanishes, the crust rises to reestablish its isostatic equilibrium and a mountain range comes into existence. Although crustal compression must be caused in part by crustal contraction, the contraction must be subordinate to the drag exerted on the crust by mantle currents. Important arguments for such currents are: the origin of geosynclines indicates uniaxial compression in the crust; it is difficult to explain the formation of a graben except by tension in the crust; and the regression during the first part of each orogenic cycle and the transgression afterwards are difficult to account for without admitting episodic convection currents in the mantle. The topography of the earth's surface also shows a correlation with the distribution of current-systems in the mantle.

The temperature of the sialic root pressed down into the subcrustal material will increase, because it is more radioactive than the surrounding subcrustal matter, and because the temperature of the subcrustal material is higher than that of the crustal material. As the temperature of the root increases, it will become plastic, and being less dense than the surrounding material, it will flow off under the foreland. This must lead to the lowering of the range and the rising of adjacent areas. The Alpine range and the European foreland have experienced both phenomena.—*D. R. M.*

171–158. Jobert, G[eorges]. Influence de la structure de la croûte sur les déformations causées par les marées océaniques (II) [Influence of crustal structure on the deformations caused by oceanic tides]: Annales Géophysique, tome 13, no. 1, p. 83–86, 1957.

Jobert has shown that for a semi-infinite elastic medium, composed of two different parts in contact along a vertical fault, the bending under a concentrated load at the surface of one of the parts takes place, in all cases toward the load (see Geophys. Abs. 168–54). The case considered here is that of a medium of finite thickness overlying a medium of zero rigidity. The layer consists of an elastic and a rigid half separated by a vertical fault. Here the direction of the bending depends strongly on the surface load. As the resultant forces on the block must be zero, it is necessary to interpose a depression which results, in certain cases, in a reversal of the bending for a surface point between the load and the fault, with the surface inclined toward the fault.—*P. E. B.*

171–159. Vecchia, Orlando. Aspects géologiques et géophysiques des failles lithosphériques (Sicile, Préalpes italiennes, Jura, Fossé rhénan) [Geological and geophysical aspects of lithospheric faults (Sicily, Italian Pre-Alps, Jura, Rhine graben)]: Geol. Rundschau, Band 46, Heft 1, p. 50–69, 1957.

Comparative analysis shows that in the vicinity of certain great regional faults, gravity maps show elongated positive isostatic anomalies or series of highs; magnetic maps show corresponding anomalies. It is inferred that these represent belts along which dense magnetic matter (mafic rocks) had been uplifted. This dislocation is confirmed by the distribution of rows of earthquake epicenters, volcanoes, and hot mineral springs. In some places earthquake foci reach the upper, in others the lower limit of "intermediate depths" (60 to 300 km). The volcanic rocks are mainly basaltic, but in the Alps neutral or felsic rocks are equally common. The northern coast of Sicily is discussed in most detail, but other examples cited include the east coast of Sicily, the inner borders of the western and southern Alps, the "Giudicarie-Adige"-zone across the southern Alps, the Jura Mountains, and the Rhine graben. Paleogeographic analysis shows that these "lithospheric fault" zones have been characterized intermittently since remote epochs by great vertical instability, volcanism, and peculiar stratigraphic facies; the age and fixed position of these vertical faults controvert orogenic theories involving great horizontal movements or thrusting of continental margins over one another.—*D. B. V.*

171–160. Egyed, László. A kéregmozgások okai és a Magyarországi keregmozgasok [The causes of crustal movements in Hungary]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 6, szám 1–2, p. 47–52, 1957.

The first part of the paper deals with the origin and proper interpretation of tectonic forces and with an exact definition of the concepts of orogenetic, epeirogenetic and isostatic movement.

In the second part of the paper it is proved that the observed changes of level in Hungary are true ones instead of being caused by errors in measurement and that they are caused by primarily tectonic factors.—*Author's abstract*

171–161. Cotton, C. A. An example of transcurrent drift tectonics: New Zealand Jour. Sci. Technology, sec. B, no. 9, p. 939–942, 1957.

The upthrust of Mt. Miroroa, New Zealand, an unusual block mountain bounded on four sides by faults (including the transcurrent Ruahine fault), is attributed to accumulation of stress due to transcurrent drift along this major fault. An analogous case is cited in California, where stresses accumulated by transcurrent drift are relieved by activity on the White Wolf fault, such as the destructive earthquake of July 1952.—*D. B. V.*

171–162. Cameron, H. L. Tectonics of the Maritime Area: Royal Soc. Canada Trans., v. 50, ser. 3, sec. 4, p. 45–51, 1956.

Synclinal structures bound by inward-dipping thrust faults throughout the Canadian Maritime Area are believed to represent the Appalachian geosyncline and are considered to be epieugeosynclines bounded by positive uplifts that formed periodically and in different places during the development of the Appalachian geosyncline. The Appalachian geosyncline consisted of local geo-

synclines that were compressed into folds and marginal overthrusts and uplifts to form a highland source of sediments for middle and late Paleozoic sediments in eugeosynclines. The cycle was repeated and the present outcrop pattern of the Appalachian geosyncline can be explained on this basis. Thus the development of a major geosyncline is a long-continued and complex series of cycles of deposition, collapse, uplift, and erosion and does not require marginal highlands to provide sediments but does require continued compression operating in the zone between the continental craton and the oceanic block.—*V. S. N.*

171–163. Takada, Michio. Tele-observation of the crustal movement [in Japanese with English abstract]: Kyōto Univ. Disaster Prevention Research Inst. Bull., 5th Anniversary Memorial issue, p. 28–34, 1956.

A description of the observatory established by the Disaster Prevention Research Institute in the adit of an old copper mine at Ide-cho.—*M. C. R.*

GLACIERS

171–164. Sharp, Robert P. Glaciers in the Arctic: Arctic, v. 9, nos. 1 and 2, p. 78–117, 1956.

This is a summary paper describing the size, nature, and distribution of arctic and subarctic glaciers based largely on the writings and observations of others. The classification and modern regimen of arctic glaciers is discussed and a description of each of the 19 areas of glaciation is given.—*V. S. N.*

171–165. Martin, Jean. Note sur un phénomène électrique observé dans un puits de glace sur l'inlandsis groenlandais [Note on an electrical phenomenon observed in an ice pit on the Greenland ice cap]: Annales Géophysique, tome 13, no. 1, p. 87–89, 1957.

Between the water contained in the spherical cavity surrounding the thermal proble of a "thermal drill" frozen in place and the surface, a potential difference of 29 volts, corresponding to a current of 29 microamperes, was measured with an ordinary voltmeter. This is a manifestation of the Workman-Reynolds effect, involving potential differences across the solid-liquid interface, in the freezing of dilute solutions.—*P. E. B.*

171–166. Loewe, F[ritz]. Remarques concernat des mesures de température et d'accumulation sur l'inlandsis groenlandais [Notes on temperature and accumulation measurements on the Greenland icecap]: Annales Géophysique, tome 13, no. 2, p. 158–159, 1957.

Temperature data discussed by Georgi (Geophys. Abs. 167–128) are re-interpreted. Differences in temperature maxima noted in 1930–31 at a depth of around 8 meters at station Eismitte I and in 1950 at the same stratigraphic position at a depth of around 19 meters at station Eismitte II are interpreted in terms of differing elevation and geographic position and an increase in mean surface temperature in an accreting snowfield.—*P. E. B.*

LeFèvre, Colette, Albertinoli, P., Bauer, A., Blum, A., Cagniard, L[ouis], and Fournier, H. Electrical and telluric measurements on the great Aletsch glacier. See Geophys. Abs. 171–130.

GRAVITY

171–167. Abel'sky, M. E., Andreyev, B. A., Golomb, V. E., and Samsonov, N. N. Kurs gravirazvedki dlya geologorazvedochnykh tekhnikumov [Textbook of gravimetry for technical schools of geological exploration]: 358 p., Moscow, Gosudarstvennoye nauchnotekhnicheskoye izdatel'stvo literatury po geologyii i okhrane nedr, 1954.

This text covers the theory of the potential, types of gravimeters and torsion balances (with special attention to instruments of Russian manufacture), the organization and methods of gravimetric surveying, and the interpretation of gravimetric anomalies.—*S. T. V.*

171–168. Graf, Anton. Beschreibung eines neuentwickelten Seegravimeters und Ergebnisse der ersten Messfahrt auf dem Starnberger See an Bord der "Seeshaupt" [Description of a newly developed marine gravimeter and results of the first voyage of measurement on the Starnberger See aboard the *Seeshaupt*]: Bayerische Akad. Wiss. Abh., Math.-Naturw. Kl., Heft 75, 16 p., 1956.

A new gravimeter apparatus developed for use at sea is described, with photographs, and the results obtained with it during two round trips between Starnberg and Seeshaupt on the Starnberger See (Würmsee) in sourthern Germany in the 400-ton motor vessel *Seeshaupt* are presented. Comparison with known gravity values at five points ashore shows that the accuracy of the apparatus is better than 0.5 mgal.—*D. B. V.*

171–169. Rybár, I[stván]. Eötvös torsion balance model E–54: Geofisica Pura e Appl., v. 37, p. 79–89, 1957.

A description of the automatically rotating, photographically recording Eötvös torsion balance model E–54. Quadruple-wall construction is such that variations in external temperature do not affect the equilibrium position of the balances. The scale and reticle are photographed on the plate so that the equilibrium positions can be read simply by means of a magnifying glass, without any measuring; the number of the instrument and station are also recorded on the plate. A mechanical device makes the exposure and then sets the instrument in rotation. Sensitivity of the instrument is 0.255×10^{-9} cgs = 0.255 Eötvös units for gradient and 0.724 Eötvös units for curvature (referred to 0.1 of the scale division); relaxation time is 40 minutes. The sensitivity and reliability of the instrument are shown by means of some of the photographs and their interpretation.—*D. B. V.*

171–170. Popov, Ye. I. Issledovaniye vozmozhnosti umen'sheniya temperaturnykh koeffitsientov kvartsevykh gravimetrov putem perekhoda k steklu s malym termoelektricheskim koeffitsientom [Investigation of the possibility of decreasing the temperature coefficients of quartz gravimeters through the use of glass with low thermoelastic coefficient]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 808–812, 1957.

The great drawback of quartz glass in the elastic system of gravimeters is the variation of its elastic properties with temperature (for one degree Centigrade this variation is from 500 to 1,000 times greater than the required pre-

cision) so that thermostats must be used. The thermoelastic coefficients of different glasses are always high but differ by some 40 percent. The temperature coefficients of the modulus of rigidity of different quartz glasses are all the same within the limits of accuracy (± 1 percent) so the only way to lower the temperature coefficient of a gravimeter is to change the composition of the glass. Investigation of different kinds of glass leads to the conclusion that use of other glasses (containing sodium, boron, or molybdenum, for example) introduces other, and worse, difficulties in the form of lowered mechanical resistance and increased instrumental drift, and thus thermocompensation of the elastic system seems to be the only possible way of avoiding the difficulties caused by temperature variation.—*S. T. V., D. B. V.*

171–171. Caputo, M. A procedure for the calibration of gravimeters: Geofisica Pura e Appl., v. 35, p. 8–13, 1956.

Description of a method of calibration Worden gravimeters to neutralize the effect of drift. See also Geophys. Abs. 170–180.—*M. C. R.*

171–172. Gabrielli, I., and Poiani, G. On the heat exchange through the walls of Dewar vessels: Geofisica Pura e Appl., v. 37, p. 45–54, 1957.

The thermal insulation of the Dewar vessels containing the gravimeters used during the Italian Karakorum Expedition of 1954–1955 has been tested in order to ascertain the instrumental variation caused by temperature. Variations in temperature of a generic body of known heat capacity and of one of the expedition's gravimeters, each enclosed in a Dewar vessel, were measured while the external temperature was kept constant (but higher or lower than the initial temperature of the body within) or was modified sinusoidally with a period of 24 hours. The results show that heating and cooling vary approximately exponentially. The sinusoidal variation of external temperature produces, after a transitory phase, a nearly sinusoidal variation of the body temperature, with reduced amplitude and a phase shift. An elementary calculation of the heat exchange processes leads to establishment of a simple relation between the time constants on which the heating and cooling depend and the amplitude reduction and phase shift.—*D. B. V.*

171–173. Norinelli, Armando. Il gradiente del campo gravitazionale. [The gradient of the gravitational field]: Accad. Naz. Lincei Atti, Cl. sci. fis., mat. e nat. Rend., v. 22, fasc. 4, p. 470–477, 1957.

A mathematical discussion of the behavior and use for interpretative purposes of the gravity gradient in the presence of one and of two spherical masses.—*D. B. V.*

171–174. Petrov, L. V. Ob odnom sposobe resheniya obratnoy zadachi gravimetrii [On one method of solving the inverse problem of gravimetry]: Prikladnaya geofiz., vypusk 16, p. 161–166, 1957.

In 1930 Numerov derived an approximate formula for determining from gravity anomalies the depth of the boundary between two formations with different densities. This formula which had never been tested in the field, was applied to the case of two inclined strata where the upper boundary plane is 1 km keep, the lower one, 3 km keep, the angle of dip is 11°19′, and the density contrast is 0.5. The error in depths computed by this formula, under the worst assumed conditions, is 11 percent, whereas an error of ±12.2 percent results from the assumption of an infinite stratum usually made.—*S. T. V.*

171–175. Tyapkin, K. F. K voprosu graficheskogo vychisleniya V_{zz} po rezul'tatam izmereniy Δg [On the graphical determination of U_{zz} from measured Δg values]: Prikladnaya geofiz., vypusk 16, p. 167–174, 1957.

A graphical method of determining U_{zz} from the results of a gravity survey, is based on replacement of the double integration in the formulas for U_{zz} at height h, above the surface and at the surface by double summation.—*S. T. V.*

171–176. Tomoda, Yoshibumi, and Aki, Keiiti. Use of the function sin x/x in gravity problems: Acad. Japan Proc., v. 31, no. 7, p. 443–448, 1955.

The impulse response and Duhamel's integration are used for calculating the subterranean mass distribution responsible for given gravity anomalies observed on the surface. By this method, the mass distribution is directly obtained without computing the Fourier coefficients. An example based on some of Vening Meinesz' data in the East Indies is given. The method may also be used to calculate anomalies in the vertical gradient of gravity and deflection of the vertical from gravity anomalies.—*B. T. E.*

171–177. Balavadze, B. K. K voprosu klassifikatsii anomaliy sily tyazhesti geosinklinal'noy oblasti [Concerning the classification of gravitational anomalies of a geosynclinal region]: Akad. Nauk Gruzinskoy SSR Soobshcheniya, tom 18, no. 2, p. 155–157, 1957.

Four terms for denoting gravity anomalies in the geosynclinal area of Caucasus are proposed. A first-order regional anomaly is the smoothly varying part of the observed anomaly over the entire territory (not less than 10^6 sq km). This anomaly has wide waves and is clearly visible even on maps of ± 4 mgal accuracy; its cause is usually relief on the Mohorovičić discontinuity. A second-order regional anomaly is spread over a rather extended territory (about 10^4 sq km) and is clearly visible as a closed anomaly on a map of ± 10 mgal accuracy. This anomaly is usually caused by variations in the boundary between granite and basalt or by changes in the crystalline basement. A first-order local anomaly is noticeable on maps of the accuracy of ± 3 to 5 mgal and covers an area of about 10^2 sq km. A second-order local anomaly is noticeable on a map of an accuracy of ± 1 mgal and covers about the same area. The local anomalies are caused by the peculiarities of the geologic structure of the uppermost part of the crust.—*S. T. V.*

171–178. Ichinohe, Tokio. On change of gravity with time [in Japanese with English abstract]: Kyōto Univ. Disaster Prevention Research Inst. Bull., 5th Anniversary Memorial issue, p. 35–41, 1956.

Results of two studies by Ichinohe are summarized: the most reliable value of the earth tidal factor of gravity is 1.18 (see Geophys. Abs. 169–75) and secular changes in gravity have been observed on the western shore of Lake Biwa and in Osaka.—*M. C. R.*

171–179. Coron, S[uzanne]. Contributions à l'étude du champ de la pesanteur en France [Contribution to the study of the gravity field in France]: Sciences de la terre, tome 2, no. 4, 150 p., 1954.

The first part is a description of the measurement of the gravity field in France and a critical study of the methods of reduction and the resultant maps. The second part is a regional study of the isostatic anomalies with emphasis on their relation to the geologic structure of the area.

The following conclusions are made: Local variations of the gravity field in the ancient regions of France are in close relation with the surface structure. Extensive positive or negative anomalies are also on the whole related to the geology. The principle of isostasy certainly applies to France—Bouguer anomalies are closely related to altitude and they are much more dispersed than the isostatic anomalies. By using Airy's schema with a compensation depth of 30 km a minimum dispersion of the isostatic values is obtained. There is irregularity in the surface layers of the crust which seems to be formed of two different units; the one comprises lighter granitic massifs (higher than the surrounding region) and the other seems to concur more with Pratt's hypothesis being the more dense the lower the relief. In an isostatic equilibrium there is a certain tension between two fields with anomalies of unlike sign. Isostatic anomalies indicate a certain retardation in isostasy since positive values correspond to basins of sedimentation whereas negative values mark, as in Brittany, the ancient eroded cordilleras.—*B. T. E.*

171–180. Sans Huelin, Guillermo. Levantamiente gravimetrico en el Adriatico Septentrional mediante un gravimetro con mando a distancia [Gravimetric survey of the northern Adriatic Sea with a remote control gravimeter]: Rev. Geofísica, año 13, no. 50, p. 199–202, 1954.

A discussion of the gravimetric survey of the northern part of the Adriatic Sea (see Geophys. Abs. 159–25) and its value for study of crustal structure.—*S. T. V.*

171–181. Closs, Hans, and Hahn, Albrecht. Bemerkungen zur Karte der Schwerestörungen des deutschen Alpenvorlands [Remarks on the map of gravity anomalies of the German Alpine foreland]: Geol. Jahrb., Band 72, p. 503–528, 1957.

Regional gravity measurements were made from 1936 to 1945 in the German part of the Alpine foreland; for this survey a first order gravimetric net was established, starting from existing pendulum stations. True Bouguer values were approximated by use of a two-step method with interpolation of an intermediate reference level. After graphic correction for regional gravity (60 to 70 mgals per 100 km) the residual Bouguer anomalies show a high southeast of Augsburg, a low southeast of Munich, and a ridge of high values in the Landschut-Neuötting region. Comparison, in part, with seismic results shows fairly good agreement. Correspondence of the vertical magnetic anomalies and gravity anomalies indicates that the source probably lies in the basement. (The gravity low southeast of Munich, however, has no magnetic counterpart.) The regional southward decrease in gravity is attributed to the southward dip of the strata. Seismic reflection and refraction observations show that at least down to the granite-gabbro boundary all layers dip toward the Alps. On the basis of isostasy (Airy-Heiskanen) there should be a flexure in the sial-sima boundary under the northern edge of the Alps at about 35 to 40 km, but the gravity results suggest that isostatic equilibrium is reached at 15 to 20 km and that this equilibrium clearly is achieved not vertically but regionally.—*D. B. V.*

Renner, János. A függövonalalhajlások regionális jellege [Regional character of deviations of the vertical]. See Geophys. Abs. 171–151.

171–182. Vecchia, Orlando. Geophysikalische Strukturlinien und Tiefengeologie in Silizien und den anliegenden Gebieten [Geophysical features and deep geology of Sicily and surrounding areas]: Geologie, Jahrg. 6, Heft 4, p. 451, 1957.

A postscript to the German version of Vecchia's paper (see Geophys. Abs. 169–175) mentioning that subsequent telluric surveys have shown a maximum of more than 7,500 m of sediments near Caltanissetta, thus confirming his gravity interpretation of the depth of the Tertiary basin in central and southern Sicily.—*D. B. V.*

171–183. Feuguer, L[éon]. Géologie de la feuille de Pontoise au 50,000e [Geology of the Pontoise 1/50,000 sheet]: Service Carte géol. France Bull., tome 53, no. 245, 155 p., 1955.

The last two pages of this bulletin summarize the results of the gravity survey of the area including and surrounding the Pontoise sheet of the geologic map of France. The anomalies correspond broadly to undulations in the Tertiary formations. Over the upper Cretaceous chalk they are much higher than expected and may signify larger deep structures that are only weakly reflected in the chalk layers.—*D. B. V.*

171–184. Yokoyama, Izumi, and Tajima, Hirokazu. A gravity survey on Volcano Mihara, Ooshima Island by means of a Worden gravimeter: Tokyo Univ. Earthquake Research Inst Bull., v. 35, pt. 1, p. 23–33, 1957.

The results of a 1956 gravimeter survey of Ooshima Island, Japan are presented in detail, with a table giving normal and observed values, free-air, Bouguer and topographic corrections, and Bouguer anomalies, and sketch maps of the Bouguer anomalies. In general the anomalies are similar to the shape of the island. Two highs occur, in the northern and eastern parts of the island. The former corresponds to a positive vertical magnetic anomaly and suggests the existence of a dense mass completely covered by ejecta from the present central cone, Mihara. The latter may indicate a dense mass of which the Hudeshima basalt on the east coast may be an outcrop. The outer somma is absent in the eastern part of the caldera where the high prevails; this may mean that the dense mass existed before the subsidence. Lows are found on the parasitic cones Atago and Takenohira as well as on the central cone, indicating coarse material around the vents.—*D. B. V.*

171–185. Salgueiro P., Reynaldo. Algunos aspectos de la gravimetria en la America Latina [Some aspects of gravimetry in Latin America]: Ciencia (Mexico), v. 16, no. 11–12, p. 272–281, 1956.

A review of absolute and relative gravity determinations in Latin America, related problems, and some specific recommendations for the participation of Latin American countries in the gravity program of the International Geophysical Year.—*D. B. V.*

171–186. Shereshevskaya, S. Y. Rezul'taty gravimetricheskikh rabot, vypolnennykh v Dneprovsko-Donetskoy vpadine i severo-zapadnykh okrainakh Donetskogo skladchatogo svoruzheniya [Results of gravimetric investigations in the depression of the Dniepr and Donetz rivers and the northwestern borderlands of the Donetz fold]:

Akad. Nauk Ukraynsk SSR Inst. geol. Nauk Trudy, ser. geofiz., vypusk 1, p. 48–64, 1956.

Geophysical exploration for oil and gas in the Dniepr-Donetz depressions has indicated the presence of a series of gravitational maximums and minimums and several zones of salt domes. The depression is about 700 km long, is elongated in the northwest direction, and has a very complicated structure. The total depth of the faults forming the depression is about 4 km. The gravitational field of the depression shows five separate zones. A detailed geological description of the region and three gravitational profiles are given.—*S. T. V.*

171–187. Nevolin, N. V. O prirode gravitatsivnnykh i magnitnykh anomaliy tsentral'nykh i vostochnykh rayonov Russkoy Platformy [Nature of the gravity and magnetic anomalies of the central and eastern regions of the Russian platform]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 8, p. 1069–1072, 1957.

A striking correlation is observed between the deep geology of the Russian platform and the general distribution of Bouguer and magnetic anomalies. The regional gravity background seems to be independent of variations in the structural and petrographic features of the upper part of the sedimentary cover. Gravity anomalies and the more significant structural elements of the foundation are inversely related—the important gravity maximums correspond the depressions of the Precambrian basement, and large regional lows correspond to the positive structural elements such as the Baltic shield, the Voronezh massif, and the Tokmov anticline.—*S. T. V.*

161–188. Harrison, J[ohn] C., Brown, G. L., and Spiess, F. N. Gravity measurements in the northeastern Pacific Ocean: Am. Geophys. Union Trans., v. 38, no. 6, p. 835–840, 1957.

Gravity data obtained on seven submarine cruises are reported as free air, Bouguer, and isostatic anomalies at 124 stations for which latitude, longitude, and sounding depth are given. Five continental borderland profiles, one seamount, and six profiles across fracture zones are represented.—*M. C. R.*

171–189. Ritsema, A. R. Contributions to the geology of Timor X. Gravity measurements on Timor Island: Indonesia Madjalah Ilmu Alam, v. 112, pt. 2, p. 171–175, 1956.

This is substantially the same paper as one published in the Geol.-Mijnb. Genootschap Verh, geol. ser., deel 16, p. 380–384, 1956 (see Geophys. Abs. 169–173).—*D. B. V.*

171–190. Lakavchenko, P. I. Gravimetricheskaya razvedka na neft' i gaz [Gravimetric exploration for oil and gas]: 336 p., Moscow, Gostoptekhizdat, 1956.

A textbook on the gravitational method of exploration.—*S. T. V.*

171–191. Davis, W. E., Jackson, W. H., and Richter, D. H. Gravity prospecting for chromite deposits in Camaguey Province, Cuba: Geophysics, v. 22, no. 4, p. 848–869, 1957.

Detailed gravity surveys were made in Camaguey Province, Cuba, as part of a systematic exploration program conducted by the U. S. Geological Survey on behalf of the General Services Administration to locate deposits of refractory-

grade chromite. During the period August 4, 1954, to April 5, 1956, a total of 41,921 gravity stations were established in nine areas embracing about 11.8 square miles in the Camaguey chromite district. The results of the surveys were used in connection with information obtained in geologic investigations to guide exploratory drilling.

Gravimeters with low scale constants were used in making measurements sufficiently accurate to delimit anomalies as small as 0.5 gravity unit. The measurements were made over 20×40 and 30×60 meter grids and at stations 20 and 30 meters apart, respectively, along intermediate traverses in anomalous areas. Gravity differences were determined by single observations at individual stations, observing base stations hourly, and re-observing a few stations to check drift and accuracy of measurement. About 11 percent of the stations established had to be re-run because of errors in closure, microseisms, and instrument trouble.

A large number of anomalies were found and evaluated according to geology, areal extent, and gravity relief. Depths to disturbing hypothetical bodies were computed to guide drilling. Test drilling of 106 positive anomalies revealed that ten features overlie deposits of chromite and 89 occur over bodies of other dense materials. The other seven anomalies were not explained by materials found in drilling. Core drilling on five of the chromite deposits revealed about 236,000 tons of chromite. An additional estimated 12,000 tons are contained in three deposits which were not blocked out. No estimate was made of the tonnage in two small deposits.—*Authors' abstract*

HEAT AND HEAT FLOW

171–192. Clark, Sydney P., Jr. Radiative transfer in the earth's mantle: Am. Geophys. Union Trans., v. 38, no. 6, p. 931–938, 1957.

The equation governing the transfer of heat in non-opaque media is derived and reduced to a form suitable for calculation. The optical absorption coefficients of minerals are estimated to be 10 cm^{-1} to 30 cm^{-1} under surface conditions, but they rise to much higher values at high temperatures because of an increase of electrical conductivity with temperature. Hence radiative transfer will be most effective in the outermost 600 km of the earth; at these depths the effective thermal conductivity may be considerably increased by radiative transfer. The presence of an outermost shell having a high conductivity may increase the heat lost from the earth in geologic time by a factor of two over previous estimates.—*Author's abstract*

171–193. Goguel, Jean. La rapport de géothermie dans la géophysique profonde [The relationship of geothermy in deep geophysics]: Geol. Rundschau, Band, 46, Heft 1, p. 122–130, 1957.

A review of present knowledge of the thermal behavior of the earth, including the cooling of the earth; the role of radioactivity; the "cold model" hypothesis and objections to it; an outline of a "hot model" theory; energy available for tectonic phenomena by contraction and by convection currents; and the theory of progressive solidification of the mantle.—*D. B. V.*

171–194. Kappelmeyer, O. The use of near surface temperature measurements for discovering anomalies due to causes at depths: Geophys. Prosp., v. 5, no. 3, p. 239–258, 1957.

This paper is an attempt to evaluate the possibilities of obtaining geologic information at depth from temperatures measured a few feet beneath the ground surface. Such near-surface temperatures are subject to large seasonal variation from place to place owing to differences in soil and surface properties and microclimatic effects. The magnitude of these variations is sufficient to mask the effects of different rock conductivities or radioactive heat generation at depth. However, the method has been applied successfully to locate fissures along which heat is transported upward by the movement of water or steam. By reference to an idealized model, it is possible to estimate the upward flux of mass and energy along such a fissure. The thermal method was successful also in detecting the position of leaks in canal banks where water is lost by percolation.—*A. H. L.*

171–195. Lachenbruch, Arthur H. Thermal effects of the ocean on permafrost: Geol. Soc. America Bull., v. 68, no. 11, p. 1515–1529, 1957.

In high latitudes the large difference between the mean annual temperature at the ground surface and in the unfrozen sediments beneath bodies of water can affect ground temperatures to depths of several hundred feet. The effect is of particular interest near the edge of the ocean where it depends upon the magnitude of the temperature difference between the land surface and ocean bottom, the thermal properties of the ground materials, and past changes in climate and/or shore-line configuration. Theoretical considerations suggest that, except where there are transgressing shore lines, permafrost to depths greater than about 100 feet beneath the ocean bottom is not to be expected at points farther than a few thousand feet offshore. Similar considerations indicate that geothermal installations along the Arctic coast can give information regarding post-Pleistocene shore-line changes.

The geothermal effects of bodies of water offer an explanation for the anomalously large outward earth-heat flow recently reported by A. D. Misener for Resolute Bay, Cornwallis Island, N. W. T., Canada.—*Author's abstract*

171.–196. Misener, A. D., Bremner, P. C., and Hodgson, J[ohn] H. Heat flow measurements in permafrost at Resolute Bay, Northwest Territories: Royal Astron. Soc. Canada Jour., v. 50, no. 1, p. 14–24, 1956.

A report on the heat flow measurements in permafrost at Resolute Bay, Northwest Territories (see Geophys. Abs. 164–184). A technique was developed for diamond drilling in permafrost, an understanding was obtained of the relation between near-surface permafrost temperatures and air temperatures, and it was established that the temperature gradient and heat flow at Resolute Bay are much higher than normal for more southerly latitudes.—*D. B. V.*

171–197. Moum, Johan, and Rosenqvist, Ivan T. Jordtemperaturen i ost-Norge [Ground temperatures in eastern Norway (with English summary)]: Norsk Geol. Tidsskr., bind 37, heft 2, p. 267–273, 1957.

Temperature measurements to a depth of 16 m in a clay deposit near Oslo, Norway, carried on for a full year beginning June 15, 1955, showed that below 8 m the annual variation is less than 0.1° C and temperature increases by 1/50 of a degree per meter.—*D. B. V.*

171–198. Gandzyuk, G. A., and Potushanskiy, A. A. Geotermicheskiye issledovaniya i rasprostraneniye teplovogo polya v osadochnykh otlo-

zheniyakh no territorii Ukrainy [Geothermic investigations on the propagation of the thermal field in the sedimentary deposits of the territory of the Ukraine] : Akad. Nauk Ukraynsk. SSR Inst. geol. nauk Trudy, ser. geofiz., vypusk 1, p. 157–165, 1956.

A review of geothermal measurements in different parts of the Ukraine. The first reliable data were obtained in 1877–78 in the northern Crimea where temperature determinations were made in a drill hole to a depth of 800 m. On the basis of 14 measurements made from 1877 to 1934 the geothermal gradient ranges from 1.66 to 3.18° C per 100 m in the northern part, from 1.72 to 2.14° C per 100 in the central part, and 1.60 to 3.60° C per 100 m in the Carpathian foothills. The specific thermal resistivity is not affected by the mineral content of the underground water, but if the ground is saturated with oil or gas its resistivity increases. Some exceedingly high readings of temperature obtained in the Donbass and in the Carpathian Mountains are attributed to heating engendered in zones of intensive structural deformation.—*S. T. V.*

171–199. Lachenbruch, Arthur H. A probe for measurement of thermal conductivity of frozen soils in place: Am. Geophys. Union Trans., v. 38, no. 5, p. 691–697, 1957.

A probe has been used for several hundred determinations in situ of the thermal conductivity of naturally frozen and thawed soils, snow, fresh-water ice, and sea ice in northern Alaska. The probe is about 20 inches long, one-quarter inch in diameter, and contains a small bead thermistor that is used as the temperature-sensitive element. Under normal field conditions conductivity determined with the probe is reproducible within about two percent. The absolute accuracy of the instrument is estimated to be within five percent. Results obtained with this probe have suggested a modification in design that is expected to offer a practical method for determining simultaneously the thermal conductiivty and thermal diffusivity in situ.—*Author's abstract*

INTERNAL CONSTITUTION

171–200. Kuiper, Gerard P. The formation of the planets: Royal Astron. Soc. Canada Jour., v. 50, no. 2, p. 57–68; no. 3, p. 105–121; no. 4, p. 158–176, 1956.

The planets which formed from a solar nebula, formed from the contracting sun itself, were not subsequently captured. Gravitational instability set in after the temperature had dropped to about 40° K (at 1 astr unit, less farther out), and the nebula broke up into proto-planets whose masses, dimensions and orbital radii were almost entirely determined by the local surface density in the nebula and essentially independent of whatever density fluctuations initiated the break-up. Two regions of instability, separated by a stable region that formed asteroids by accretion, formed the major and minor planets, respectively; in another stable region outside proto-Neptune, comets formed by accretion. Each proto-planet developed a body at its center by condensation and sedimentation; farther out, minor satellites developed in the gravitationally stable part of its envelope. Evaporation of the proto-planet envelope began after the sun grew bright, and it lasted for nearly 10^9 yrs. The earth-moon system is a double planet, abnormal in the solar system.—*D. B. V.*

171–201. Kapustensky, A. F. A geochemical hypothesis of the earth's structure: Nature, v. 180, no. 4597, p. 1245–1246, 1957.

This is a summary of a paper read at the Symposium on Geochemistry in Paris in July 1957. With increasing pressure the outer electrons of atoms are forced into lower quantum levels, and the atoms have completely new properties. The depth at which this occurs is assumed to correspond with the Mohorovičić discontinuity (60 to 120 km); the zone above the Mohorovičić discontinuity is called the perisphere. The intersphere from the base of the perisphere to 2,900 km is made of atoms with "degenerate chemical properties." The centrisphere is a region of "squashed atoms." At a pressure of the order of 1,400,000 atmospheres (corresponding to a depth of 2,900 km) all atoms become identical in regard to chemical properties; matter in this state will be characterized by such a high electrical and thermal conductivity that the temperature of the centrisphere will remain constant.—*M. C. R.*

171–202. Ertel, Hans. Hydrostatische Homotropie im Erdinnern und Legendres Dichtgesetz [Hydrostatic homotropy in the earth's interior and Legendre's density law]: Deutsch. Akad. Wiss. Berlin Sitzungsber., Math.-Naturw., no. 1, 14 p., 1955.

It is shown that the simple homotropy relations between density, pressure, and potential in the earth's interior are valid, according to hydrostatic and potential theory, not only for Legendre's spherically symmetrical density distribution but for all mass distributions characterized by a constant homotropy coefficient of density with respect to potential. These are the density fields represented by the solutions of time-free wave equations. The spherical distribution with which Legendre's law is concerned is merely a special case.—*Author's summary, D. B. V.*

171–203. Egyed, L[ászló]. A new dynamic concept of the internal constitution of the earth: Geol. Rundschau, Band 46, Heft 1, p. 101–121, 1957.

A somewhat condensed version of Egyed's new theory of the internal constitution of the earth that appeared earlier in "Acta Geologica" of the Hungarian Academy of Sciences (see Geophys. Abs. 167–165).—*D. B. V.*

171–204. Gutenberg, B[eno]. The 'boundary' of the earth's inner core: Am. Geophys. Union Trans., v. 38, no. 5, p. 750–753, 1957.

Longitudinal waves *PKIKP* with periods of about one second which have passed through the inner core frequently arrive earlier than the corresponding waves with periods of several seconds. At epicentral distances between about 120° and 135° the difference in arrival between the first short-period waves and the long-period main impulse may reach nearly 20 sec. If this difference is a consequence of dispersion in a transition zone between the outer and inner core, the calculated 'radius' of the inner core is greater for short-period than for long-period waves. According to theoretical and laboratory research by Kuhn and Vielhauer such phenomena are to be expected if the transition from the outer to the inner core corresponds to a relatively rapid but continuous increase in viscosity without change in material. On the other hand, findings from all sources agree with the hypothesis that the boundary between mantle and core separates solid material (rock) in the mantle from a different liquid material (mainly iron) in the core.—*Author's abstract*

171–205. Fischer, Georg. Die Unterkruste vom Standpunkt des Petrographen [The lower crust from the petrographer's point of view]: Geol. Rundschau, Band 46, Heft 1, p. 130–136, 1957.

A consequence of the demonstrable rise of sialic structural blocks of the earth is that differentiation of material in the outer spheres of the earth has been going on during the whole of geologic history. The example of kimberlite and the igneous carbonatites suggests that an exchange takes place between deeper zones and the surface and that the stability of the material of the so-called "peridotite layer" must be substantially more complex than generally assumed.—*Author's summary, D. B. V.*

171–206. Roever, W. P. de. Sind die alpinotypen Peridotitmassen vielleicht tektonisch verfrachtete Bruchstücke der Peridotitschale? [Are the Alpinotype peridotite masses possibly structurally emplaced fragments of the peridotite layer?]: Geol. Rundschau, Band 46, Heft 1, p. 137–146, 1957.

This paper is a preliminary examination of the tectonic possibilities of the theory that alpinotype peridotite masses are fragments of the peridotite layer that have been brought to their present position tectonically. Solidification of the alpinotype peridotites may have taken place very early in the formation of the crust; the pronounced fabric found in many may be due to younger metamorphisms. Pillow lava volcanicity would be a normal accompaniment of the tectonic "intrusion" of the peridotites; the magma would originate in the peridotite layer and be squeezed up during movements of the upper part of the shell. This interpretation would easily explain several phenomena that are otherwise difficult to understand, such as the lack of clear contact metamorphism, tectonic character of the contacts of the ultramafites, lack of ultramafic dikes, and frequent association of ultramafites with amphibolites and other crystalline rocks that apparently come from under a geosyncline. These amphibolites and crystalline rocks may be fragments of the roof of the peridorite shell and thus part of the basaltic shell brought up with the ultramafites. Further research is necessary to establish the tectonic validity of this interpretation.—*D. B. V.*

171–207. Bederke, E. Zur Geologie und Geophysik der Tiefen. Ein erläutendes Nachwort [On the geology and geophysics of the depths. An interpretative epilog]: Geol. Rundschau, Band 46, Heft 1, p. 229–245, 1957.

A summary and correlation of the information presented in the individual papers of this issue of the Geologisch Rundschau and an attempt to fit them into the geologic picture.—*D. B. V.*

171–208. Gutenberg, B[eno]. Zur Frage der Gebirgswurzeln [On the question of mountain roots]: Geol. Rundschau, Band 46, Heft 1, p. 30–38, 1957.

Roots of mountains are studied by use of gravimetric data, dispersion of surface waves, and travel times of refracted and reflected body waves from earthquakes or artificial explosions. Under southern and central California the thickness of the crust increases from about 20 km near the coast to 30 to 35 km under the lower valleys and 50 km under the Sierra Nevada. It increases from about 20 km under the Atlantic shelf to about 30 km under the Atlantic Coast of the United States, 35 km under the Canadian shield, and about 45 km under

the Appalachians. In western Europe it is about 25 to 30 km, seems to increase under the central and southern Alps to 45 to 50 km and possibly to 60 km under the Abruzzi. The "granitic" layer seems to be 25 to 30 km under southern California and the Sierra Nevada, about 20 km under western Europe, but 35 km under the central and southern Alps. Thus the root under the Sierra Nevada may be mainly an effect of thickening of the "basaltic" layer and under the Alps an effect of thickening of the "granitic" layer, a difference that could result from differences in tectonic processes in the late geological history of the two regions. The depth at which phase changes occur, and thus the thickness of the crust, can apparently be greatly affected by local temperatures. Isostatic reestablishments probably occur mainly below the crust.—*D. B. V.*

171–209. Kosminskaya, I. P., and Tulina, Yu. V. Opyt primeneniya metoda glubinnogo seysmicheskogo zondirovaniya dlya izucheniya stroyeniya zemnoy kory nekotorykh rayonov Zapadnoy Turkmenii [An attempt at the application of deep seismic sounding in the investigation of crustal structure in several regions in western Turkmen SSR]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 7, p. 874–894, 1957.

The structure of the western part of the Turkmen S. S. R., east of the Caspian Sea, was investigated by means of deep seismic sounding (see Geophys. Abs. 154–14699 and 160–74). Four discontinuities were recognized, corresponding to the surface of the Paleozoic, the top of the granitic and basaltic layers, and the base of the crust (Mohorovičić discontinuity). Average velocities are as follows: 3.5 kmps in Cenozoic, 5.0 kmps in Mesozoic and Paleozoic rocks; 5.5 kmps in the granite layer, 6.3 kmps in the basaltic layer, and 8.0 kmps below the Mohorovičić. Thickness and structure of the crust vary from place to place according to the geologic history; under the Transcaspian basin the crust is more than 40 km thick; in the Danatinskiy and Balkhanskiy corridors it is between 30 and 40 km thick, and under the Bol'shoy Balkhan mountains it is less than 30 km. The fundamental Paleozoic structures are reflected qualitatively in the stronger local gravity anomalies with no agreement in detail. On the other hand the relief of the Mohorovičić discontinuity corresponds well with the regional gravity picture; positive anomalies occur over thinner and negative anomalies over thicker portions of the crust. Comparison with seismologic data shows that the foci of the weak earthquakes of the area are concentrated in the granite and basalt layers, near the lower limit of the latter.—*D. B. V.*

171–210. Dohr, G[erhard]. Ein Beitrag der Reflexionsseismik zur Erforschung des tieferen Untergrundes [A contribution of reflection seismology to investigation of the deeper basement]: Geol. Rundschau, Band 46, Heft 1, p. 17–26, 1957.

Most of the reflections from great depths observed during seismic surveys in several parts of Germany probably can be referred to the Conrad and Mohorovičić discontinuities. (See also Geophys. Abs. 170–209.)—*D. B. V.*

171–211. Reich, Hermann. In Suddeutschland seismische ermittelte tiefe Grenzflächen und ihre geologische Bedeutung [Deep boundary surfaces seismically determined in southern Germany and their geological significance]: Geol. Rundschau, Band 46, Heft 1, p. 1–17, 1957.

Three important discontinuities have been distinguished by deep reflection work in southern Germany and the Bavarian Alps. The first is the top of the granite zone (in which velocity of longitudinal waves is 5.6 kmps), the second is the top of the gabbro zone (with a velocity of 6.5 kmps) or Conrad discontinuity, and the third is the top of the peridotite subcrust (in which the velocity is 8.2 kmps) or Mohorovičić discontinuity. The top of the granite layer is quite irregular under southern Germany but almost horizontal under the Bavarian Alps. Although the Conrad discontinuity should lie nearer the surface under areas of positive gravity and magnetic anomalies, no difference in depth was observed in the Alpine foreland and under the Bavarian Alps; the base of the crust is almost horizontal under the whole area, so far as can be observed.—*D. B. V.*

171–212. Gálfi, J[ános], and Stegena, L[ajos]. Tiefenreflexionsversuche in Ungarn zum Studium der continentalen Aufbauung [Deep reflection investigations in Hungary for the study of continental structure]: Geol. Rundschau, Band 46, Heft 1, p. 26–29, 1957.

Seismic reflection studies of crustal structure, using 50–100 kg charges of dynamite in 40–50 m boreholes, were made at Debrecen and Pécs, Hungary. The results show that the Conrad discontinuity lies at 19.4 km and the Mohorovičić at 23.6 km in northeastern Hungary; and at 19.6 and 25.2 km, respectively, in southern Hungary. (See also Geophys. Abs. 166–364 and 168–195.)—*D. B. V.*

171–213. Gálfi, J[ános], and Stegena, L[ajos]. Szeizmikus reflexiós méréssel meghatározott néhány adat a földkéreg Magyarországi részéről [Some data obtained by seismic reflection measurements on crustal structure in Hungary]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 6, szám 1–2, p. 53–60, 1957.

Seismic surveys with equipment constructed at the Roland Eötvös Geophysical Institute, using charges of 25 to 500 kg of dynamite in boreholes 30 to 60 m deep, yielded deep reflections in five places—Sopron, Debrecen, Karád, Pécs, and Bonyhád. Depths to the Conrad and Mohorovičić discontinuities (computed on the basis of mean velocities of 5.8 kmps to the former and 6.0 kmps to the latter, and taking into account corrections for surface sedimentary layers) are summarized graphically; average depths are 20 km and 27 to 30 km, respectively, with a slight dip toward the southeast.—*D. B. V.*

Bisztricsány, Ede, and Csomor, Dezső. Analysis of microseismic data on the earthquake of January 12, 1956, and crustal structure in the Hungarian Basin. See Geophys. Abs. 171–61.

ISOTOPE GEOLOGY

171–214. Dibeler, Vernon H. The isotope reference sample program at the National Bureau of Standards: *in* Nuclear processes in geologic setting. Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 55–61, 1956.

A report on the program undertaken by the Bureau of Standards, at the request of the U. S. Geological Survey and with the support of the U. S. Atomic Energy Commission, to establish a bank of elements and compounds as isotope reference samples in forms suitable for mass spectrometric analysis. Included

is a report of the ad hoc committee appointed at the Second Conference on Nuclear Processes and Geologic Settings on the preparation and suitability of samples.—*M. C. R.*

171–215. Rafter, T. A., and Fergusson, G. J. The atom bomb effect: Recent increase in the ^{14}C content of the atmosphere, biosphere, and surface waters of the oceans: New Zealand Jour. Sci. Technology, sec. B, no. 8, p. 871–883, 1957.

Since November 1954 the carbon-14 specific activity of the air and surface water of the ocean has been monitored in the vicinity of Wellington, New Zealand; an increase of 6.7 percent in the former and 2 percent in the latter must be due to production of carbon-14 by atomic explosions. Rapid exchange between northern and southern hemispheres is indicated. The increase in the atmosphere is reflected by an increase in the biosphere, as expected. An exchange time of 20 months for transfer of carbon dioxide from atmosphere to surface ocean water is deduced. Adequate study of these increases of carbon-14 in these main reservoirs of the carbon cycle in both hemispheres should contribute much to meteorology and oceanography.—*D. B. V.*

171–216. Gavelin, Sven. Variations in isotopic composition of carbon from metamorphic rocks in northern Sweden and their geological significance: Geochim. et Cosmochim. Acta, v. 12, no. 4, p. 297–314, 1957.

The C^{12}/C^{13} ratio has been determined in 108 samples of graphites from metamorphic Precambrian and Caledonian sediments in northern Sweden. The aim of the investigation has been to ascertain if variations in the isotopic composition of carbon can contribute to a solution of petrogenetic problems when conventional petrographic methods fail. No correlation could be established between C^{12}/C^{13} ratio on the one hand and degree of kineto-metamorphism, thermal or "regional" metamorphism on the other. It seems possible that at least some C^{12}/C^{13} variations reflect fluctuations in the original sedimentary milieu, but nothing definite can be stated concerning the mechanism of isotopic fractionation in sedimentary processes.—*Author's abstract*

171–217. Brannon, H. R., Jr., Daughtry, A. C., Perry, D., Whitaker, W. W., and Williams, M. Radiocarbon evidence on the dilution of atmospheric and oceanic carbon by carbon from fossil fuels: Am. Geophys. Union Trans., v. 38, no. 5, p. 643–650, 1957.

The dilution of atmospheric carbon dioxide by carbon dioxide from fossil fuels is estimated to be about 3½ percent, on the basis of radiocarbon assays of tree rings of known ages from several trees of different genera, after allowance has been made for effects attributable to ecological differences. The cumulative mass of fossil carbon dioxide released to the atmosphere is 3.3×10^{17} g, equivalent to about 14 percent of the carbon dioxide in the atmosphere. Based on these data, the fractional part of the atmospheric carbon dioxide which enters the ocean each year is estimated to be 0.062. Radiocarbon assays of several nineteenth-century marine shells and of their modern counterparts indicate a one to two percent dilution of shallow oceanic carbonates by carbon dioxide from fossil fuels. Use of these data in a simplified mathematical model of atmosphere-ocean yields information on mixing times of the ocean.—*Authors' abstract*

171–218. Schaeffer, Oliver A., and Davis, Raymond, Jr. Chlorine-36 in nature: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 172–180, 1956.

It may be possible to use the rate of production of chlorine-36 in a surface rock to measure the time of exposure of the rock to cosmic radiation. In order to date the time of exposure it is necessary to insure that the rock surface has not been eroded more than a few inches since its exposure and the rock must also contain a workable amount of chlorine. For one sample from Cripple Creek, Colorado it is deduced that the rock has been exposed for a period of 24,000±4,000 years. Measurements of chlorine-36 radioactivities were also made for a syenite from Red Hill, New Hampshire, ocean water and water from Great Salt Lake.—*M. C. R.*

171–219. Nier, Alfred O. Determination of helium isotope abundance ratios: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 7–12, 1956.

A description of the double focusing mass spectrometer developed at the University of Minnesota for the determination of isotopic abundances where high sensitivity and high resolution are required, as for example in the determination of the helium-3 : helium-4 ratio.—*M. C. R.*

171–220. Begemann, F[riedrich]. Distribution of artificially produced tritium in nature: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 166–171, 1956.

Nuclear tests in the Pacific have changed the distribution of tritium so that the equilibrium amount of tritium produced by cosmic radiation is only about 10 percent of the total tritium present. Most of the tritium produced in the atomic explosion is burned completely to H_2O, is carried as water vapor around the earth, distributed more or less homogeneously in the Northern Hemisphere, and finally rained out of the atmosphere and carried into the oceans.—*M. C. R.*

171–221. Friedman, Irving. Water in tektites: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 1–6, 1956.

Recent analyses of the deuterium : hydrogen ratio of water obtained from tektites indicate a water content of 0.002 to 0.008 percent, several times smaller than values reported in the literature.—*M. C. R.*

171–222. Begemann, Friedrich, and Libby, W[illard] F. Continental water balance, ground water inventory and storage times, surface ocean mixing rates and world-wide water circulation patterns from cosmic-ray and bomb tritium: Geochim. et Cosmochim. Acta, v. 12, no. 4, p. 277–296, 1957.

Tritium produced by thermo-nuclear explosions is more abundant than that produced naturally by cosmic radiation, and because of its placement in time, it is in some ways more useful for measurements of rates of natural water processes. Some tritium measurements made on rain and snow and continental and ocean water samples in various parts of the world after Operation Castle are presented. Previous calculations of cosmic-ray tritium production are thought to be too low, as both the decay of tritium in ground water and the

amount by which the outward tritium vapor transport exceeds inward flow from the seas are now known to be important; the new value is 1 tritium atom per cm^2 per sec at the surface (compared to 0.14 previously calculated) and 2 tritium atoms per cm^2 per sec total, raising the world-wide inventory of cosmic-ray tritium to about 30 kg insead of 1.8 kg and placing an upper limit of escape time for helium-3 from the atmosphere at about 2.5 million years.

Applied to ground water, the study shows that in large areas the waters issuing from wells dug for normal use are older than 50 years; the tritium content of well waters is likely to be of real value in problems of underground water supply and prediction of susceptibility to drought, depletion by pumping, and replenishment from precipitation.—*D. B. V.*

171–223. Edwards, George, and Hess, David C. Isolation and isotopic analysis of lead in meteorites and rocks: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 100–108, 1956.

A method previously found effective in recovering alkali metals from silicates by volatilization have been used for the isolation of smaller amounts of lead from siliceous materials. The method satisfactorily reduces contamination but apparently gives incomplete recovery of lead, probably owing to loss through the filter in the evaporative stage.—*M. C. R.*

171–224. Paul, W. Lead isotope variations: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 181–186, 1956.

Studies of lead isotopes in galenas from southern and western Germany—a total of 120 different samples—show that the relative abundances of lead-206, lead-207, and lead-208 relative to lead-204 are 18.0 to 18.7, 15.4 to 15.7 and 37.9 to 38.8, respectively. The ages of these samples is calculated as 90 to 430×10^6 yrs.—*M. C. R.*

171–225. Hoering, T[homas]. Variations in the nitrogen isotope abundance: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Reresearch Council Pub. 400, p. 39–44, 1956.

Variations in the nitrogen-15 : nitrogen-14 ratio in four rocks, several samples of peat and coal, petroleum and natural gas, and nitrogen in plants and animals are reported. The variations seem to be somewhat smaller than those reported for carbon-13 : carbon-12, oxygen-18 : oxygen-16, or sulfur-34 : sulfur-32. The large reservoir of nitrogen, the atmosphere and rocks, seem to have a constant isotopic composition. There are few equilibrium processes operative to fractionate nitrogen isotopes, but living matter fractionates the nitrogen isotopes because of a difference in rate of turnover of isotopic molecules.—*M. C. R.*

171–226. Dole, Malcolm. The oxygen isotope cycle in nature: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 13–19, 1956.

Evidence is presented for the existence of a cycle in which photosynthesis yields oxygen containing a higher oxygen-16 : oxygen-18 ratio than the oxygen of the atmosphere, while respiration consumes oxygen containing a higher oxygen-16 : oxygen-18 ratio than the oxygen of the atmosphere and the same ratio as that of photosynthetic oxygen, thus leading to the nonequilibrium

steady state value of the oxygen-16 : oxygen-18 ratio in the atmosphere. The isotopic composition of atmospheric oxygen is constant in various geographical locations over the surface of the earth and at altitudes as high as about 50,000 meters.—*M. C. R.*

171–227. Epstein, Samuel. Variation of the O^{18}/O^{16} ratios of fresh waters and ice: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 20–28, 1956.

Relations between the oxygen-18 : oxygen-16 ratio and salinity of marine waters indicated that the evaporation-condensation cycle in the meteoric cycle should be roughly equivalent to that occurring in a multiple stage distillation process, in which the less volatile components are progressively lost and the precipitate becomes continuously richer in H_2O^{16}. Isotopic analyses of rain that fell in Pasadena during a period of one year indicate that this model explains the variations of isotopic composition of rain in a general and qualitative way; that elevation plays an important role in determining the H_2O^{18} content of rain and snow; that the state of precipitation (whether liquid or crystalline) is not a major factor in determining the oxygen-18 : oxygen-16 ratio; and that summer rains are generally more concentrated in H_2O^{18} than winter rains or snow. Analyses of precipitation from a single storm at several stations in Oregon and California with but few exceptions follow a pattern that would be expected from a simple distillation still model. Analyses of samples from the Saskatchewan glacier in Alberta, from the Malaspina glacier in Alaska and from the Greenland ice cap show that snow falling during the summer months contains more H_2O^{18} than winter snow; that the isotopic composition of glaciers is not in uniform; and that the isotopic composition of glaciers may depend on relative amounts of winter and summer snows.—*M. C. R.*

171–228. Craig, Harmon, Boato, Giovanni, and White, Donald E. Isotopic geochemistry of thermal waters: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 29–38, 1956.

Two main types of thermal springs may be roughly distinguished: the normal chloride on near neutral springs with pH in the range of 5 to 9 that have a moderate to high discharge, shallow to deep circulation, and are generally discharged from a large body of ground water; and acid hot springs, relatively high in sulfate and low in chloride, but with a pH from 1 to 5, and generally low temperatures and much smaller rates of discharge than alkaline or normal springs but relatively greater gas discharge. Waters in the normal or alkaline springs are isotopically identical to the associated surface river or lake waters or have about the same deuterium concentration as local meteoric waters but are enriched in oxygen-18 by amounts ranging up to about 0.4 percent. In the acid springs there is a linear correlation between the deuterium and oxygen-18 concentration such that the enrichment ratio is about 3 relative to local surface waters. These spring waters may contain up to 5 percent more deuterium and 1.6 percent more oxygen-18 than do local meteoric waters. These patterns indicate some sort of oxygen isotopic exchange between the circulating meteoric waters and the local rocks.—*M. C. R.*

171–229. Hoekstra, H[enry] R. Oxygen isotope variations in some uranium minerals: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 160–165, 1956.

Such variables as the origin of the deposit, exchange subsequent to deposition, weathering, and impurity, effectively mask any possible temperature fractionation effect in pitchblende and uraninite. In general, uraninite seems to have a lower oxygen-18 content than pitchblende relative to the isotopic ratio of standard sea water. Many samples of pitchblende seem to have isotopic compositions very similar to that of ground water in the regions where they were found.—*M. C. R.*

171–230. Teys, R. V., Chupakhin, M. S., and Naydin, D. P. Opredeleniye paleotemperatur po isotopnomy sostavu kisloroda v kal'tsite rakovin nekotorykh melovykh iskopayemykh Kryma [Determination of paleotemperatures according to the isotopic composition of oxygen in calcite of shells of some Cretaceous fossils from Crimea]: Geokhimiya, no. 4, p. 271–277, 1957.

Paleotemperature determinations based on the isotopic composition of oxygen in shells mainly from the Cretaceous, but including a few from the Liassic, Paleocene, and lower and middle Eocene, of the Crimea are presented. Average annual temperatures obtained from belemnites show strikingly uniform low temperatures (13.3° C) during Hauterivian, Barremian, and Aptian times, relatively high temperatures (18.8°–24.2° C) during upper Albian and Cenomanian. A marked drop in temperature is indicated for the Santonian, Campanian, and Maestrichtian. Other forms associated with belemnites give higher temperatures—for example, Maestrichtian Ostreidae, inhabiting shallow seas, indicate temperatures of 18.2–20.9° C; these are said to represent seasonal deposition of calcite.—*D. B. V.*

171–231. Rafter, T. A. Sulpher isotopic variations in nature—Part 1: The preparation of sulpher dioxide for mass spectrometer examination: New Zealand Jour. Sci. Technology, sec. B, v. 38, no. 8, p. 849–857, 1957; Part 2—A quantitative study of the reduction of barium sulphate by graphite for recovery of sulphide-sulphur for sulphur isotopic measurements: no. 9, p. 955–968, 1957; Part 3—A study of the combustion characteristics of silver sulphide and lead sulphide for sulphur isotopic measurements; no. 9, p. 969–981, 1957.

Part 1 describes a simple and almost quantitative method of preparing sulfur dioxide from various sulfur compounds with minimum fractionation of the sulfur isotopes and less than 2 percent carbon dioxide impurity, so that the product is suitable for mass spectrometric determination of the sulfur-32: sulfur-34 ratio. Parts 2 and 3 give details of the chemical procedures developed for routine reduction of $BaSO_4$ and Ag_2S for the same purpose.—*D. B. V.*

171–232. Kulp, J. Laurence, Ault, W. U., and Feely, H. W. Sulfur isotope abundances in sulfide minerals: *in* Nuclear processes in geologic setting. Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 45–54, 1956.

In samples from the Santa Rita, New Mexico, mining district, the average sulfur-32: sulfur-34 ratio is 22.24, and the data do not indicate any difference attributable to differences of location within the district or to temperature of deposition. In the Illinois-Iowa-Wisconsin and Joplin lead-zinc districts there is no correlation between the small differences in sulfur isotope abundances and lead isotope abundances although the variation in sulfur-32: sulfur-34 ratios

is at least 3 times that in the Santa Rita District, which is consistent with a possible derivation from inhomogeneous sources. In the Southeast Missouri lead-zinc district there is a clear correlation between increases in sulfur-32 : sulfur-34 ratios and decreases in lead-207 : lead-206 ratios, which is consistent with a theory that places the source in the crust. A wide range in sulfur isotope composition is found in sulfide minerals from Sterling Hill and Franklin, New Jersey. A highly inhomogeneous original source is suggested, presumably in the crust rather than the mantle. Sulfur ratios in other hydrothermal sulfide minerals and pegmatitic and magnetic sulfide minerals are also discussed. (See also Geophys. Abs. 164–212 and 165–244.)—*M. C. R.*

MAGNETIC FIELD OF THE EARTH

171–233. Takeuchi, Hitoshi, and Shimazu, Yasuo. Convective fluid motions in a rotating sphere: Jour. Physics of the Earth, v. 2, no. 1, p. 13–26, 1954.

The earth's main magnetic field is attributed to induction currents caused by fluid motion within the earth's core resulting from convection due to nonhomogeneous heating. The problem of convective motion in a viscous fluid is treated here, taking into account the effects of the earth's rotation and magnetic field, and it is shown that fluid motion of the quasi S_2^{20} type can exist if the kinematic viscosity is 10^{11} poise. With this viscosity, the thermal diffusivity must also be 10^{11}~10^{12}; if such values of viscosity and diffusivity are admitted, the thermal gradient is of the order of magnitude of the adiabatic gradient.—*M. C. R.*

171–234. Chopra, K. P. Magnetic fields in a conducting fluid sphere with volume currents: Jour. Geophys. Research, v. 62, no. 4, p. 573–579, 1957.

The study of force-free and other equilibrium configurations of magnetic fields in a conducting fluid sphere with volume currents flowing in the interior of the sphere forms the subject matter of this note. In part I assuming the electrical conductivity of the sphere to be infinite, the general conditions governing the force free and other equilibrium fields are derived, and their solutions obtained. It is found that a force-free field must be a suitable combination of a poloidal and a toroidal part. The magnetic energy is equally divided in its poloidal and toroidal components. Part II deals with the case of finite electrical conductivity. Here, the possibility of a current distribution is explored such that the corresponding magnetic field does not decay with time. It is concluded that it is difficult to imagine a poloidal configuration of the magnetic field, whereas a purely toroidal non-decaying magnetic field is certainly possible.—*Author's abstract*

171–235. Takeuchi, Hitoshi, and Shimazu, Yasuo. On a self-exciting process in magneto-hydrodynamics (III) : Jour. Physics of the Earth, v. 2, no. 1, p. 5–12, 1954.

Inclusion of magnetic fields of higher harmonics in the dynamo model previously discussed (Geophys. Abs. 157–25 and 158–36) does not affect the result.—*M. C. R.*

171–236. Takeuchi, Hitoshi. The dynamo theory of the earth's main magnetic field: Jour. Physics of the Earth, v. 4, no. 1, p. 11–20, 1956.

The possibility of dynamo action in the core is considered for the case when the toroidal fluid velocity is larger than the poloidal velocity. Infinite numbers of stationary dynamos, each corresponding to a different eigen-value $y=4\pi k a V_{3.3c}$, are shown to be possible. The dynamo including the dipole field is that for the smallest y. Possible reversals of the field are explained as follows: If convective fluid motion in the core and the corresponding y become less than the stationary value and again increase, the magnetic field would decay, vanish, and then be restored, but whether the direction of the new field would be the same would be a matter of chance.—*M. C. R.*

171–237. Gaibar-Puertas, Constantino. Variación secular del campo geomagnético [Secular variation of the geomagnetic field]: Observatorio Ebro Mem. 11, 475 p., 1953.

Secular variation of the intensity and direction of the geomagnetic force has been studied using data from 112 permanent magnetic observatories and 112 temporary observatories and 41 polar stations established during the first two International Polar Years. Both secular variation curves and migration of isoporic foci suggest the occurrence of pulsations in the region of India that propagate radially at a velocity that depends at least in part on geologic structure. A process of demagnetization of the earth was reversed in about 1930, and the intensity is now increasing. Secular changes in the direction of the geomagnetic force also indicate a periodic change. Paleomagnetic observations must be analyzed with these observations in mind. Both magnetic poles and equator may have been moved during geologic time and the intensity may have undergone great changes.—*M. C. R.*

171–238. Barta, György. A földmágneses tér évszázados változásáról [On the secular variation of the geomagnetic field]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közleményet, kötet 6, szám 1–2, p. 9–27, 1957.

Geomagnetic secular variation is the consequence of a general process affecting the whole earth. As the direction of the XYZ axes of the generally used coordinate system varies with location, these components cannot be compared directly. A clearer picture of secular variation is obtained by use of a coordinate system in which one axis is the earth's axis of rotation and the other two pass through the points 21°C and 291°E on the equator, respectively. The vectors orthogonally projected to the planes of this coordinate system shows a center of symmetry lying in Pakistan. Around this center flows a circuit with a radius of about 3,000 km in a depth of about 10^7 to 10^8 amp. Secular variation is due to temporal change in the position and intensity of the circuit. The surface projection of the magnetic center of the earth (which lies eccentrically toward the Marshall Islands) is moving north-northwestward at a rate of 10 km per year. If the source of the geomagnetic field is in the core, then this variation is equivalent to motion in the core. This motion causes an increase of pressure and a spreading out of material around a spot below Pakistan; if the moving mass is electrically charged the resulting convection current may cause the secular variation of the geomagnetic field. It is inferred that the magnetic center of the earth revolves around the axis of rotation in 400 years; this time interval does not agree with the secular period of 500 years of the long declination series at London. The movement of the core may be oscillatory with a period of 400–500 years. Precision of the axis of the eddy may cause the super-

posed wave as well as the observed helical course of secular variation. Further investigations are in progress to unravel this complex of problems.—*D. B. V.*

171–239. Bartels, J[ulius]. Erdmagnetische Tiefen-Sondierungen [Geomagnetic depth soundings]: Geol. Rundschau, Band 46, Heft 1, p. 99–101, 1957.

Temporal variations of the geomagnetic field (caused primarily by electric currents in the ionosphere) induce secondary currents in the earth that also contribute to variations in the earth's magnetic field. By analysis of worldwide geomagnetic variations the internal part of the field can be differentiated from the external and models calculated for the internal portion. From these can be inferred the current distribution in the interior. Local inhomogeneities in electrical conductivity, thus indicated in the crust under northern Germany, will be more closely investigated during the International Geophysical Year.—*D. B. V.*

171–240. Bouška, Jan. Rozložení geomagnetického pole v Českých zemích k epoše 1950.0 [Distribution of the geomagnetic field in Czechoslovakia reduced to the epoch 1950.0]: Československé Akad. Věd Geofys. Ústav Práce, Geofys. Sborník, no. 30, p. 173–238, 1955.

Between 1946 and 1948 a complete magnetic survey of Czechoslovakia was made by the Statni Ústav Geofysikalni with the cooperation of other scientific institutions. The 161 stations occupied were scattered more or less uniformly over the entire area, except in very disturbed regions where they were more densely distributed. The results of the survey are presented in tables and on seven isogonic, isodynamic, and isoclinic maps.—*S. T. V.*

171–241. Ingall, L. N. Magnetic results from Heard Island, 1952: Australian Bur. Min. Resources, Geology and Geophysics Rept., no. 21, 8 p., 46 tables, 1955.

A report in tabular form of magnetic observations at Heard Island in the southern Indian Ocean from March to December, 1952. The observatory site, buildings, and instruments used are described.—*V. S. N.*

171–242. Barta, György. A földmágneses tér változása a Kárpát-medencében [Variations of the geomagnetic field in the Carpathian basin]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 6, szám 1–2, p. 29–35, 1957.

Magnetic isopors for *D*, *H*, and *Z* are computed for Hungary and vicinity for the intervals between magnetic surveys made in 1870, 1875, 1890, and 1950 and compared with world isoporic maps. It is suggested that the normal values valid for vast areas be computed and that characteristics of secular variation and its local anomalies be examined with the help of national secular stations.—*D. B. V.*

171–243. Malurkar, S. L. Geomagnetic records at Colaba and Alibag on days of solar eclipse: Indian Jour. Meteorology and Geophysics, v. 5, special no., p. 213–230, 1954.

Magnetograms from the records at Alibag have been examined for the days when solar eclipses passed near Bombay. The information from 17 is summarized in a table. Only two, in April 1894 and January 1898, were on quiet

days and show disturbances that might be attributed directly to an eclipse; in all the others any such effect is masked by other disturbances. To study properly the geomagnetic effect of an eclipse, the mean diurnal curve for a sufficient number of reasonably quiet days before and after the eclipse should be obtained from centers on or near the central track. Most expeditions, planned mainly for optical observations, stay too short a time for this. Another line of approach to the problem is to study past records of all the various permanent observations on days when eclipses passed near, in the hope that some definite conclusions might be drawn from the totality of data.—*D. B. V.*

171–244. Rikitake, Tsuneji, and Satō, Setsuko. The geomagnetic D_{st} field of the magnetic storm on June 18–19, 1936: Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 1, p. 7–21, 1957.

Examination of the D_{st} part of many magnetograms from widely distributed observatories for the magnetic storm of June 18–19, 1936 reveals that the relation between the parts of external and internal origin of the D_{st} field is well explained by the electromagnetic induction within the earth. The distribution of electrical conductivity within the earth is taken as the one obtained by Rititake and Satō.—*D. B. V.*

171–245. Bartels, Julius. The contrast between geomagnetic S and L at Huancayo: Indian Jour. Meteorology and Geophysics, v. 5, special no., p. 69–74, 1954.

An analysis of solar and lunar diurnal variation observed at Huancayo, based mainly on a new reduction of hourly values of H for 1922–1947, shows a striking seasonal change in the amplitude of L in contrast to the small seasonal variation in S. A similar contrast occurs in the critical frequency of the ionospheric F_2 layer.—*D. B. V.*

171–246. Coulomb, J[ean]. Sur une origine aurorale possible de certaines pulsations géomagnétiques [On a possible auroral origin of certain geomagnetic pulsations]: Annales Géophysique, tome 13, no. 2, p. 91–102, 1957.

There is a priori possibility for some pulsations to be generated during polar auroras and to be propagated from polar zones toward lower latitudes. A theory, rather incomplete mathematically, of the propagation, gives correct orders of magnitude for "giant pulsations"; but for the "pulsation trains" often associated with geomagnetic bays, the results are in contradiction with observed phenomena. *Author's abstract*

171–247. Haáz, István Béla. BMZ-mérések hömérsékleti javítása [The effect of temperature on BMZ measurements]: Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kötet 4, szám 1, p. 11–14. 1955.

A formula ($\alpha=\alpha_0+\Delta\alpha$) is derived for temperature corrections for BMZ magnetometer measurements where α is the total temperature correction and α_0 and $\Delta\alpha$ can be calculated from observed vertical intensity and temperature readings. This formula avoids the use of the as yet unknown value of Z.—*D. B. V.*

MAGNETIC PROPERTIES

171–248. Gorter, E. W. Chemistry and magnetic properties of some ferromagnetic oxides like those occurring in nature: Advances in Physics, v. 6, no. 23, p. 336–361, 1957.

A detailed review of the crystal chemistry of the spinel structure, the origin of negative exchange reactions postulated by Néel, and exchange coupling between two phases.—*M. C. R.*

171–249. Graham, John W. The role of magnetostriction in rock magnetism: Advances in Physics, v. 6, no. 23, p. 362–363, 1957.

Interaction of the stress history of rocks and their magnetostrictive properties must affect the magnetization. For example, the present direction of magnetization of red beds may have been acquired when the rocks were exposed at the surface; the unloading and upward elongation by erosion would affect the hematite, deposited under hydrostatic equilibrium at depth, as tension and the magnetic moment of the hematite would therefore be subject to change by magnetostriction. Regionally consistent directions could result from the fact that the unloading is everywhere primarily upwards.—*M. C. R.*

171–250. Slichter, L. B. Remarks relative to Maxwell's formula for the magnetic susceptibility of disseminated materials: Advances in Physics, v. 6, no. 23, p. 333–335, 1957.

Maxwell's solution (1873) for the effective electrical conductivity of a medium containing a dispersion of small conducting spheres is valid for the corresponding magnetic case with a change of notation. An important part of the spread in the determinations of the susceptibility of disseminated magnetite particles is probably due to uncertainties in the effective values of the demagnetization factors.—*M. C. R.*

171–251. Taychinov, R. S. Ob ispol'zobanii magnitnoy vospriimchivosti porod dlya korrelyatsionnykh tseley [On the use of the magnetic susceptibility of rocks for correlation purposes]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 7, p. 940–943, 1957.

In order to determine whether rocks can be correlated by their magnetic susceptibility, more than 500 samples of sedimentary rocks from boreholes in oilfields in the Bashkir A. S. S. R. were measured with a "permeability-meter" and 116 of these were also measured with a magnetometer for comparison purposes. In all cases the magnetometer results were slightly higher but approximately of the same magnitude; the correlation coefficient was 0.8. Correlation possibilities depend on conditions of sedimentation; magnetic susceptibility could probably be used for this purpose on sediments deposited far out in a calm sea. Comparison with electrical conductivity shows an inverse relation; local exceptions may be due to the presence of salty or mineralized ground water. There is apparently no general relation between magnetic susceptibility and density; exceptions showing a direct relationship are attributed to the presence of heavy magnetic minerals.—*D. B. V., S. T. V.*

171–252. Jaeger, J. C. The variation of density and magnetic properties. Appendix to The problems of the quartz dolerites: Some significant facts concerning mineral volume, grain size and fabric *by* Ger-

maine C. Joplin: Royal Soc. Tasmania Papers and Proc., v. 91, p. 143–144, 1957.

Measurement of the density and the magnetic susceptibility on samples of two dolerite sills in Tasmania shows that the density increases to a maximum of about 2.97 a few hundred feet above the base of the sill, decreases to a minimum of about 2.8 a few hundred below the top, and then rises to an intermediate value at the conjectured top. The magnetic susceptibility seems to fall from about 2×10^{-3} cgs at the base to a minimum of about 1×10^{-6} at approximately the same level as the density maximum, rises steadily to about 4×10^{-3} at the gravity minimum, and then decreases to an intermediate value at the conjectured top of the sill.—*J. R. B.*

171–253. Bol'shakov, A. S. O vozmozhnosti vosstanovleniya nachal'noy ostatochnoy namagnichennosti gornykh porod [On the possibility of reestablishing the initial remanent magnetization of rocks]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 737–743, 1957.

The stability of remanent magnetization of rocks depends on their geologic history as the initial magnetization decreases in the course of time under the influence of various demagnetizing factors such as mechanical shocks, heating, alternation of magnetic fields. Experimental comparison of the measured remanent magnetization with that of artificially "aged" specimens provides the basis of a graphic method of determining what the initial magnetization must have been. The method is applied to an example of titanomagnetite from the Kuzin deposit.—*D. B. V.*

171–254. Petrova, G. N., and Pospelova, G. A. O nekotorykh osobennostyakh termonamagnichivaniya [Certain peculiarities of thermomagnetization]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 6, p. 728–736, 1957.

Several important differences have been discovered in behavior of paramagnetic bodies (mainly magnetite from the Kursk magnetic anomaly) magnetized in 3 different ways—normally, ideally, and thermomagnetically. The curves comparing the field intensity, the remanent magnetization, and the coercive force of these specimens show striking differences, especially in low intensity fields. Similar differences were found between the intensities of thermal, ideal, and normal magnetization at different temperatures; these are very pronounced at low temperatures and disappear near the Curie point. Normal and ideal magnetization are somewhat similar but thermally magnetized material is qualitatively different; it is magnetically anistropic and more stable. As most rocks are thermomagnetized, application to them of laws of behavior established in laboratories for normally magnetized bodies may lead to significant errors in interpretation of magnetic anomalies.—*S. T. V.*

171–255. Akimoto, S[yun-iti]. Magnetic properties of ferromagnetic oxide minerals as a basis of rock-magnetism: Advances in Physics, v. 6, no. 23, p. 288–298, 1957.

In the ferromagnetic minerals investigated, the calculated content of ulvöspinel ($TiFe_2O_4$) in titanomagnetite ranges from 0 to about 70 percent and causes changes in the lattice parameter, intensity of saturation magnetization, and Curie point in the ranges from 8.38 Å to 8.49 Å, from 93 emu per gram to 14 emu per gram, and from 58° C to 120° C. Minerals in the ilmenite-hematite series, x $FeTiO_3$ (1—x) Fe_2O_3 can be classified in three groups: feebly magnetic when $0 \leqq x \leqq 0.55$; ferro-

magnetic when $0.55 \leqq x \leqq 0.75$ and paramagnetic when $0.75 \leqq x \leqq 1$. Study of the recently synthesized $TiO_2 \cdot Fe_2O_3$–$2TiO_2 \cdot FeO$ solid solution series indicates they are paramagnetic at atmospheric temperatures and should be considered in studying natural ferromagnetic minerals, especially in interpreting oxidation products.—*M. C. R.*

171–256. Aramaki, Shigeo, and Akimoto, Syun-iti. Temperature estimation of pyroclastic deposits by natural remanent magnetism: Am. Jour. Sci., v. 255, no. 9, p. 619–627, 1957.

The formation temperature of pyroclastic deposits can be estimated by measuring the orientation of natural remanent magnetism of the fragments contained in the deposits. If the N. R. M. has a uniform orientation in all the fragments, the formation temperature was higher than the Curie point of the constituent ferromagnetic mineral, provided that the N. R. M. originated from the stable thermo-remanent magnetism. If the fragments show a random orientation of N. R. M., the formation temperature was lower than the Curie point. Examples of the random and uniform orientation from several pyroclastic deposits are reported. By this means, nuée ardente deposits can be distinguished from mud flow deposits.—*Authors' abstract*

171–257. Millman, A. P. Reflection microscopy of ferromagnetic minerals: Advances in Physics, v. 6, no. 23, p. 323–326, 1957.

"The general purpose of this review is to draw the attention of those engaged on research in rock magnetism to some aspects of their problems which . . . may be more readily investigated by reflection microscopy than by the more conventional electron and X-ray diffraction techniques . . ." Identification of mineral components, interpretation of textural relations, and of paragenesis of minerals in intimate intergrowth are discussed by examples.—*M. C. R.*

171–258. Nagata, T[akesi], Uyeda, S[eiya], and Ozima, M. Magnetic interaction between ferromagnetic minerals contained in rocks: Advances in Physics, v. 6, no. 23, p. 264–287, 1957.

Experimental studies of natural ferromagnetic ilmenites and titanomagnetite indicate that when two ferromagnetic minerals coexist in a grain in the form of an alternately laminated structure, the magnetic interaction is negative. When non-ferromagnetic minerals, such as titanhematite, rutile, or ilmenite with a Curie point lower than room temperature, are intergrown in the ferromagnetic mineral, the coercive force is intensified and the thermoremanent magnetization is intensified in the normal direction. An empirical relation between the increase in coercive force and increase in intensity has been obtained for ferromagnetic ilmenite containing titanhematite and rutile.—*M. C. R.*

171–259. Parry, J. H. The problem of reversed magnetizations and its study by magnetic methods: Advances in Physics, v. 6, no. 23, p. 299–305, 1957.

Magnetic properties such as initial susceptibility, saturation magnetization, coercive force, and Curie point can be used in studying rock magnetism as well as natural remanent magnetization. As examples the composition of Icelandic basalts collected by Hospers; of Deccan trap, as measured by Irving; and of Torridonian sandstone, and Adirondack gneiss, supplied by J. R. Balsley is discussed on the basis of thermomagnetic curves.—*M. C. R.*

171–260. Kuzhelov, G. K. Nekotoryye sluchai termonamagnichivaniya ferromagnitnykh tel [Some cases of thermomagnetization of ferromagnetic bodies]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 7, p. 944–949, 1957.

Investigation of the magnetic properties of oriented specimens of mafic and ultramafic rocks from drill holes in magnetic anomalies reveals apparent contradictions to present concepts of thermoremanence. In particular, the finding of different directions of remanent magnetization in a single igneous body is not consistent with the generally accepted idea that the direction of magnetization reflects the direction of the geomagnetic field in which the body cooled. Examination of some general laws governing thermomagnetization of ferromagnetic bodies leads to the following conclusions: The thermomagnetization developed in ferromagnetic bodies heated above the Curie temperature and then slowly cooled follows the pattern of magnetization of a thin layer. It is not uniform; the magnitude and direction in different parts of the body depend not only on the magnetic properties of the body at normal (below Curie point) temperatures and at the Curie temperature, but also on the position of the cooling surface (Curie layer) relative to the magnetizing field. If magnetic susceptibility at the Curie point is sufficiently high, under certain conditions of cooling, thermomagnetization should develop in a direction close to the surface of the Curie layer in each part of the body. Thermoremanent magnetization decreases from the periphery toward the center; in particular cases spontaneous demagnetization during the process of thermomagnetization may reduce the magnetic intensity at the center of a body to zero. For some bodies having a sufficiently high magnetic susceptibility at the Curie temperature, the direction of thermoremanent magnetization may be explained by the contemporaneous geomagnetic field.—*D. B. V., S. T. V.*

171–261. Griffiths, D. H., King, R. F., and Wright, A. E. Some field and laboratory studies of the depositional remanence of recent sediments: Advances in Physics, v. 6, no. 23, p. 306–316, 1957.

Previously described experiments (see Geophys. Abs. 166–278) indicate that sediments deposited in still water on a horizontal surface had a remanence in the magnetic meridian but at a shallower inclination than that of the ambient. The difference is referred to as the "inclination error". Deposition on a sloping surface results in a rotation of the remanence vector in the direction that would be expected if the magnetic particles were rolling slightly down the slope. Experiments on the effect of deposition in moving water indicate there are large deviations of the remanence in currents of only a few centimeters per second. No satisfactory theory to explain inclination and bedding errors is yet possible although it is believed that the theory based on deposition by the settling of flat particles and rolling of round particles into equilibrium positions is essentially correct.—*M. C. R.*

171–262. Doell, Richard R. Crystallization magentization: Advances in Physics, v. 6, no. 23, p. 327–332, 1957.

The mean directions of magnetization of samples of "blue" sandstones of uppermost Miocene age from three areas near San Francisco, Calif. are all close to that of the present earth's field, although the sandstones are flat lying in only one of the three areas. A general correlation between intensity of magnetization and grain size and degree of cementation indicates the magnetization

is associated with later authigenic processes. This hypothesis is supported by the results of experimental heating of samples in which magnetization was induced. The natural remanent magnetization is believed due to the dark rim on the clay coating the grains and is, therefore, the result of a low temperature deposition of magnetic minerals after the formation of the sediments and unrelated to magnetization of the detrital grains. To distinguish this magnetization from isothermal remanent magnetization or thermoremanent magnetization, the term crystallization magnetization is proposed.—*M. C. R.*

171–263. Vogelsang, Dieter. Beziehungen zwischen der umgekehrten Eigenmagnetisierung und dem Gefüge von Eruptivgesteinskörpen [Relations between the reverse magnetization and the fabrics of igneous rock bodies]: Hesse Landesamt für Bodenforschung Notizbl., Band 85, p. 390–419, 1957.

Mapping of basalt dikes in the Werra region (both below and above ground), the Rossberg stock near Darmstadt, and five of the Siebengebirge sub-volcanoes near Bonn, all Miocene in age, included measurement of flow banding, axes of basalt columns, and other macroscopic structural elements; the horizontal and vertical magnetic intensity were also surveyed with an Askania field balance. Comparison of the geologic and geomagnetic data shows that the fabrics of all the inversely magnetized bodies have been affected by reheating (either by post-volcanic gaseous exhalations or by renewed intrusion of molten material), whereas the normally magnetized bodies have obviously gone through only one phase in their genesis.—*D. B. V.*

171–264. Quiring, Heinrich. Kontinentendrift und Erdmagnetismus [Continental drift and geomagnetism]: Forschungen u. Fortschr., 31 Jahrg., Heft 7, p. 193–196, 1957.

A criticism of Blackett's thesis that geomagnetic evidence (paleomagnetism, westward drift) supports the theory of continental drift. Blackett's assertions are analyzed and his conclusions shown to be erroneous; whether or not continental drift takes place, the geomagnetic data cannot be used as evidence, for they either contradict it or can be explained otherwise, or are valid only for local movements up to about 30 to 40 km.—*D. B. V.*

171–265. Angenheister, G. [H.]. Der Gegenwärtige Stand der paläomagnetischen Forschung [The present state of paleomagnetic research]: Geol. Rundschau, Band 46, Heft 1, p. 87–99, 1957.

The origin of natural remanent magnetization of rocks and the difficulties of interpretation of paleomagnetic measurements are discussed. The methods used by different authors to determine the position of the poles in the geologic past are described. It is then suggested that these methods are based on assumptions whose correctness is difficult to demonstrate directly. The pole positions in the geologic past resulting from paleomagnetic measurements are given in a table (from Irving). The values in this table reflect only the present state [of knowledge] and will surely undergo a change in the future.—*Author's summary, D. B. V.*

171–266. DuBois, P. M., Irving, I., Opdyke, N. D., Runcorn, S. K[eith], and Banks, M. R. The geomagnetic field in Upper Triassic times in the United States: Nature, v. 180, no. 4596, p. 1186–1187, 1957.

Reasonable agreement is found among positions of the pole calculated from measurements made at Newcastle, Cambridge, and Canberra, Australia, of the magnetization of samples of rocks of Late Triassic age from four places in the United States. The axis of this dipole intersected the earth's surface in what are now central Siberia and southern South America. The equivalent pole based on measurements of the Keuper Marls in England is more than 20° southeast probably owing to post-Triassic continental drift.—*M. C. R.*

171–267. Crook, Keith A. W. A polarity reversal in the Tertiary volcanics of the Kurrajong-Bilpin District, with petrological notes: Royal Soc. New South Wales Jour. and Proc., v. 91, pt. 1, p. 57–65, 1957.

In the Kurrajong-Bilpin district, 50 miles northwest of Sydney, Australia, the Triassic sandstones and shales have been intruded by dikes, flows, and necks of alkali olivine basalt containing titanomagnetite. An anomaly of —2219 gammas is observed over the Merroo Neck. The reversal is apparently due to a reversal of the geomagnetic field although detailed laboratory studies are necessary for final judgment.—*V. S. N.*

171–268. Brynjólfsson, Ari. Studies of remanent magnetism and viscous magnetism in the basalts of Iceland: Advances in Physics, v. 6, no. 23, p. 247–254, 1957.

Four investigations are briefly described: (1) the construction of a portable induction instrument for measurement of the direction of magnetization in large samples; (2) a study of demagnetization in an alternating field (the results are explained by assuming that only two directions of easy magnetization exist in each grain) and viscous magnetism (which indicated that the diameter of the smallest domains is about 2×10^{-6} cm); (3) secular variation in Iceland during the last 5,000 years (a magnetic south pole in the neighborhood of the present geographic north pole is indicated); (4) a study of Tertiary basalts in which the direction of magnetization changes gradually from reversed to normal.—*M. C. R.*

171–269. Nagata, T[akesi], Akimoto, S[yun-iti], Uyeda, S[eiya], Shimizu, Y[asuo], Ozima, M., and Kobayashi, K. Palaeomagnetic study on a Quarternary volcanic region in Japan: Advances in Physics, v. 6, no. 23, p. 255–263, 1957.

Directions and intensities of the remanent magnetization of oriented rock samples from 58 localities in the North Izu and Hakone volcanic regions indicate the north magnetic pole shifted from 72° N., 86° E. to 81° N., 32° W. during the Quaternary and that a complete reversal of the magnetic field may have occurred during the earliest Quaternary during the middle period of the formation of Usami.—*M. C. R.*

171–270. Asami, Eizo. A palaeomagnetic consideration on the remanent magnetism of the basalt lavas at Kawajiri-misaki, Japan: Jour. Geomagnetism and Geoelectricity, v. 8, no. 4, p. 147–155, 1956.

Fairly continuous sampling from an area of one meter square of the outcrop of one block has confirmed that both normal and reverse remanent magnetization occur. Thermomagnetic analyses suggest that the normal magnetization is primarily due to titanomagnetite with an intermediate Curie point (370° C) and the reverse magnetization to phrases with Curie points at about 120° C and

560° C. Self-reversal following exsolution of polyphased titanomagnetite is a more probable explanation than reversal of the geomagnetic field.—*M. C. R.*

171–271. Armstrong, D. Dating of some minor intrusions of Ayrshire: Nature, v. 180, no. 4597, p. 1277, 1957.

Two groups of minor intrusions among the alkalic rocks of Ayrshire were originally classified together and thought to be differentiates of the same magma; later work suggests different origins. Directions of magnetization confirm the dual classification based on petrology and are consistent with the inferred Permian and Tertiary ages.—*M. C. R.*

171–272. Boer, J. C. den. Étude géologique et paléomagnétique des Montagnes du Coiron, Ardèche, France [Geologic and paleomagnetic study of the Montagnes du Coiron, Ardèche, France]: 64 p., Utrecht, Netherlands, Drukkerij Storm, 1957.

The fourth chapter of this thesis on the Coiron plateau is devoted to paleomagnetic observations on the basalts that form the plateau. By correlation of the "magnetic stratigraphy" of the Coiron flows with that worked out by Roche in Auvergne (see Geophys. Abs. 163–33), the age of the flows is found to range from upper Miocene to Pliocene-Pleistocene. This age fully agrees with the paleontologic, petrographic, and geomorphic evidence. Three periods of reverse magnetization (upper Miocene, middle Pliocene, and Pliocene-Pleistocene) and two of normal (lower and upper Pliocene) are indicated. The direction of magnetization varies so widely that calculation of a mean value is without significance. This diversity of orientation might be explained by further detailed physical and chemical study of numerous oriented specimens.—*D. B. V.*

171–273. Balsley, J. R., and Buddington, A. F. Remanent magnetism of the Russell belt of gneisses, northwest Adirondack Mountains, New York: Advances in Physics, v. 6, no. 23, p. 317–322, 1957.

A statistical study has been made of the magnetic properties and mineralogy of rocks from a belt of gneisses about 50 miles long and 5 miles wide which geologic evidence indicates has acted as a unit and which has undergone more or less homogeneous metamorphism. Remanent magnetism of rocks with magnetite as the major or predominant magnetic mineral is normal and shows a strong concentration at approximately 56° from the present field, almost exactly perpendicular to the lineation of the rocks in the vertical plane containing the lineation. In the rocks of reverse magnetism, the major, predominant, or exclusive portion of the oxide mineral assemblage is almost without exception a member of the Fe_2O_3–$FeO \cdot TiO_2$–(TiO_2) system. The direction of the reversed magnetism is almost random.—*M. C. R.*

MAGNETIC SURVEYS

171–274. Veshev, A. V., Meyer, V. A., Larionov, L. V., and Barkhatov, D. P. Karottazh magnitnoy vospriimchivosti v usloviyakh slabomagnitnykh porod [Magnetic susceptibility logging of the weakly magnetic formations]: Vses. nauchno-issled. inst. razved. geofiz. Voprosy rudnoy geofiz., Sbornik statey 1, p. 69–78, 1957.

Detailed description, with wiring diagrams, of a new very sensitive apparatus for the measurement of magnetic susceptibility of any stratum located at a given depth. The main element of this scheme is a Wheatstone bridge with two sides containing only ohmic resistance, two others having inductive resistance. All elements of the apparatus can be placed in the hole; the sensitivity is thus increased to the order of 5×10^{-6} cgs units. The results of several series of measurements are presented in graphs.—*S. T. V.*

171–275. Blinstrubas, S. Obzor metodov interpretatsii magnitnykh anomaliy [A review of the methods of interpretation of magnetic anomalies]: Lietuvos TSR Mokslų Akad., Geol. ir Geog. Inst., Moksliniai Pranešimai, tomas 2, Geofizika, p. 87–99, 1955.

Methods of interpretation are either indirect or direct. The most frequently used indirect method consists of comparison with some geometrically simple form that produces vertical and horizontal components similar to those observed. In more complicated cases these components can be measured on models. The favorable feature of this method is that it can be applied without knowledge of the magnetic state of the body; the drawback is the impossibility of proving the uniqueness of the solution. Direct methods include those of Gamburtsev, Kazamskiy, and B. A. Andreyev. In the method of Kazamskiy the measured curve of H is integrated twice and the Z-curve is integrated three times. Andreyev's method is based on the analytic continuation of the potential function upward and downward from the surface where its value is known. Andreyev's method necessitates very complicated computations and is applicable only to the bodies of infinite extension. Both of these procedures can produce great errors.—*S. T. V.*

171–276. Henderson, Roland G., and Zietz, Isidore. Graphical calculation of total-intensity anomalies of three-dimensional bodies: Geophysics, v. 22, no. 4, p. 887–904, 1957.

Calculation of the total-intensity anomaly of a three-dimensional body of arbitrary shape is greatly facilitated by the orthographic projection of a topographic map of the body onto a plane normal to the inducing field. The graphical integration is then effected by a modified Gassmann integration process. Applications to theoretical and laboratory models establish the relative accuracy of the method. Examples are given of applications to observed anomalies over two laccoliths, Round Butte and Square Butte, in Montana.—*Authors' abstract*

171–277. Blinstrubas, S. I. Naklonnyye plasty bol'shogo pogruzheniya i beskonechnogo prostiraniya, namagnichennyye po napravleniyu padeniya (Obratnaya zadacha magnetometrii) [Inclined strata of steep dip and infinite extent, magnetized in the direction of the dip (The inverse problem of magnetometry)]: Lietuvos TSR Mokslų Akad. Geol. ir Geog. Inst., Moksliniai, ser. B, no. 2, p. 51–60, 1957.

Simplified formulas are derived and several graphs constructed which make possible the solution of the inverse problem of magnetometry, illustrated by the example of the Saltykov maximum of the Kursk magnetic anomaly. In the solution of the direct problem the source of the anomalous magnetic field is assumed to be the plane of the magnetic poles, therefore in the inverse problem the position of the plane of the magnetic poles in space is determined, rather than the position of the layer. In a simple model (steel plate magnetized in the direction of the main axis) it is shown that the width of the plane of the

magnetic poles approximately coincide only in cases of parallelism; otherwise they differ. The satisfactory agreement of the results of the interpretation with borehole data proves the effectiveness of the proposed method. In addition it is possible to analyze and to show up the discrepancies between the computed values and the drilling results and thus to improve the methods of magnetic interpretation.—*Author's summary, S. T. V.*

171–278. Vyskočil, Vincenc. Určení rozhraní dvou prostředí z geomagnetických anomalií [The determination of the boundary between two media from geomagnetic anomalies]: Československé Akad. Věd Geofys. Ústav Práce, Geofys. Sborník, no. 32, p. 249–254, 1955.

Following the method suggested by Shwank and Lyustikh, Vyskočil derives a new formula—more convenient for computations—for the analytical determination of the boundary surface between two media of different magnetic properties, using the second derivatives of the magnetic potential. Only the two dimensional problem is discussed. The new formula can be applied when the depth of at least one point of the boundary surface is known, as well as the intensity and the direction of the vertical component of the magnetization of the masses separated by the boundary in question.—*S. T. V.*

171–279. Seedsman, K. R. Magnetic and gravity investigations at Curramulka: South Australia Dept. Mines Min. Rev., no. 103, p. 116–121, 1957.

Detailed vertical magnetic-force measurements and some reconnaissance gravity traverses were made of an anomaly, previously located by an aerial survey, just north of Curramulka on the Yorke Peninsula. The lower order of the magnetic anomalies compared to those recorded over rocks known to be low in iron content in other parts of Yorke Peninsula and depth considerations suggest that further work is not warranted.—*V. S. N.*

171–280. Pearson, W. J. An investigation into the geological significance of some magnetic anomalies in the Lac la Ronge area of northern Saskatchewan Dept. Mineral Resources Rept., no. 29, 52 p., 1957.

From a geologic investigation of four anomalies located by an airborne magnetometer and scintillation counter survey in 1953, it is evident that the anomalies are caused by pyrrhotite and magnetite minerals or by mafic and ultra-mafic intrusive bodies containing small amounts of these minerals.—*V. S. N.*

171–281. Krutikhovskaya, Z. A. Voprosy metodiki geofisicheskikh izzledovaniy s tsel'yu poiskov bogatykh rud Krivorozhskogo tipa [Certain questions on geophysical exploration methods for rich iron ores of the "Krivoy Rog" type]: Akad. Nauk Ukraynsk. SSR Inst. Geol. Nauk Trudy, ser. geofiz., vypusk 1, p. 75–87, 1956.

The first discoveries of iron ores in the Ukraine were made by the magnetic method. Later the gravimetric method was used and at present both the electrical and seismic methods are also used. Use of several methods makes it possible not only to establish the presence of iron bodies underground but also to delineate them and obtain some information on their mineralogic composition. There are two main kinds of ore in the region: one found near Krivoy Rog is very rich in iron and the other, which causes the same magnetic anomalies at the surface, contains a much smaller percentage of iron. Because of the thick

overburden, exploratory drilling to distinguish the two was prohibitively expensive. The results of several years of the exploratory geologic and geophysical work in the Ukraine indicate that deposits of the Krivoy Rog type are found in areas of strong magnetic field but in places where the intensity of the ΔZ vector drops from the absolute maximum, and not over the greatest values of ΔZ. For example, in the region of the Kremenchng magnetic anomaly, where the intensity of the magnetic field dropped from 15,000 to 18,000 gammas to 2,000 to 3,000 gammas, subsequent drilling confirmed the presence of rich martite-, martite-hydrohematite and hydrohematite ores. The slight local decrease of ΔZ must be combined with a constant high intensity gravity anomaly. In places where the ΔZ intensity was as high as 140,000 gammas but where the density did not show local positive anomalies, no deposits of Fe_2O_3 were found.—*S. T. V.*

171–282. Balsley, J. R., Blanchett, J., Kirby, J. R., and others. Aeromagnetic maps of Maine: U. S. Geol. Survey Geophys. Inv. Map GP 154 and 155, 1957.

Aeromagnetic maps which show by contour lines the total intensity at about 500 feet above ground level have been published for the following: 154, Jo-Mary Mountain area, Piscataquis and Penobscot Counties; and 155, Harrington Lake quadrangle, Piscataquis County.—*W. L. G.*

171–283. Meuschke, J. L., Books, K. G., Henderson, J. R., and Schwartz, G. M. Aeromagnetic and geologic maps of Minnesota: U. S. Geol. Survey Geophys. Inv. Map GP 128–134, 1957.

Aeromagnetic and geologic maps which show by contour lines the total intensity at about 1,000 feet above ground level have been published for the following counties: 128, northern Lake of the Woods and northeastern Roseau; 129, northern Beltrami and southern Lake of the Woods; 130, north-central Beltrami and northeastern Clearwater; 131, northwestern Koochiching; 132, southwestern Koochiching; 133, northeastern Koochiching; and 134, southeastern Koochiching.—*W. L. G.*

171–284. Balsley, J. R., Gilbert, F. P., Mangan, G. B., and others. Aeromagnetic maps of Montana: U. S. Geol. Survey Geophys. Inv. Map GP 150–153, 1957.

Aeromagnetic maps which show by contour lines the total intensity at about 1,000 feet above ground level have been published for the following: 150, Laredo quadrangle, Bearpaw Mountains; 151, Shambo quadrangle, Bearpaw Mountains; 152, part of the Centennial Mountain quadrangle, Bearpaw Mountains; and 153, Warrick quadrangle.—*W. L. G.*

171–285. Bromery, R. W., Kirby, J. R., Vargo, J. L., and others. Aeromagnetic maps of New Hampshire: U. S. Geol. Survey Geophys. Inv. Map GP 138 and 139, 1957.

Aeromagnetic maps which show by contour lines the total intensity at about 1,000 feet above ground level have been published for the following: 138, Umbagog Lake and vicinity, and 139, Berlin and vicinity.—*W. L. G.*

171–286. Henderson, J. R., and others. Aeromagnetic maps of New Jersey and New York: U. S. Geol. Survey Geophys. Inv. Map GP 157–173, 1957.

Aeromagnetic maps which show by contour lines the total intensity at about 500 feet above ground level have been published for the following quadrangles: in New York: 157, Warwick, Orange County; in New Jersey: 158, part of Hamburg, Sussex County; 161, Newton, Sussex County; 162, Franklin, Sussex and Morris Counties; 163, Newfoundland, Passaic, Morris and Sussex Counties; 164, Wanaque, Passaic County; 165, Stanhope, Sussex and Morris Counties; 166, Dover, Morris County; 167, Boonton, Morris County; 168, Pompton Plains, Morris, Passaic, and Essex Counties; 169, Chester, Morris County; 170, Mendham, Morris County; 171, Morristown, Morris County; 172, Caldwell, Essex and Morris Counties; and 173, Gladstone, Somerset, Morris, and Hunterdon Counties; and in New York and New Jersey: 159, Wawayanda and part of Pine Island, Sussex and Passaic Counties; and 160, Greenwood Lake, Passaic and Orange Counties.—*W. L. G.*

171–287. Canada Geological Survey. Aeromagnetic maps of the Province of Alberta: Dept. Mines and Tech. Surveys, Geophysics Papers 333, 338, 351, 407–422, 437–460, 462–467, 469–493, 499–502, and 588–591, 1957.

Aeromagnetic maps which show by contour lines the total magnetic intensity at about 1,000 feet above ground level have been published for the following quadrangles: west of fifth meridian: 333, Willow River; 338, Mistehae Lake; and 351, Godin Lake; and the following quadrangles west of fourth meridian: 407, Boiler Rapids; 408, Buffalo Creek; 409, Kerchief Lake; 410, Woodenhouse River; 411, Edwin Creek; 412, Campbell Lake; 413, McMurray; 414, Crooked Rapids; 415, Seaforth Creek; 416, Chipewyan Lake; 417, Dunkirk River; 418, MacKay River; 419, Ruth Lake; 420, Clarke Creek; 421, Steepbank River; 422, Sutton Creek; 437, High Hill River; 438, Shillelagh Lake; 439, Muskeg River; 440, Fort MacKay; 441, Upper Dover River; 442, Snipe Creek; 443, Osi Creek; 444, Osi Lake; 445, Bitumount; 446, McClelland Lake; 447, Firebag River; 448, Trout Creek; 449, Burnt Lakes; 450, Mikkiwa River; 451, Namur Lake; 452 Joslyn Creek; 453, Tar River; 454, Gardiner Lake; 455, Bergeron Creek; 456, Upper Mikkwa River; 457, Raymond Creek; 458, Bolton Creek; 459, Louise River; 460, Eaglenest Lake; 462, Marguerite River; 463, Reid Creek; 464, Coffey Lake; 465, Eymundson Creek; 466, Ronald Lake; 467, Pearson Lake; 469, Robert Creek; 470, Warspite; 471, Thorhild; 472, Westlock; 473, Dapp; 474, Perryvale; 475, Newbrook; 476, Bondiss; 477, Athabasca; 478, Coalidge; 479, Grosmont; 480, Sawdy; 481, Vincent Lake; 482, Cache Lake; 483, Goodfish Lake; 484, Maloy; 485, Pinehurst Lake; 486, Beaver Lake; 487, Lac La Biche; 488, Touchwood Lake; 489, Smoky Lake; 490, Victor Lake; 491, Hylo; 492, Horse Lake; 493, Pine Creek; 499, Reita Lake; 500, Cold Lake; 501, Marie Lake; 502, Medley River; 588, Muriel Lake; 589, Bonnyville; 590, Marguerite Lake; and 591, Wolf River.—*W. L. G.*

171–288. Canada Geological Survey. Aeromagnetic maps of the Province of Manitoba: Dept. Mines and Tech. Surveys, Geophysics Papers 628–645, 1957.

Aeromagnetic maps which show by contour lines the total magnetic intensity at about 1,000 feet above ground level have been published for the following quadrangles: 628, Nichol Lake; 629, Lovat Lake; 630, Wither Lake; 631, Meades Lake; 632, Quinn Lake; 633, Steel River; 634, Knights Hill; 635, Cape Churchill; 636, Eppler Lake; 637, Howard Lake; 638, Knife Delta; 639, Churchill; 640, Button Bay; 641, Nowell Lake; 642, Langille Creek; 643, Duddles Lake; 644, White Whale River; and 645, Norton Lake.—*W. L. G.*

171–289. Canada Geological Survey. Aeromagnetic maps of the Province of New Brunswick: Dept. Mines and Tech. Surveys, Geophysics Papers 592–600, 1957.

Aeromagnetic maps which show by contour lines the total magnetic intensity at about 1,000 feet above ground level have been published for the following quadrangles: 592, Musguash (Saint John, Charlotte, and Kings Counties); 593, McDougall Lake (Charlotte, Queens and Sunbury Counties); 594, Rolling Dam (Charlotte County); 595, St. Stephen (Charlotte County); 596, St. George (Charlotte County); 597, Codys (Queens and Kings Counties); 598, Sussex (Kings and Queens Counties); 599, Hampstead (Queens, Kings, and Sunbury Counties); and 600, Saint John (Charlotte, Queens, Kings, and Saint John Counties).—*W. L. G.*

171–290. Canada Geological Survey. Aeromagnetic maps of the Province of Newfoundland: Dept. Mines and Tech. Surveys, Geophysics Paper 206, 1957.

An aeromagnetic map which shows by contour lines the total magnetic intensity at about 1,000 feet above ground has been published for the Dashwoods Pond quadrangle.—*W. L. G.*

171–291. Canada Geological Survey. Aeromagnetic maps of Northwest Territory: Dept. Mines and Tech. Surveys, Geophysics Papers 402 and 403, 1957.

Aeromagnetic maps which show by contour lines the total magnetic intensity at about 1,000 feet above ground level have been published for the following quadrangles in the District of Mackenzie: 402, Stephenson Lake, and 403, Rauta Lake.—*W. L. G.*

171–292. Canada Geological Survey. Aeromagnetic maps of the Province of Nova Scotia: Dept. Mines and Tech. Surveys, Geophysics Papers 601–619, 1957.

Aeromagnetic maps which show by contour lines the total magnetic intensity at about 1,000 feet above ground level have been published for the following quadrangles: 601, Yarmouth (Yarmouth County); 602, Comeau Hill (Yarmouth County); 603, Lockeport (Shelburne County); 604, Cape Sable Island; 605, Pubnico (Yarmouth and Shelburne Counties); 606, Tusket (Yarmouth and Shelburne Counties); 607, Baccaro (Shelburne County); 608, Shelburne (Shelburne and Queens Counties); 609, Port Mouton (Queens and Shelburne Counties); 610, Meteghan (Digby and Yarmouth Counties); 611, Church Point (Digby County); 612, La Have Islands (Lunenburg County); 613, Liverpool (Queens and Lunenburg Counties); 614, Lake Rossignol (Queens, Shelburne, Yarmouth, and Digby Counties); 615, Wentworth Lake (Digby, Yarmouth and Shelburne Counties); 616, Weymouth (Digby and Annapolis Counties); 617, Kejimkujik Lake (Annapolis, Queens, and Digby Counties); 618, Bridgewater (Lunenburg and Queens Counties); and 619, Lunenburg (Lunenburg County).—*W. L. G.*

171–293. Canada Geological Survey. Aeromagnetic maps of the Province of Ontario: Dept. Mines and Tech. Surveys, Geophysics Papers 14–16, 279, 280, 285, 286, 504–512, 514, 515, and 551, 1957.

Aeromagnetic maps which show by contour lines the total magnetic intensity at about 500 feet above ground level have been published for the following

quadrangles: 14, Brannockburn (Hastings and Petersborough Counties); 15, Bancroft (Hastings, Renfrew, Lennox and Addington Counties); 16, Coe Hill (Hastings, Petersborough and Haliburton Counties); 279, Thorlake (Sudbury District); 280, Opikimika Lake (Sudbury and Timiskaming Districts); 285, Shining Tree (Sudbury and Timiskaming Districts); 286, Sinclair Lake (Sudbury and Timiskaming Districts); 504, Milnet (Sudbury District); 505, Lake Timagami (Nipissing and Sudbury Districts); 506, Marten Lake (Nipissing District); 507, Ingall Lake (Nipissing District); 508, Ottertail Creek (Nipissing District); 509, Fabre (Temiscamingue County and Timiskaming and Nipissing Districts—Quebec and Ontario); 510, Timagami (Nipissing and Timiskaming Districts); 511, Cobalt (Timiskaming District and Temiscamingue County—Quebec and Ontario); 512, Villi-Marie (Timiskaming District and Temiscamingue County—Quebec and Ontario); 514, Earlton (Timiskaming District and Temiscamingue County—Quebec and Ontario); 515, Englehart (Timiskaming District and Temiscamingue County—Quebec and Ontario); and 551, Venetian Lake (Sudbury District.)—*W. L. G.*

171–294. Canada Geological Survey. Aeromagnetic maps of the Province of Quebec: Dept. Mines and Tech. Surveys, Geophysics Papers, 509, 511–542, and 544–549, 1957.

Aeromagnetic maps which show by contour lines the total magnetic intensity at about 500 feet above ground level have been published for the following quadrangles: 509, Fabre (Temiscamingue County and Timiskaming and Nipissing Districts—Quebec and Ontario); in Timiskaming District and Temiscamingue County—Quebec and Ontario: 511, Cobalt; 512, Villi-Marie; 514, Earlton; and 515, Englehart; in Temiscamingue County: 512, Angliers; and 516, Lac Barriere; in Abitibi County: 517, Opawica Lake-Lewis Lake; 518, Michwacho Lake; 519, Opemisca Lake; 520, Miller Creek; 522, Adam River; 524, Lac Quevillon; 525, Riviere Coigny; 528, Lac Madeleine; 529, Puskitamika; 530, Waswanipi; 536, Maicasagi Lake; 537, McDonald Lake; 539, Lac A L'eau-Jaune; 540, Dickson Lake; 541, Lac Inconnu; in Abitibi Territory: 521, Kistabiche Creek; 523, Riviere Subercase; 526, Indian River; 527, Canica Island; 532, Opaoca River; 533, Riviere Allard; 534, MacIvor River; 535, Olga Lake; and 531, Ramsay Bay; in Abitibi and Lac St. Jean West Counties: 538, Lac Boisvert; 542, Chibougamau; and 544, Riviere De L'Epervier; 545, Canoe Lake (Mistassini and Abitibi Territories and Lac St. Jean West and Abitibi Counties); 546, Mistassini Post (Mistassini Territory and Lac St. Jean West Counties); 547, Waconichi Lake (Abitibi and Mistassini Territories and Abitibi County); 548, Crinkle Creek (Abitibi Territory and Abitibi County); and 549, Lac Damas (Abitibi Territory and Abitibi County).—*W. L. G.*

171–295. Canada Geological Survey. Aeromagnetic maps of the Province of Saskatchewan: Dept. Mines and Tech. Surveys, Geophysical Papers 305–307, 319–324, 494–496, 543, and 552–587, 1957.

Aeromagnetic maps which show by contour lines the total magnetic intensity at about 1,000 feet above ground level have been published for the following quadrangles west of third meridian: 305, Watapi Lake; 306, Nipin Lake; 307, McCuskes Lake; 319, Niska Lake; 320, Vermette Lake; 321, McAlister Lake; 322, Graham Lake; 323, Michel; 324, Dillon; 494, Apps Lake; 495, Kazan Lake; 496, Buffalo Narrows; 543, Deep Bay; 552, Canoe Lake; 553, Juggins Creek;

554, Carlton Lake; 555, Calder River; 556, Primrose Lake; 557, Kesatasew Lake; 588, Lost Lake; 599, Keeley Lake; 560, Lac La-Plonge; 561, La-Plonge; 562, Ile-A-La-Crosse; 563, Cinder Lake; 564, Alstead Lake; 565, Abitau Lake; 566, Shagwenaw Lake; 567, Dipper Lake; 568, Dore Lake South; 569, Aubichon Lake; 570, Durocher Lake; 571, Dore Lake North; 572, Waterhen Lake; 573, Flotten Lake; 574, Muskeg Lake; 575, Cold River; 576, Taggart Lake; 577, Green Lake South; 578, Green Lake North; 579, Sled Lake; 580, Meadow Lake; 581, Rapid View; 582, Makwa Lake; 583, Ministikwan Lake; 584, Pierceland; 585, Goodsoil; 586, Dorintosh; and 587, Island Hill.—*W. L. G.*

171–296. Gräbe, R., and Lehmann, M. Geomagnetische Kartierung eines Diabasganges bei Schönbrunn Thür [Geomagnetic mapping of a diabase dike near Schönbrunn, Thuringia]: Zeitschr. angew. Geologie, Band 3, Heft 7, p. 313–314, 1957.

A hydrographically important diabase dike in Schönbrunn, Germany, was traced by a magnetic survey for a distance of 2,100 m. The generally steep dip was reflected in the anomalies. Correspondence of the magnetic map with the geologically mapped portion of the dike (about 600 m and an isolated railway cut) was good; most of the dike was revealed only by the magnetic survey.—*D. B. V.*

MICROSEISMS

171–297. Kanai, Kiyoshi; Tanaka, Teiji; and Osada, Kaio. Measurement of the micro-tremor. II. (Tokyo Metropolis): Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 1, p. 109–133, 1957.

Kanai, Kiyoshi; Tanaka, Teiji; and Osada, Kaio. Measurement of the micro-tremor. III. (Yokohama City): ibid., p. 135–148, 1957.

Kanai, Kiyoshi; Nasu, Nobuji; Tanaka, Teiji; and Osada, Kaio. Measurement of the micro-tremor. IV. (Sakata and Tsuruoka): ibid., p. 149–162, 1957.

Kanai, Kiyoshi; Kawasumi, Hirosi; Tanaka, Teiji; and Osada, Kaio. Measurement of the micro-tremor. V. (Osaka City): ibid., p. 163–180, 1957.

Kanai, Kiyoshi; Tanaka, Teiji; Morishita, Tosizo; and Nakagawa, Kyoji. Measurement of the micro-tremor. VI. (Ichinomiya City, Aichi Prefecture): ibid., p. 181–190, 1957.

Kanai, Kiyoshi; Tanaka, Teiji; and Osada, Kaio. Measurement of the micro-tremor. VII. (Kawasaki City): ibid., p. 191–200, 1957.

The distribution of periods of micro-tremor (continuous vibration of the ground) shows a definite form for different kinds of subsoils. The properties of the ground as inferred from the characteristics of micro-tremor are utilized for the determination of the foundation coefficients relating to earthquake-proof construction. These papers (all in Japanese with English summaries) are part of a series of investigations of micro-tremor, and present the results of systematic measurements made at various places in the great earthquake districts of Japan.

As in the first paper (see Geophys. Abs. 164–251) it is found that the predominant, mean, and maximum periods of micro-tremor differ slightly according to time and depend greatly on vibrational characteristics of the subsoil. The maximum amplitude in the daytime is 2 to 10 times greater than at night because amplitudes depend greatly on artificial vibration sources surrounding the place of measurement. Furthermore there is found to be a close relation of predominant period of earthquake motion and the distribution curve of micro-

tremor periods; when the latter has a single peak it coincides with the former, and when there are two peaks one of them coincides. The wave form of micro-tremor is determined not only by the thickness of the alluvium but also by the physical condition of each layer. For bed rock the distribution curve of periods of micro-tremor is flat; thus amplitudes of vibration at the surface become relatively large at such periods as are synchronous with the natural period of the stratum from selective resonance. The predominant period of micro-tremors is in many cases influenced by the properties of the first layer. All the properties between the free surface and bed rock seem to play an important part in deciding the maximum period.—*D. B. V.*

171–298. Akamatu, Kei. Tomoda's method for calculating the correlation coefficients as applied to micro-tremor analysis: Jour. Physics of the Earth, v. 4, no. 2, p. 81–83, 1956.

Tomoda's method for calculating the correlation coefficients (Geophys. Abs. 171–148) has been applied to micro-tremor analysis and it is shown that the method can safely be used for the purpose if the sample size is larger than about 300.—*M. C. R.*

RADIOACTIVITY

171–299. Cherdyntsev, V. V. O postoyanstve universal'nykh mirovykh konstant [On the invariability of universal world constants]: Akad. Nauk SSSR Komiss. opredel. absolyut. vozrasta geol. formatsiy Byull., vypusk 2, p. 35–37, 1957.

The closeness of the results of determinations by different radioactive methods of the age of very old parts of the earth's crust, besides confirming the authenticity of the basis of radioactive analysis, is evidence of a great invariability of universal world constants. The ±5 percent accuracy of determinations on Archean minerals indicates that Planck's constant and the elementary charge vary by no more than 3×10^{-4} of their value in one billion years. For the mass of α-particles and radius of nuclear forces, the limit is twice as great.—*D. B. V.*

171–300. Isräel, Hans. Das natürlich-radioaktive Milieu unserer Umwelt [The naturally radioactive environment of the world around us]: Naturw. Rundschau, Jahrg. 10, Heft 7, p. 249–252, 1957.

A review of the radioactivity cycles of the ground and atmosphere. The total radioactive charge in the air near the ground is about 10^{-15} curie per cm^3 from α particles and 5×10^{-16} curie per cm^3 from β-particles and γ-rays. Over oceans and ice-covered regions the total radioactivity is about one percent of this.—*D. B. V.*

171–301. Riezler, W., and Kauw, G. Natürliche Radioaktivität von Cer 142 [Natural radioactivity of Ce^{142}]: Zeitschr. Naturforschung, Band 12a, Heft 8, p. 665–666, 1957.

The cerium-142 isotope has been isolated from cerium-140 and its radioactivity measured by means of nuclear emulsion plates. The average length of α-tracks is 4.7 μ, corresponding to an energy of 1.5 mev. A decay constant of 1.47×10^{-20} yrs and a half life of 5.1×10^{19} yrs are calculated.—*D. B. V.*

171–302. Huster, E. A redetermination of the half-life of ^{87}Rb: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 195–202, 1956.

A redetermination of the half-life of rubidium, using RbCl evaporated onto thin aluminum foils laid inside a counter, confirms the measurements of Kemmerich and indicates a half-life of 4.0 to 4.45×10^{10} yrs, depending on the correction for backscattering.—*M. C. R.*

171–303. Senftle, F. E. Half-life of Th^{232} and branching ratio of Bi^{212}: *in* Nuclear processes in geologic settings, Natl. Acad. Sci.—Natl. Research Council Pub. 400, p. 187–194, 1956.

Two different methods have been used to redetermine the half-life of thorium-232; one physical, the other radiochemical. The physical method consists of measuring the specific gamma activity of thallium-208, one of the daughter products of thorium-232. A preliminary value of 1.54×10^{-18} sec for the decay constant (or half-life of 1.42×10^{10} yrs) is obtained in this way. The radiochemical method yields a decay constant of 1.43×10^{-18} sec (or half-life of 1.54×10^{10} yrs). (See also Geophys. Abs. 168–258.)—*M. C. R.*

171–304. Rona, Elizabeth. A method of determine the isotopic ratio of thorium^{232} to thorium^{230} in minerals: Am. Geophys. Union Trans., v. 38, no. 5, p. 754–759, 1957.

Thorium isotopes are first separated from other elements in the mineral, the sample is then subjected to bombardment of slow neutrons, the β activity of the thorium-233 produced from thorium-232 by the (n, γ) reaction and the α activity of the naturally radioactive thorium-230 are determined and compared with those of a standard sample, and the thorium-232 to thorium-230 ratio calculated. Ratios are reported for eleven minerals.—*M. C. R.*

171–305. Hurley, Patrick M., and Fairbairn, Harold W. Abundance and distribution of uranium and thorium in zircon, sphene, apatite, epidote, and monazite in granitic rocks: Am. Geophys. Union Trans., v. 38, no. 6, p. 939–944, 1957.

Uranium and thorium contents in different minerals are listed in seven tables. The average ratio of thorium to uranium in accessory zircon is 0.4; in pegmatite zircon 1.0; in accessory apatite 1.3; in pegmatite apatite 10; in accessory sphene 1.7; in monazite about 25; and in epidote 1.8. The data are presented without conclusions because the distribution ratios have shown enough variability that it is not possible to say how closely the observed and calculated average ratios may be to the true partition values.—*M. C. R.*

171–306. Sinitsyna, Z. L. Ob opredelenii malykh kolichestv radona i torona v ikh smesi [On the determination of small amounts of radon and thoron in mixtures of them]: Akad. Nauk SSSR Izv. Ser. geofiz., no. 7, p. 950–953, 1957.

Formulas are derived by means of which small amounts of radon and thoron mixed in soil air can be determined individually, with some accuracy, from two readings (for instance, one minute apart) of overall ionization current in an ionization chamber. First the initial ionization current produced by each is calculated from the two readings, then the concentration of each is calculated from this information. Because of the statistical nature of radioactive decay, possible error is inversely proportional to the concentration of the gas under investigation.—*D. B. V.*

171–307. Reiter, Reinhold. Schwankungen der Konzentration und des Verhältnisses der Radon- und Thoronabkömmlinge in der Luft mach Messungen in den Nordalpen [Variations in concentration and ratios of radon and thoron derivatives in the air according to measurements in the northern Alps] : Zeitschr. Naturforschung, Band 12a, Heft 9, p. 720–731, 1957.

A total of 672 measurements of natural radioactivity of the air were made from April 1956 to April 1957 in the north-south trending Loisach valley in the northern Alps. Radioactivity was found to be higher when upper air currents were from the south, regardless of season. Local winds in the valley have no systematic effect. The effect of snow and ice cover on the amount of thoron derivatives is great. The ratio of radon-series products to thoron-series products corresponds in summer to the uranium : thorum ratio in the region from which the upper air currents blow. Wind velocity and relative humidity have no effect on mean values of radioactivity of the air. Radioactivity increases with decrease in pressure, owing not to increased exhalation from the ground but to simultaneous veering of the high winds to the southerly direction. The activation and filtration method, both of which were used in these measurements, are compared. The effect of variation of the natural radioactivity of the atmosphere on ionization at 700 to 3,000 m altitude is discussed, on the basis of records of atmospheric electricity at 7 stations during 8 months; when radioactivity is below average (500 to 1,000 impulses per minute), the electric field intensity increases at all stations and conductivity decreases; when radioactivity is average (1,000 to 1,500 impulses per minute), the potential values fluctuate unsystematically around the mean; but when radioactivity is above average the field strength at all stations is distinctly to strongly reduced and conductivity correspondingly increased.—*D. B. V.*

171–308. Jurain, Georges. Remarques sur la teneur en uranium des eaux des Vosges méridionales [Remarks on the uranium content of the waters of the southern Vosges] : Acad. Sci. Paris Comptes Rendus, tome 245, no. 13, p. 1071–1074, 1957.

The curve representing the distribution of uranium in 170 hot and cold spring waters of the southern Vosges, France, is a characteristic logarithmal curve with a maximum at 0.8 micrograms per liter; content above 2.4 micrograms per liter suggests genetically different conditions. Nearly all the cold waters give results close to these figures. Certain thermal waters (including those of Luxeuil and Reherry) and some cold waters have about 4 micrograms per liter and hot springs of Bains-les-Bains average 7 micrograms per liter. Comparison with radon measurements made between 1900 and 1923 on some of these waters shows little correlation between radon and uranium content.—*D. B. V.*

171–309. Bates, Thomas F., and Strahl, Erwin O. Mineralogy, petrography, and radioactivity of representative samples of Chattanooga Shale: Geol. Soc. America Bull., v. 68, no. 10, p. 1305–1314, 1957.

Alpha-tracks obtained from emulsion-covered thin sections of Chattanooga shale are not sufficiently concentrated at any spot to indicate the presence of a uranium mineral. Approximately 70 percent of the uranium atoms are randomly distributed throughout the fine-grained matrix; another 25 percent is concentrated in organic-pyrite-clay complexes such as nodules and discrete organic bodies. In unweathered samples there is no relation between uranium

distribution and textural features such as bedding. The uranium was precipitated from sea water under reducing conditions and has not been redistributed following compaction of the sediment, except along joint planes and weathered surfaces.—*D. B. V.*

171–310. Sastry, A. V. R., and Mahadevan, C. Radioactivity of sea-floor sediments off Visakhapatnam: Jour. Sci. Indus. Research (India), v. 16B, no. 10, p. 429–431, 1957.

Measurements on 30 representative sea-floor sediments off Visakhapatnam on the Bay of Bengal (India) show an inverse relation between carbonate content and radioactivity. Radioactivity ranges from a minimum of 2.80×10^{-6} g eU per g to a maximum of 15.88×10^{-6}; carbonate content ranges from 77.3 percent to less than 0.5. Five zones of sedimentation are indicated, corresponding fairly well with those established earlier by Mahadevan and Rao.—*D. B. V.*

RADIOACTIVITY LOGGING AND SURVEYING

171–311. Baker, P. E. Neutron capture gamma-ray spectra of earth formations: Jour. Petroleum Technology, v. 9, no. 3, Transactions section, p. 97–101, 1957.

Neutron capture gamma-ray spectra were obtained under simulated borehole conditions for artificial formations of sand and fresh water, sand and salt water, limestone and fresh water, dolomite and fresh water, and synthetic anhydrite and water. Qualitative analysis for hydrogen, chlorine, calcium, silicon, sulfur and magnesium was possible. The various formations could be identified by their neutron capture gamma-ray spectra. These spectra were obtained under open-hole type conditions, with a polonium-beryllium neutron source and a scintillation spectrometer. The success of these experiments demonstrates that the same type of spectral information could be obtained in a well.

Spectra taken in different hole sizes showed that the effect of drilling fluid is negligible and that spectra can be taken in holes at least 10 inches in diameter. Comparison of the sand-fresh water and sand-salt water curves indicated that the spectra can be used to obtain information on the salinity of formation water, or related information such as the elevation of an oil-salt water interface.—*Author's conclusions*

171–312. Youmans, Arthur, and Monaghan, Ralph. Stability requirements for scintillation counters used in radioactivity logging: Jour. Petroleum Technology, v. 9, no. 8, Transactions section, p. 231–234, 1957.

A discussion of the possible causes of instability in counters and methods of minimizing them.—*M. C. R.*

171–313. Muench, N. L., and Osoba, J. S. Identification of earth materials by induced gamma-ray spectral analysis: Jour. Petroleum Technology, v. 9, no. 3, Transactions section, p. 89–92, 1957.

Various earth materials were subjected to bombardment by neutrons from a polonium-beryllium source in laboratory experiments, and the spectra of the resultant gamma radiation were analyzed. The geometry of the laboratory system was designed to simulate drill hole conditions. The laboratory work demonstrated that some elements such as chlorine and sulfur can be identified rather easily and also can be determined quantitatively. Use of a more intense source of more energetic neutrons may lead to the identification and measurement of additional elements.—*M. C. R.*

171–314. Grosmangin, Michel, and Walker, Edward B. Gas detection by dual-spacing neutron logs in the Greater Oficina area, Venezuela: Jour. Petroleum Technology, v. 9, no. 5, Transactions section, p. 140–147, 1957.

Rapid and accurate detection of gas from well logs is made possible by running a second neutron log with a larger source-to-detector spacing. The log is calibrated so the two logs have the same deflection in shale and in a known water or oil sand. Under such conditions gas is indicated by a positive separation.—*M. C. R.*

171–315. Mercier, V. J., and Redford, W. H. New calibration and conversion techniques for radioactivity logs: Jour. Petroleum Technology, v. 28, no. 9, p. 11–15, 1957.

By use of newly developed gamma-ray calibrators and neutron calibrators, logs can be expressed in terms of radiation units (gamma-ray logs) or environment units (neutron logs). Neutron curve conversion charts provide a means of comparing neutron curve responses obtained under various borehole conditions or with various types of instruments at various source spacings. By use of the neutron curve conversion charts, a measurement of a property of the surrounding rock material that is independent of the instrument or borehole characteristics can be obtained. This property, termed the well strata index, numerically corresponds closely to liquid-filled porosity in pure calcium carbonate or other similarly non-hydrogenous rock matrix materials.—*M. C. R.*

171–316. Baker, P. E. Density logging with gamma rays: Jour. Petroleum Technology, v. 9, no. 10, p. 289–294, 1957.

An improved method of logging formation density has been developed in which the formation is bombarded with a collemated beam of gamma rays. By means of a scintillation detector and pulse height discriminator, the gamma-ray energy band is accepted and recorded which corresponds to deepest penetration into the formation. Laboratory tests on a field tool revealed no borehole diameter effect for smooth holes and no effect of formation chemistry, except insofar as chemistry affects density. In extensive field tests, the density log has exhibited satisfactory agreement with core measurements and has correlated accurately with other logs.—*Author's abstract.*

171–317. Rabe, C. L. A relation between gamma radiation and permeability, Denver-Julesburg basin: Jour. Petroleum Technology, v. 9, no. 2, p. 65–67, 1957.

A qualitative relation has been found between gamma radiation and clay-bonded Muddy and Dakota sands of the Denver-Julesburg basin. To make use of the relation, surveys must be adjusted to a common scale and corrections must be made for thin bed effects.—*M. C. R.*

171–318. Kucharenko (Kukharenko), N. K., Schimelewitsch, S. J. (Shimelevich, Yu. S.), Bespalov, D. F. B. (Bespalov, D. F.), and Odinokow, W. A. (Odinokov, V. A.). Ein neues geophysikalisches Verfahren zur Festellung erdöl- und wasserführender Schichten und zur Bestimmung der Erdöl-Wasser-Grenze in verrohrten Bohrungen [A new geophysical method of locating oil-bearing and water-bearing strata

and of determining the contact between water and oil in cased oil wells] : Zeitschr. angew. Geologie, Band 3, Heft 5/6, p. 245–249, 1957.

A German version of a paper originally published in Neftyanoye Khozyaystvo, no. 3, p. 43–49, 1956 (see Geophys. Abs. 166–320).—*D. B. V.*

171–319. Wendt, Immo, and Wolters, Richard. Eine weitere Methode zur Bestimmung des Raumgewichtes von Böden durch Gammastrahlen [An additional method of determining the bulk density of soils by means of gamma rays] : Geol. Jahrb., Band 72, p. 73–83, 1956 (1957).

A method of determining bulk density of soils in place by means of gamma radiation is investigated. Counting tube and source, shielded from one another by lead, are placed in a steel tube 22 cm in diameter which is introduced to the desired depth in the ground. The effect of various factors other than density on counting rate is found to limit the accuracy by no more than ±2 percent.—*D. B. V.*

171–320. Webb, J. E. Radiometric probings of developmental faces in underground workings at Crocker Well East: South Australia Dept. Mines Min. Rev., no. 103, p. 111–115, 1957.

Gamma-ray probing of shot holes in underground workings was undertaken as a substitute for bulk sampling of material removed by each firing. The results are examined statistically and show that little reliance can be placed on probing for a single face but that a reasonable assay can be determined for all of the material removed from the workings at any one time.—*V. S. N.*

SEISMIC EXPLORATION

171–321. Posgay, Karóly. A robbantási körülmények figyelembevétele sekélyszeizmikus méréseknél [Consideration of explosion conditions in shallow seismic measurements] : Magyar Állami Eötvös Loránd Geofiz. Intézet Geofiz. Közlemények, kőtet 4, szám 1, p. 25–37, 1955.

A description of improved shooting methods that increase the accuracy of shallow seismic measurements. In an area of Holocene and Pleistocene sediments, the mean error of arrival time was reduced by increasing the shot hole depth. Details of shot hole depth, spread, and change of first arrival times are discussed at some length, with practical examples.—*D. B. V.*

171–322. Gurvich, I. I. O primenenii neprodol'nykh profiley v metode prelomlennykh voln [On the use of nonlongitudinal profiles in the refracted-wave method] : Prikladnaya geofiz., vypusk 16, p. 85–97, 1957.

Nonlongitudinal (transverse) profiles have been used recently in the refracted-wave method. The data are interpreted by comparing observed traveltime curves with those theoretically computed. Detailed discussion shows that use of this method in exploration of dipping structures can lead to important errors. Presence of small variations of the limiting velocity distorts the cross sections so that caution must be exercised when using transverse profiles. Even if it is known that the limiting velocity does not vary greatly, it is recommended that the results be verified by repeating the calculations using several longitudinal profiles.—*S. T. V.*

171–323. O'Brien, P. N. S. The variation with distance of the amplitude of critically refracted waves: Geophys. Prosp., v. 5, no. 3, p. 300–316, 1957.

Amplitude measurements have been made of the height of the first peak of an arrival refracted from a shallow refractor. If the amplitude is assumed to decay as the inverse mth power of the distance, the least squares value for m is found to be 2.16 ± 0.04. Because of this value and because of the character of the recorded event it is concluded that the arrival is a simple critical refraction. After applying the theoretical 'spread' factor for critical refraction there remains a residual attentuation of 1.96 ± 0.28 decibels per 1000 feet. The predominant frequency in the pulse is about 20 c and this attenuation agrees with the losses found for such a frequency by extrapolation of the published results of other workers. Although no evidence could be seen on the records for a change of pulse frequency with distance, the quoted result would be consistent with a dependence of residual attenuation on the first power of the frequency, and would be inconsistent with a dependence on the second power of the frequency.

It is concluded that studies of the amplitudes of refracted events will give useful estimates of the attenuation factors of rocks.—*Author's abstract*

171–324. Menzel, Heinz, and Rosenbach, Otto. Theoretische Untersuchungen über den Einfluss der Verwitterungsschicht auf das Spektrum elastischer Wellen in der Reflexionsseismik [Theoretical investigations of the effect of the weathered layer on the spectrum of elastic waves in seismic reflection surveys]: Geophys. Prosp., v. 5, no. 3, p. 328–348, 1957.

The following assumptions are made in the mathematical treatment of the problem. Below a plane earth's surface there is a three-layered elastic medium, the interfaces of which are parallel to the earth's surface. The uppermost layer represents the weathered layer in which the velocity of propagation of seismic waves increases linearly with depth. The two lower layers, the so-called intermediate layer and the substratum each have a constant velocity. The surface of the earth is acted on simultaneously by a normal pressure N in the form of a Heaviside pulse. The seismic wave thus generated is propagated through the elastic media.

The aim of the investigation is to study the shape of the wave (1) in the intermediate layer, after the wave has entered it the first time, (2) at the earth's surface, after the wave has been reflected once at the interface between the intermediate layer and the substratum.

The mathematical solutions can in both cases be expressed as series of Bessel functions. Some numerical examples illustrate the quasi-periodic nature of the solutions. The pseudo-frequency is determined by the gradient of velocity in the uppermost layer; it assumes a value of approximately 50 c for a gradient of approximately 600 m per sec per m.—*Authors' abstract*

171–325. Korovnichenko, Ye. G. Ob odom istipov obmennykh voln, zaregistrirovannykh pri seysmicheskikh issledovaniykh korrelyatsionnym metodom prelomlennykh voln [On one of the transformed waves recorded during the seismic investigations by the method of correlated refracted waves]: Akad. Nauk Ukraynsk. SSR Inst. geol. nauk Trudy ser. geofiz., vypusk 1, p. 127–135, 1956.

When surveying the surface of the crystalline basement by the seismic method of correlated refracted waves, refracted waves were recorded in the zones of later arrivals. On the basis of a detailed analysis of their kinematic and dynamic characteristics, these waves can be positively classified as transformed waves of the type $P_1S_2P_1$. These waves can be used for more complete and reliable interpretation of seismic evidence together with refracted longitudinal waves, because they give additional data on the elastic properties of the refracting layer and often make possible the determination of the depth of the refracting horizon and of the velocity of propagation of the longitudinal waves in the covering formation.—*Author's summary, S. T. V.*

171–326. Gershanik, simon. Seismic prospection by Wiechert-Herglotz method of calculus: Geofisica Pura e Appl., v. 37, p. 21–34, 1957.

The Wiechert-Herglotz method of seismic investigation is adapted for refraction prospecting. The case of a single layer bounded by a sloping interface is considered, assuming that velocity increases with depth within the layer and is constant below it. In addition to an outline of the general procedure, special formulas are given for the case in which the traveltime curve D_1, corresponding to disturbances propagated only through the layer, is parabolic. Values of layer thickness calculated for a horizontal interface with these formulas are higher than those based on rectilinear D_1.—*D. B. V.*

171–327. Kovalev, O. I. Nekotoryye pribory dlya obrabotki seysmogramm [Some instruments for the processing of seismograms]: Akad. Nauk SSSR Geofiz. Inst. Trudy, no. 35 (162), p. 268–276, 1956.

Two instruments helpful in the processing of seismograms on film are described: one for precise measurement of time intervals, and the other for precise measurement of amplitudes. Construction of the instruments is simple.—*S. T. V.*

171–328. Raykher, L. D. Nomogramma dlya opredeleniya znacheniy effektivnykh skorstey [Nomogram for determination of effective velocities values]: Akad. Nauk Ukraynsk. SSR Inst. Geol. Nauk Trudy ser. geofiz., vypusk 1, p. 136–141, 1956.

Describes construction and use of a nomogram for the determination of effective velocities of propagation of elastic waves, intended primarily for use in field work.—*S. T. V.*

171–329. Hadley, C. F., and Eisler, J. D. Electrical recorder for seismic data: Geophysics, v. 22, no. 4, p. 829–841, 1957.

A method of making multitrace seismic records using electrically sensitive paper is described. The record is immediately available for use without any type of processing. A disk carrying wire brushes on its periphery is revolved with its axis parallel to the direction of the motion of the electrical paper. The paper is pulled under the scanning disk and is shaped so that brushes remain in contact with it. Short electrical pulses are fed to the brushes to produce a number of traces composed of closely spaced dots. The position of the dots is determined by the time of occurrence of the pulses. This time is a function of the amplitude of the seismic signal. Timing lines are placed on the record by feeding a series of dots to all brushes. Provision is made to count down and emphasize the fifth and tenth timing lines. A system of multiplexing is used

to employ each brush on many traces and thus reduce the rotational speed of the rotating disk. This recorder has proved its usefulness in reproduction of magnetically recorded seismic data.—*Authors' abstract*

171–330. Glotov, O. K. Ob uchete prelomleniya na promezhutochnykh granitsakh razdela pri interpretatsii godografov prelomlennykh i otrazhennykh voln [On accounting for refraction on intermediate discontinuities when interpreting traveltime curves of refracted and reflected waves] : Prikladnaya geofiz., vypusk 16, p. 114–129, 1957.

A simple and sufficiently accurate grapho-analytical procedure is given for determining corrections for the refraction effect in constructing traveltime curves of reflected and refracted waves for 2, 3, and *n*-layered strata.—*S. T. V.*

171–331. Pommier, Gilbert, and Richard, Henri. Supermultiplication des charges et des sismographes au Sahara (zone nord) [Supermultiplication of charges and seismographs in the Sahara (northern zone)] : Geophys. Prosp., v. 5, no. 3, p. 282–299, 1957.

In desert countries, reflection seismic prospecting is often very difficult due to bad surface conditions, which adversely affect the quality of the reflections. From the beginning the Northern Sahara proved to be particularly unfavorable. In 1954 a series of systematic tests led to a shooting method which gave satisfactory results. This method used a high multiplicity of the shotholes (up to 100 per shotpoint) combined with a high multiplicity of geophones (up to, and sometimes more than 100 per trace). The method has proved effective and relatively economical to run since 1954. The evident conclusion is that, under special conditions, high multiplicity may be very helpful in the future.—*Authors' abstract*

171–332. Garrett, M. J. Seismic reflection survey, Darriman, Gippsland, Victoria : Australian Bur. Min. Resources, Geology and Geophysics Rept., no. 19, 13 p., 1955.

A seismic reflection survey was made of the area between the towns of Darriman and Giffard to evaluate a gravity anomaly that may indicate a structure favorable to the accumulation of oil and gas. Results showed an anticlinal structure plunging east but rising and broadening to the west with two probable closures on the crest. Maximum thickness of Tertiary sediments was estimated as 6,000 feet, with a possibility of only 3,000 feet on the crest and 4,000 feet on the flanks.—*V. S. N.*

171–333. Willmore, P. L., and Tolmie, R. Geophysical observations on the history and structure of Sable Island, *in* Ocean floors around Canada (a symposium) : Royal Soc. Canada Trans., ser. 3, v. 50, p. 13–20, 1956.

A seismic refraction survey near the western end of Sable Island, the exposed part of a shoal area 100 miles off the south coast of Nova Scotia, indicated no difference in structure between Sable Island and the submerged banks nearby. The velocity of 7,100 fps is close to those found by Officer and Ewing for unconsolidated sediments at various places on the Atlantic Shelf and fits in well with marine seismic data obtained by them in the vicinity of Sable Island (Geophys. Abs. 158–156).

Historical evidence for net wastage of the island is not conclusive. The character of the sand indicates a continuous interchange of sand between the beach and the unstabilized dunes; circulating ocean currents which tend to return sand blown into the sea may play a part in the cycle.—*V. S. N.*

171–334. John, Horst. Die Gliederung der deutschen Alpenvorlandsmolasse mit Hilfe seismischer Geschwindigkeiten [The subdivision of the German Alpine foreland Molasse by means of seismic velocities]: Erdöl u. Kohle, Jahrg. 10, Heft. 8, p. 493–496; Heft. 9, p. 570–573; Heft. 10, p. 661–664, 1957.

The Molasse sediments of the Alpine foreland in Germany are subdivided on the basis of their elastic behavior. The measured thicknesses and velocities for the sections in 22 deep borings are tabulated, together with the "reduced velocities" derived for each. (The effect of pressure down the dip is eliminated by means of a reduction diagram, valid only for the Molasse, which gives the increase of velocity as a function of depth for materials of different acoustic properties.) Statistical analysis of the reduced velocities shows five groups of sediments distinguished by different velocity ranges: the Bavarian (1,500 to 2,000 m per sec), Bavarian-Swabian (2,000 to 2,200), Swabian (2,200 to 2,500), Swabian-Swiss (2,500 to 2,900) and Swiss (more than 2,900). These values depend on a complex combination of factors (porosity; grain material, size and distribution; cementation; fluid filling of pores; and temperature). A given formation in the Molasse can be recognized by the distribution of the five basic types within it, much as polychromatic light is characterized by its spectrum. Diagrams illustrate several characteristic patterns and the structural contours on the upper and lower freshwater Molasse and the upper and lower marine Molasse based on their reduced velocity fields.—*D. B. V.*

Gálfi, J[ános], and Stegena, L[ajos]. Some data obtained by seismic reflection measurements on crustal structure in Hungary. See Geophys. Abs. 171–212.

171–335. Gough, D. I., and Niekerk, C. B. van. Seismic investigations in South West African river beds: Geofisica Pura e Appl., v. 37, p. 35–44, 1957.

This paper describes preliminary seismic refraction investigations in three sand-filled river beds in arid parts of South West Africa, using the hammer-electronic instrument developed by Gough for shallow refraction work (see Geophys. Abs. 149–13710). The method in general, and the instrument in particular, proved satisfactory. Some traveltime diagrams, their interpretation, and profiles deduced from them are shown. Velocity variations in the sand at two or three sites made standard calculations of dip and depth from two-way shooting inapplicable, but in such situations depth could still be estimated reasonably reliably near the origin of the traverse. There was evidence of a superficial layer having a velocity less than that of sound in air.—*D. B. V.*

171–336. Tateishi, Tetsuo, and Hirasawa, Kiyoshi. Seismic prospecting in the vicinity of Yokoshiba Town, Chiba Prefecture: Geol. Survey Japan Bull., v. 8, no. 11, p. 41–50, 1956.

A seismic-refraction survey was made in the vincity of Yokoshiba, northeastern Chiba Prefecture, to find the southern extension of the Tertiary for-

mations and the basement rocks. Four seismic layers were determined and correlated with Quaternary, Neogene, and pre-Tertiary basement formations. These results were checked with well-boring data.—*V. S. N.*

171–337. Berzon, I. S., and Ratnikova, L. I. O prirode nekotorykh voln meshayuschikh vydeleniyu otrazhennykh voln na Russkoy platforme [On the nature of certain waves making difficult the separation of reflected waves on the Russian Platform]: Akad. Nauk SSSR Izv., ser. geofiz., no. 6, p. 697–708, 1957.

During several years of reflection surveying in certain regions of the eastern Tatar and western Bashkir Autonomous Republics, difficulties were caused by the appearance of unknown disturbing waves, observed near the shot point, due to existence of an inclined refracting boundary. A detailed investigation of the nature of these disturbing waves was possible because the geologic structure and the seismic velocities in various strata were known. Of many possible schemes investigated, the path most closely corresponding to the observations is that of $P_1S_{232}P_1$, which traverses the first layer as a longitudinal wave, is converted to a transverse wave as it enters the second, is refracted along the lower boundary of the second layer, and is converted back into a longitudinal wave when it reenters the upper layer.—*S. T. V.*

171–338. Sollogub, V. B. O tektonicheskom stroyenii Predkarpatskogo progiba po dannym seysmorazvedki [The tectonic structure of the Precarpathian depression according to seismic data]: Akad. Nauk Ukraynsk. SSR Inst. Geol. Nauk Trudy, ser. geofiz., vypusk 1, p. 3–20, 1956.

On the basis of geophysical investigations, chiefly seismic, several detailed profiles of the depression between the southwestern border of the Russian platform and the eastern Carpathian Mountains have been constructed. The main reflecting horizon as well as older formations drop downward through a system of faults directed mostly toward the east.—*S. T. V.*

Kosminskaya, I. P., and Tulina, Yu. V. An attempt at the application of deep seismic sounding in the investigation of crustal structure in several regions in western Turkmen SSR. See Geophys. Abs. 171–209.

171–339. Swenumson, Glen H. Geophysical case history of the Anderson Ranch field, Lea County, New Mexico: Geophysics, v. 22, no. 4, p. 870–886, 1957.

Discovery of the Anderson Ranch oil field in 1953 followed drilling based on results of seismic reflection surveys in 1950–51. The first indication of possible structure in the area was obtained by drilling in 1927.—*M. C. R.*

171–340. Wayne, W. J. Thickness of drift and bedrock physiography of Indiana north of the Wisconsin glacial boundary: Indiana Geol. Survey Rept. Progress, no. 7, 70 p., 1956.

Data from well logs, rock outcrops, and a refraction seismograph survey provide information for a reasonably accurate reconstruction of pre-Pleistocene bedrock physiography and drainage.—*V. S. N.*

STRENGTH AND PLASTICITY

171–341. Vinogradov, S. D. Akusticheskiye nablyudeniya v shakhtakh Kizelovskogo ugol'nogo basseyna [Acoustic observations in the mines of the Kizelov coal basin] : Akad. Nauks SSSR Izv. Ser. geofiz., no. 6, p. 744–755, 1957.

Acoustic phenomena in mines of the Kizelov coal basin were studied to establish a correlation between the increase of rock pressure leading to rock bursts and changes in the frequency, intensity, and pitch of the cracking observed in the mines. The acoustic apparatus consisted of a geophone, a linear amplifier, a magnetic tape recorder (the tape was subsequently analyzed in the laboratory) and an electronic generator to mark time intervals. Two kinds of relations were found, short impulses related to shearing breaks and some quasi-sinusoidal waves related to the appearance of tension cracks. It was established that changes in intensity of the acoustic impulses often is the sign of mechanical destruction of the wall and even of an approaching rock burst. Changes in frequency spectrum also may precede breaks. No simple, general relationship could be established, however, although in certain individual cases such is likely. A combination of seismic and acoustic methods allows more complete understanding of stress conditions in a massif.—*S. T. V.*

171–342. Hubbert, M. King, and Willis, David G. Mechanics of hydraulic fracturing: Jour. Petroleum Technology, v. 9, no. 6, Transactions section, p. 153–168, 1957.

A theoretical examination of the fracturing of rocks by means of pressure applied in boreholes leads to the conclusion that, regardless of whether the fracturing fluid be of the penetrating or non-penetrating type, the fractures produced should be approximately perpendicular to the axis of least stress. The general state of stress underground is that in which the three principal stresses are unequal. For tectonically relaxed areas characterized by normal faulting, the least stress should be horizontal; the fractures produced should be vertical with the injection pressure less than that of the overburden. In areas of active tectonic compression, the least stress should be vertical and equal to the pressure of the overburden; the fractures should be horizontal with injection pressures equal to or greater than the pressure of the overburden. Horizontal fractures cannot be produced by hydraulic pressures less than the total pressure of the overburden. These conclusions are compatible with field experience in fracturing and with the results of laboratory experimentation.—*Authors' abstract*

SUBMARINE GEOLOGY

171–343. Knott, S. T., and Hersey, J. B. Interpretation of high-resolution echo-sounding techniques and their use in bathymetry, marine geophysics, and biology: Deep-Sea Research, v. 4, no. 1, p. 36–44, 1956.

The design and construction of a correlation recorder for sounding ocean depths that combines shallow- and deep-water sounders in one instrument and improves the application to other research is described. Examples are given of its application to the study of small scale bottom features, to the echo location of marine animals, and to general bathymetric surveying. The instrument can be used for mapping geologic structures to shallow depth by using a sound source with a broad spectrum rather than the usual single-frequency ping and by extending the receiver design to record in two or more filter bands.—*V. S. N.*

VOLCANOLOGY

171–344. Yokoyama, Izumi. Energetics in active volcanoes: Tokyo Univ. Earthquake Research Inst. Bull., v. 35, pt. 1, p. 75–97 (2nd paper), and p. 99–107 (3rd paper), 1957.

In the first part of the second paper, analysis of the energy distribution of the 1950–1952 activity of Mihara Volcano (Ooshima Island, Japan) leads to conclusions similar to those reached in the first paper, on its 1953–1954 activity (see Geophys. Abs. 167–285). In the second part the study is extended to 24 other eruptions of Japanese and Indonesian volcanoes, discussed individually and also tabulated. The amount of energy released depends on the volume of ejecta and even more on the physical (especially thermal) conditions of the ejecta. The total energy of a recent "large" eruption was of the order of 10^{24}—10^{25} ergs, comparable to the energy of a large earthquake. The lower limit of the total energy of an "eruption" may be about 10^{16}—10^{17} ergs while fumarolic activity releases smaller amounts of energy.

In the third paper the same method of estimating energy is extended to the determination of the total energy required to form a particular volcanic zone such as the Seven Izu Islands. This is found to be 10^{-7} cal per cm^3 per sec. Comparison with estimates made by others of the energy release by earthquake waves in Japan, by igneous activity of the earth as a whole, and by earthquakes of the earth as a whole suggests that terrestrial heat flow is more or less focussed in the seismic and volcanic zones. It is not yet possible to say whether volcanism is a derivative of earthquakes; Yokoyama prefers to say that "both are equally the derivatives of the same rank from the thermal energy contained in the bottom of the crust or the mantle."—*D. B. V.*

171–345. Bésairie, H[enri], Boulanger, J. [D], Brenon, P. Brussière, P., Emberger, A., and Saint Ours, J. de. Le volcanisme à Madagascar [Volcanism in Madagascar]: Madagascar Bur. géol. Travaux, no. 83, 237 p. (plus bibliography), 1957.

This is mainly a regional petrographic and petrochemical description of the volcanic rocks of Madgascar, erupted in Cretaceous, Tertiary (lower and upper) and Quaternary magmatic epochs. The only volcano still active is Karthala, on Great Comoro Island, largest island of the Comores Archipelago in Mozambique Channel. Ten eruptions have been recorded since 1857, mostly of strombolian character. In the 1918 activity a first stage of hawaiian type was succeeded by a second of volcanian type. The last eruption was in February 1952, with explosions and emission of dark gases. Since the 1918 paroxysm all activity has been confined to the north vent created at that time. Between eruptions fumarolic activity is constant. Seismic activity, which is strong in the whole archipelago, is related to fractures radiating from Karthala and the neighboring Massif de la Grille.—*D. B. V.*

171–346. Taylor, G. A., Best, J. G., and Reynolds, M. A. Eruptive activity and associated phenomena, Langila volcano, New Britain: Australian Bur. Min. Resources, Geology and Geophysics Rept., no. 26, 53 p., 1957.

Mt. Langila is a complex volcano at the western end of New Britain Island. The oldest crater, Mt. Manlulu, is probably extinct; the most northerly of the two more recent craters, north-northeast of Mt. Manlulu, was active in the most

recent eruption. Increased gas emissions, high temperatures, and anomalous tilts were observed in the summer and fall of 1952. Eruption began on May 18, 1954 and continued intermittently until March 25, 1956. The volcano is of the closed conduit type with low grade vulcanian eruptions tending toward pure steam explosions.

Each of the four explosive phases of the volcano's activity began during periods close to maximum lunar declination when the north-south tangential forces of the moon were at a maximum. As the cones in this area are thought to be controlled by a deep-seated east-west fracture, the tangential component of the tractive forces of the moon and sun reach a maximum in positions of extreme declination and produce tension along the fracture. The resulting relief of tension probably aids eruption if conditions within the volcano are close to critical equilibrium. The theory of influence of lunar-solar forces on the activity is supported by the fact that many of the recorded eruptions in this arc have begun in March or June.—*V. S. N.*

Yokoyama, Izumi, and Tajima, Hirokazu. A gravity survey on Volcano Mihara, Ooshima Island by means of a Worden gravimeter. See Geophys. Abs. 171–184.

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