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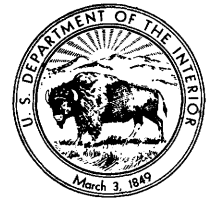
By JAMES W. CLARKE, DOROTHY B. VITALIANO, VIRGINIA S. NEUSCHEL, *and others*

GEOLOGICAL SURVEY BULLETIN 1166-A

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



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GEOPHYSICAL ABSTRACTS 188, JANUARY-MARCH 1962

By James W. Clarke, Dorothy B. Vitaliano, Virginia S. Neuschel, and others

INTRODUCTION

Extent of Coverage

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

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

List of Journals

Lists of journals published in Geophysical Abstracts 160 (January-March 1955, Bulletin 1033-A) and subsequent issues through 184 (January-March 1961, Bulletin 1146-A) have been compiled into a single list, which may be obtained by writing to the U.S. Geological Survey, Washington 25, D. C.

Supplements to this master list have been published in each issue since Geophysical Abstracts 184. The following is an additional supplement that lists references cited in Geophysical Abstracts 188 that have not been listed previously.

Acad. Romîne, Probleme de Geofizică -- Academia Republicii Populare Romîne, Institutul de Geologie, Geofizică şi Geografie. Probleme de Geofizikă [Academy of the Rumanian People's Republic, Institute of Geology, Geophysics, and Geography. Problems of Geophysics]. Bucharest, Rumania.

Acad. Royale Sci. Outre-Mer [Belgique] Bull. -- Academie Royale des Sciences d'Outer-Mer, Section des Sciences Techniques Bulletin [Royal Academy of Overseas Sciences, Section of Technical Sciences Bulletin]. Brussels.

Akad. Nauk Ukrain. SSR. Materialy Karpato-Balkan. Assots. -- Akademiya Nauk Ukrainskoy SSR, Materialy Karpato-Balkanskoi Assotsiatsii [Academy of Sciences of the Ukraine S.S.R., Materials of the Carpathian-Balkan Association]. Kiev, U.S.S.R.

Anales Inst. Geofisica -- Anales del Instituto de Geofisica. Instituto de Geofisica, Universidad Nacional Autonoma de Mexico [Annales of the Institute of Geophysics. Institute of Geophysics, National Autonomous University of Mexico]. Mexico, D.F.

Egyptian Jour. Geology -- The Egyptian Journal of Geology. The Geological Society of Egypt in collaboration with the National Research Center under the auspices of The Science Council. Cairo, Egypt.

Internat. Assoc. -- Associations Internationales [International Associations]. Union of International Associations. Brussels.

Jökull -- Jökull. Ársrit Jöklarannsóknafélags Íslands. [Annals of the Iceland Glaciological Society]. Reykjavik.

Jour. Acoust. Soc. Am. -- Acoustical Society of America Journal. American Institute of Physics. New York, N.Y.

Kwartalnik Geologiczny -- Kwartalnik Geologiczny. Instytut Geologiczny [Geological Quarterly. Institute of Geology]. Warszawa (Warsaw), Poland.

Kyoto Univ. Inst. of Astrophysics and Kwasan Observatory Contr. -- Contributions from the Institute of Astrophysics and Kwasan Observatory, University of Kyoto. Kyoto, Japan.

Kyushu Univ., Mem. Fac. Sci. -- Kyushu University, Faculty of Science Memoirs. Fukuoka, Japan.

Louvain Univ. Inst. Géol. Mém. -- Mémoires de l'Institut Géologique de l'Universite de Louvain. Institut Géologique de l'Université [Memoirs of the Geological Institute of the University of Louvain. Geological Institute of the University]. Louvain, Belgium.

Materials Research and Standards -- Materials Research and Standards. American Society for Testing and Materials. Philadelphia, Pennsylvania.

Norske Videnskak.-Akad. Skr., Mat.-Naturv. Kl. -- Skrifter utgitt av det Norske Videnskaps-Akademi i Oslo, Mat.-Naturv. Klasse [Bulletin published by the Norwegian Academy of Science in Oslo, Mathematics and Natural Science Class]. Oslo, Norway.

Novosti Neftyanoy i Gazovoy Tekhniki, Geologiya --Novosti Neftyanoy i Gazovoy Tekhniki, Geologiya. Gosudarstvennyy Nauchno-Issledovatel'skiy Institut Nauchnoy i Tekhnicheskoy Informatsii [News of Petroleum and Gas Technique, Geology. Government Scientific-Research Institute of Scientific and Technical Information]. Moskva (Moscow), U.S.S.R.

Pakistan Jour. Sci. and Indus. Research -- Pakistan Journal of Scientific and Industrial Research. Pakistan Council of Scientific and Industrial Research. Karachi.

Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull. -- Bulletin of the Mineral Industries Experiment Station. College of Mineral Industries. The Pennsylvania State University. University Park, Pennsylvania.

Quaderni di Geofisica Applicata -- Quaderni di Geofisica Applicata. Instituto di Geofisica Applicata Ing. C. M. Lerici de Politecnico [Quarterly of Applied Geophysics. Lerici Institute of Applied Geophysics of the Polytechnicum]. Milan, Italy.

Soc. Petroleum Engineers Jour. -- Society of Petroleum Engineers Journal. Society of Petroleum Engineers of AIME. Dallas, Texas.

Southern Rhodesia Geol. Survey Bull. -- Southern Rhodesia Geological Survey Bulletin. Southern Rhodesia Geological Survey. Salisbury, Southern Rhodesia.

Swedish Deep-Sea Exped. Repts. -- Reports of the Swedish Deep-Sea Expedition. Göteborgs Kunglig Vetenskaps-och Vitterhets-Samhälle. Göteborg.

Tennessee Univ. Eng. Expt. Sta. Bull. -- Bulletin of the Engineering Experiment Station, The University of Tennessee. Knoxville, Tennessee.

Vesnik Primenjena Geofizika -- Vesnik Primenjena Geofizika. Zavod za Geološka i Geofizička Istraživanja [Notes of Applied Geophysics. Institute of Geological and Geophysical Research]. Beograd (Belgrad), Yugoslavia.

World Conf. on Earthquake Eng., 2d, Tokyo and Kyoto 1960, Proc.-- Proceedings of the Second World Conference on Earthquake Engineering, Tokyo and Kyoto, Japan, July 11-18, 1960. Science Council of Japan. Tokyo, Japan.

Yorkshire Geol. Soc. Proc. -- Proceedings of the Yorkshire Geological Society. Yorkshire Geological Society. Hull, England.

Form of Citation

The abbreviations of journal titles used are those used in the U.S. Geological Survey publications and 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 of Geographic Names. This system of transliteration for Russian is given in Geophysical Abstracts 148 (January-March 1952, Bulletin 991-A), and in the new "List of Journals" announced above. Titles of papers in Japanese and Chinese are given in translation only.

Abstracters

Abstracts in this issue have been prepared by J. C. Antweiler, R. S. Cannon, B. R. Doe, H. Faul, I. Friedman, S. S. Goldich, Ruth M. Gove, Patricia C. Ives, H. R. Joesting, R. F. Marvin, L. Peselnick, J. N. Rosholt, F. E. Senftle, A. J.

Shneiderov, T. W. Stern, H. Thomas, and J. S. Watkins, as well as by the principal authors. Authors' abstracts are used in many instances. The initials of an abstracter following the notation "author's abstract" indicates a translation from the original language.

AGE DETERMINATIONS

188-1. Stockwell, C. H. Structural provinces, orogenies, and time classification of rocks of the Canadian Precambrian shield: Canada Geol. Survey, Dept. of Mines and Tech. Surveys, Paper 61-17, p. 108-118, 1961.

The shield is divided into six main structural provinces and several subprovinces. Three main Precambrian orogenic periods are clearly distinguishable with peaks at about 2,500, 1,700, and 950 m.y. The three orogenies, when considered in conjunction with major unconformities, give a natural, fourfold, time-classification of the sedimentary, volcanic, and intrusive rocks. There are certain advantages, however, in a major twofold classification, for which the names Archean and Proterozoic are retained. These are divided at the 2,500 m.y. orogeny and the Proterozoic is subdivided by the two other orogenies into Lower, Middle, and Upper parts. Further subdivisions may be possible in the future. — Author's abstract

188-2. Lambert, R[ichard] St. J[ohn], and Mills, A. A. Some critical points for the Paleozoic time scale from the British Isles: New York Acad. Sci. Annals, v. 91, art. 2, p. 378-388, 1961.

Analytical data for Rb-Sr and K-Ar age determinations on 3 Caledonian and 2 Hercynian granites from the British Isles are given. The closely agreeing results indicate a mean age of 395 m.y. for the Caledonian intrusives of probable Late Devonian age and 285 m.y. for the Hercynian intrusives of Carboniferous or Late Permian age. The new data show that the earlier K-Ar determinations by Mayne (see Geophys. Abs. 176-1) were too high. — S.S.G.

188-3. Polkanov, A. A., and Gerling, E[rik] K[arlovich]. The pre-Cambrian geochronology of the Baltic shield: New York Acad. Sci. Annals, v. 91, art. 2, p. 492-499, 1961.

This is virtually the same as the paper published in Internat. Geol. Cong., 21st, Copenhagen 1960, Proc., pt. 9, p. 183-191, 1960 (see Geophys. Abs. 183-31). — S.S.G.

188-4. Afanas'yev, G. D., Shanin, L. L., Gol'tsman, Yu. V., and Noskova, V. G. O repernykh probakh dlya absolyutnoy geokhronologicheskoy shkaly i nekotorykh printsipakh yeye razrabotki [Tie points for the absolute time scale and some principles of its establishment]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 5-18, 1961.

The potassium-argon ages of rough biotite concentrates from the late Paleozoic microcline granite of the main ridge of the Caucasus are at about 280 m.y., and those from the pre-Triassic Khevisdzhvarsky granodiorite near the Tsypka River are at about 170 m.y. Pure biotite concentrates from the post-Jurassic granites of the western Caucasus give ages from 145 to 175 m.y. In the Zelenchuk River basin, Upper Devonian sediments concordantly overlie conglomerates that contain plagiogranite cobbles. Pure mica concentrates from these Caledonian granites in the zone of the forward ridge of the Caucasus give K/Ar ages of 340-360 m.y. Hercynian (Permotriassic) crystalline rocks of the main ridge of the Caucasus give about 200 m.y. for micas, feldspar, and whole rock samples, and a post-Apsheronian (late Pliocene) ignimbrite gives

3-4 m.y. The time scale of Mayne, Lambert and York (see Geophys. Abs. 176-1) cannot be accepted because their tie points are unsatisfactory, both stratigraphically and analytically.— H.F.

188-5. Semenenko, N. P. Geokhronologicheskaya shkala dokembriya po materialam Akademii Nauk Ukrainskoy SSR [Geochronological scale of the Precambrian according to measurements in the Academy of Sciences of the Ukraine SSR]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess. p. 19-40, 1961.

Precambrian history is divided as follows (in millions of years): (I) Katarchean, 3,500-2,650; (II) Archean, 2,650-1,900; (III) Proterozoic, 1,900-1,150; and (IV) Rifean, 1,150-540. A correlation of Precambrian formations of the U.S.S.R., India, Canada, and Africa is presented in a table, based almost entirely on K/Ar analyses.— H.F.

188-6. Garris [Harris], M. A., Dyadin, N. N., and Zakirova, F. S. Predvaritel'naya geokhronologicheskaya shkala dokembriya i paleozoiya Yuzhnogo Urala i vostochnoy chasti Russkoy platformy [Preliminary time scale of the Precambrian and Paleozoic of the southern Urals and the eastern part of the Russian platform]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 56-75, 1961.

Potassium-argon age measurements on biotite and other minerals give the following time scale in this area (in millions of years): Archean metamorphic rocks of the Tatar arch (from drill cores), 2,010 and 2,180; Lower Proterozoic (Karelian) metamorphic rocks of the eastern Russian platform (from drill cores), 1,620-1,820; Middle Proterozoic Berdyauchsky pluton, western Urals, 1,350; Upper Proterozoic gabbro-diabases of western Bashkiria, 1,100-1,150; Rifean Min'yarskaya series (glauconite), 670-730; Silurian effusive rocks (Baymak-Buribayevskaya series) of the Bakr-Tau deposit (drill cores, whole rock), 370-380; pre-Eifel (pre-Middle Devonian) granites of the Marininsko-Andreyevskaya intrusion 375-385; pre-Eifel silicic tuff, Kaluzhskaya area (from drill core), 380; Givetian (Middle Devonian) effusive rock (from drill core), Deposit XIX, Southern Urals, 335; granitic bodies of Carboniferous age, about 280; and rocks of Permo-Triassic age, about 250.— H.F.

188-7. Garris [Harris], M. A. Materialy k geokhronologicheskoy shkale SSSR, vyrazhennoy v absolyutnom letoschislenii [Materials for the absolute time scale of the USSR]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 76-82, 1961.

This is another presentation of the data presented in Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, no. 9, p. 56-75, 1961 (see Geophys. Abs. 188-6.)— H. F.

188-8. Ovchinnikov, L. N. Ural'skiye materialy k absolyutnoy geokhronologicheskoy shkale [Ural materials for the absolute time scale]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 83-91, 1961.

Age measurements on muscovite and biotite by the K/Ar method give the following tie-points for the time scale (in millions of years): post-Viséan granites and syenites of the Central and Southern Urals, 315; post-Givetian (post-Middle Devonian) rocks of the Sultanovsky pyrite deposit, Central Urals, 350; post-Eifelian (post-Lower Middle Devonian), pre-Upper Devonian sericite, Sibaysky pyrite deposit, Southern Urals, 370; post-Upper Ludlow (post-Silurian) syenites, Tagilo-Kurshinsky region, Central Urals, 380; biotite from Lower

Ordovician (Arenigian) graptolite slate, Blyava Station, Southern Urals, 450; and post-Proterozoic (post-Satkinska formation) Berdyaushsky granite, Southern Urals, 1,400. Two K/Ar ages on glauconite are also reported: Upper Lias (Lower Jurassic) carbonate-manganese ore of the Urkut deposit, Vengriya, 168 m.y.; and Middle Ordovician calcareous sandstone, Paga River, Polar Urals, 420 m.y.— H.F.

188-9. Rubinshteyn, M. M., Gel'man, O. Ya., Grigor'yev, I. G., Lashkhi, B. A., Uznadze, E. D., Khutsaidze, A. L., and Chikvaidze, B. G. K voprosu o sostavlenii absolyutnoy geokhronologicheskoy shkaly [Problem of compilation of the absolute geochronologic scale]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 165-172, 1961.

Potassium-argon ages of stratigraphically well-defined rocks from Georgia are presented and discussed critically. Biotite from Upper Eocene pegmatite of Bakis-Dzhvari gives 37 m.y.; biotite from the Bathonian (Middle Jurassic) Kelasury granite, 167 m.y.; biotite from the Bathonian Gumisty granite, 174 m.y.; hornblende-biotite mixture from the Bathonian Khevsky quartz-diorite, 168-185 m.y. (3 samples); Upper Aptian-Lower Albian (Lower Cretaceous) glauconite, Postozha River, 103 m.y.; and Upper Lower and Lower Middle Ordovician glauconite of the Tallin horizon, 467 m.y.— H.F.

188-10. Polevaya, N. I. Materialy dlya sostavleniya posledokembriyskoy shkaly absolyutnoy geokhronologii [Data for compilation of the post-Precambrian scale of absolute geochronology]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 173-215, 1961.

Potassium-argon age determinations on 132 samples of mica, glauconite, sylvite, and whole rock and isotopic U/Pb age determinations on 2 samples of pitchblende (both highly discordant) are presented. A detailed time scale is established and compared with the 1947 and 1959 time scales of Holmes.— H.F.

188-11. Kommissiya po Opredeleniyu Absolyutnogo Vozrasta Geologicheskikh Formatsiy. Shkala absolyutnogo letoschisleniya po dannym geokhronologicheskikh laboratoriy SSSR na 1960 god [Absolute time scale based on the data of geochronologic laboratories of the USSR in the year 1960]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 320-329, 1961.

This is virtually the same as the paper published in Akad. Nauk SSSR Izv. Ser. Geol., no. 10, p. 17-21, 1960 (see Geophys. Abs. 185-4).— H.F.

188-12. Cobb, James C. Dating of black shales: New York Acad. Sci. Annals, v. 91, art. 2, p. 311-316, 1961.

The calculated lead-uranium ages of the Swedish kolm are highly discordant with the Pb-206/U-238<Pb-207/U-235<< Pb-207/Pb-206 age sequence. A sequence from 225 to 920 m.y. is reported for one sample but more typical sequences are 360-865 m.y. Shales sampled close to kolm have high U-238/Pb-206 ages and low Pb-207/Pb-206 ages suggesting migration of U-238 daughter products. U-238 - Th-230 and Ra-226 - Pb-210 equilibrium relations of the kolm are variable from sample to sample. Ground water leaching is suggested as the cause. Using a Pb-206/U-238 vs Pb-207/Pb-206 plot of the data a minimum age of 500 m.y. for the Upper Cambrian kolm is proposed.

Upper Devonian Chattanooga shale from Tennessee has an apparent age of 320-350 m.y. These samples require large common lead corrections.—T.W.S.

188-13. Rosholt, John N., Jr. Uranium migration and geochemistry of uranium deposits in sandstone above, at, and below the water table. Part I, Calculation of apparent dates of uranium migration in deposits above and at the water table: Econ. Geology, v. 56, no. 8, p. 1392-1403, 1961.

The distribution of the radioactive daughter products is determined by radiochemical analyses of samples from ore deposits in sandstone, and the apparent minimum and maximum dates of uranium introduction or redistribution calculated from the Pa-231/Th-230 ratio. The upper limit of age determination is about 250,000 yr, based on the half lives of Pa-231 and Th-230. Their growth and decay patterns, analyzed mathematically, are used to determine the apparent date of uranium migration.— J.N.R.

188-14. Robinson, Charles S., and Rosholt, John N., Jr. Uranium migration and geochemistry of uranium deposits in sandstone above, at, and below the water table. Part II, Relationship of uranium migration dates, geology, and chemistry of uranium deposits: Econ. Geology, v. 56, no. 8, p. 1404-1420, 1961.

Apparent age calculations made from radiochemical data were used to study uranium migration from ore samples representing deposits above the water table, deposits just above and below perched water tables, and deposits at least 250 feet below the water table in the Hulett Creek Area, Wyoming. The first uranium deposition occurred more than 250,000 yr ago for deposits now at or above the water table. Approximately 60,000 to 80,000 yr ago these deposits were oxidized, leached, and locally enriched. Accumulation of uranium in the deposits below the water table probably did not start before 180,000 yr ago. (See Geophys. Abs. 188-13.) — J. N. R.

188-15. Isabayev, Ye. A., Cherdyntsev, V. V., and Yenikyeyev, R. Sh. Opredeleniye vozrasta molodykh obrazovaniy po otnosheniyu izotopov toria i urana [Determination of the age of young formations by the ratio of thorium and uranium isotopes]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 313-319, 1961.

The age of fossil bones is determined from the ratios of Th-230 and Th-227 to Th-234, which is in equilibrium with U-238. Ages from about 20,000 to about 500,000 yr are found for Late Paleolithic bones from Kostenki; Mousterian and Acheulian bones from the Kudaro cave in Southern Osetiya; Pleistocene bones from Konĕprusy, Czechoslovakia; and bones from the Sinanthropus fauna from Chow-Kau-Tien, China.— H.F.

188-16. Burkser, Ye. S., Alekseyeva, K. N., Vetshteyn, V. Ye., Gol'denfel'd, I. V., Davidyuk, L. A., Demidenko, S. G., Yeliseyeva, G. D., Lechekhleb [Lechekhlev], V. R., and Shcherbak, N. P. [M. P.]. Kharakteristika standartnykh obraztsov radioaktivnykh mineralov dlya opredeleniy absolyutnogo vozrasta svintsovym metodom [Properties of the standard samples of radioactive minerals for absolute age determination by the lead method]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 281-290, 1961.

Determinations of Th, U, and Pb content, Pb isotopic composition, and gross mineralogical characteristics of a sample of pitchblende and two samples of monazite from unstated localities are presented.— H.F.

188-17. Glendenin, L. E. Present status of the decay constants: New York Acad. Sci. Annals, v. 91, art. 2, p. 166-176, 1961.

Using a liquid scintillating detector, the β^- decay constant of Rb-87 was determined to be $(1.47\pm0.03)\times10^{-11}$ yr^{-1} giving a half life of $(4.70\pm0.10)\times10^{10}$ yr. The need for further investigation of the decay constants of Rb-87, K-40, U-235, and other nuclides useful in geochronology is emphasized.—S.S.G.

188-18. Gast, P[aul] W. The rubidium-strontium method: New York Acad. Sci. Annals, v. 91, art. 2, p. 181-183, 1961.

The Sr-87/Sr-86 ratios for a number of basalts range from 0.704 to 0.712. Strontium extracted from sea water and from modern sea shells gives a restricted range of 0.711-0.712. Granitic rocks give a greater variation (0.700-0.733); however, uncertainties in the ages and in the Sr/Rb ratios of the granites affect the determinations of the original abundance of Sr-87, and the initial abundance of Sr-87 in granitic rocks may be essentially the same as that for present-day sea water and for basalts.—S.S.G.

188-19. Compston, W., and Jeffery, P. M. Metamorphic chronology by the rubidium-strontium method: New York Acad. Sci. Annals, v. 91, art. 2, p. 185-188, 1961.

A graphical method of representing Sr and Rb isotopic data for rocks and for component minerals permits determination of the time of original crystallization as well as of subsequent metamorphism.—R.M.G.

188-20. Herzog, Leonard F. Analyses of identical samples by more than one laboratory: New York Acad. Sci. Annals, v. 91, art. 2, p. 207-220, 1961.

Results of Rb-Sr analyses of lepidolite samples from four laboratories indicate a reproducibility of age determination of ±4 percent by mass-spectrometric isotope-dilution techniques. The ranges in using a half life of 50 b.y. for Rb-87 is as follows (in millions of years): Bikita, Southern Rhodesia, 2,530-2,760; Bob Ingersoll, S. D., 1,630-1,770; Pala, Southern Calif., 100-120; Southeast Manitoba, Canada, 2,300-2,690; and Varutrask, Sweden, 1,775-1,790.

Other methods of analysis such as neutron activation, X-ray fluorescence, and optical spectrographic have promise of development as useful techniques.—S.S.G.

188-21. Pinson, William H., Jr. The potassium-argon method: The problem of potassium analysis: New York Acad. Sci. Annals, v. 91, art. 2, p. 221-222, 1961.

Comparative results on the potassium content of a sample of biotite (M.I.T. B3203) determined in a number of laboratories by various analytical techniques range from 7.4 to 7.8 percent and average 7.6 percent. Variations in results by different analysts using the same basic technique are nearly as large as the overall variation for all methods.—T.W.S.

188-22. Gerling, Erik Karlovich. Sovremennoye sostoyanie argonovogo metoda opredeleniya vozrasta i yego primeneniye v geologii [Present status of the argon method of age determination and its application in geology]: Leningrad Akad. Nauk SSSR, Laboratoriya Geologii Dokembriya, 132 p., 46 figs., 44 tables, 1961.

A concise review and critical discussion of the K/Ar method of geologic age determination as used in the U.S.S.R. are presented. The following subjects are covered: radioactivity of K-40 and age calculation, techniques of argon measurement, argon retention in minerals and rocks, kinetics of argon release from micas and microcline, geologic applications, study of metamorphic rocks, comparison of K/Ar, U/Pb, and Rb/Sr age determinations, minerals with excess argon and helium, the age of meteorites, primary inert gases, and age of the elements.—H.F.

188-23. Gerling, E[rik] K[arlovich], Morozova, I. M., and Kurbatov, V. V. The retentivity of radiogenic argon in ground micas: New York Acad. Sci. Annals, v. 91, art. 2, p. 227-234, 1961.

Mechanical grinding of micas results in damage to crystal structure, as shown by X-ray and activation energy studies for argon loss. Mechanically ground micas lose about 30 percent of their argon. Scissors should be used to cut micas for use in K-Ar age determinations.—S.S.G.

188-24. Amirkhanoff, [Amirkhanov], K. [Kh.] I., Brandt, S. B., and Bartnitsky, E. [Ye.] N. Radiogenic argon in minerals and its migration: New York Acad. Sci. Annals, v. 91, art. 2, p. 235-275, 1961.

Various diffusion hypotheses to explain apparent loss of radiogenic argon from K-feldspar compared to micas are considered and rejected. The loss of radiogenic gases during geologic time in undisturbed minerals by means of volume diffusion is said to be impossible. Loss of radiogenic gases is attributed to desorption of the gases from boundaries during phase transitions. Apparatus and a technique for obtaining K/Ar ages of K-feldspar are described.—S.S.G.

188-25. Schaeffer, O[liver] A., Stoenner, R. W., and Bassett, W. A. Dating of Tertiary volcanic rocks by the potassium-argon method: New York Acad. Sci. Annals, v. 91, art. 2, p. 317-319, 1961.

Comparative K-Ar ages for volcanic glass and biotite show a large loss of argon for fine-grained glassy material; the latter gives a K-Ar age of 13 m.y. compared to 25 m.y. for biotite. Massive glass samples have experienced smaller loss of argon and the average apparent K-Ar age is 19 m.y. compared to 24 m.y. for biotite. Replicate determinations show considerable variation: 20-27 m.y. for biotite and 13-25 m.y. for the massive glass.—T.W.S.

188-26. Baadsgaard, H[alfdan], Lipson, J[oseph I.], and Folinsbee, R. E. The leakage of radiogenic argon from sanidine: Geochim. et Cosmochim. Acta, v. 25, no. 2, p. 147-157, 1961.

Argon is quantitatively retained by most sanidine at temperatures below 400°C. Sanidine that is fine-grained (-325 mesh) or with lattice irregularities may lose argon. K-40/Ar-40 ages of seven biotite-sanidine pairs from bentonite clay horizons indicate that sanidine retains argon as well as does biotite. Samples from 65 to 450 m.y. were examined.—R.M.G.

188-27. Hurley, P[atrick] M., Hughes, H., Pinson, W[illiam] H., Jr., and Fairbairn, H[arold] W. Radiogenic argon and strontium diffusion parameters in biotite at low temperatures obtained from Alpine Fault uplift in New Zealand: Geochim. et Cosmochim. Acta, v. 26, p. 67-80, 1962.

Potassium-argon ages on micas show radiogenic argon losses that are related to depth of burial. Almost complete loss of argon occurs for samples buried 9,000 feet. A mean value of D/a^2 (the diffusion parameter) was calculated as 6×10^{-16} sec^{-1} at 110°C.—T.W.S.

188-28. Polevaya, N. I., Murina, G. A., and Kazakov, G. A. Utilization of glauconite in absolute dating: New York Acad. Sci. Annals, v. 91, art. 2, p. 298-310, 1961.

Glauconites from many occurrences are suitable for K-Ar dating, providing they are free of impurities such as entrapped feldspar. Analytical data and ages calculated with constants used in the United States are given for many samples, with Early Cambrian ages up to 600 m.y. The numerous

samples in the age range from 500 to 1,300 m.y. are of particular interest; these are reported from the Russian platform, the Southern Urals, Siberia, and China.—S.S.G.

188-29. Wanless, R. K., and Lowdon, J. A. Isotopic age measurements on coeval minerals and mineral pairs: Canada Geol. Survey, Dept. of Mines and Tech. Surveys, Paper 61-17, p. 119-124, 1961.

Potassium-argon age measurements on mica are compared with Pb-U and Pb-Th age measurements on coeval uraninite and thorianite. Potassium-argon ages of biotite-muscovite pairs and of chloritized biotite pairs are also compared. Excellent agreement has generally been observed where fresh unchloritized material is used. There is no definite trend to indicate that throughout geological time muscovite retains a greater percentage of its radiogenic argon content than does biotite.— Authors' abstract

188-30. Curtis, G[arniss] H. A clock for the ages: Potassium-argon: Nat'l. Geog. Mag., v. 120, no. 4, p. 590-592, 1961.

This is a simple description of the K-40/Ar-40 method for the layman. An example is cited where anorthoclase from volcanic tuff associated with Olduvai fossils is dated at 1.75 m.y.— R.M.G.

188-31. Koczy, F[ritz] F. Ratio of Th-230 to Th-232 in deep-sea sediments: Science, v. 134, no. 3494, p. 1978-1979, 1961.

Shortcomings of the ionium-thorium method of age determination in deep-sea sediments are discussed with the conclusion that the chief error arises from changes in the rate of sedimentation which alters the Th-230/Th-232 ratio in a manner independent of Th-230 decay. A formula for calculating this error in the method is given for the case of a known or estimated change in the rate of Th-232 sedimentation. An additional formula is given to estimate the rate of sedimentation from the Th-230 concentration in the superficial layer of the sediment.— J.N.R.

188-32. Hart, Stanley R. Mineral ages and metamorphism: New York Acad. Sci. Annals, v. 91, art. 2, p. 192-195, 1961.

Redistribution of radiogenic strontium among mineral phases during metamorphism is discussed, and several cases are cited where equilibrium distribution has been achieved.

A study of mineral ages in a contact metamorphic zone between Precambrian country rock and a Tertiary intrusive is also reported. The biotite in the country rock shows very little retention of radiogenic argon at a distance of 76 m from the contact, whereas the hornblende shows almost complete retention of argon at only 41 m distance. This remarkable difference in retentivity of argon is supported by laboratory measurements of the diffusion rates of argon in biotite and hornblende.

Finally, results are reported on the K-Ar ages of various grain size fractions of muscovite from a Precambrian marble that was partially heated during a Paleozoic metamorphism. The two smallest sizes record the age of metamorphism, and the other sizes show progressively greater ages with increasing grain size.—S.S.G.

188-33. Nicolaysen, L. O. Graphic interpretation of discordant age measurements on metamorphic rocks: New York Acad. Sci. Annals, v. 91, art. 2, p. 198-206, 1961.

Plots of Sr-87/Sr-86 against Rb-87/Sr-86 and of Sr-87/Sr-88 against Rb-87/Sr-88 are useful in interpreting the metamorphic history of crystalline rocks. Whole rock and mineral Rb-Sr analyses can be used. U-Th-Pb anal-

yses may provide independent age data, and plots of U-238/Pb-204 against Pb-206/Pb-204 may supplement the Sr/Rb plots.—S.S.G.

188-34. Krylov, A. Ya. The possibility of utilizing the absolute age of metamorphic and fragmental rocks in paleogeography and paleotectonics: New York Acad. Sci. Annals, v. 91, art. 2, p. 324-340, 1961.

Potassium-argon data are given for metamorphic rocks and for sedimentary materials ranging from gravel to clay from central Tien Shan, Antarctica, and other localities. It is concluded that the maximum argon loss accompanying weathering does not exceed 30 percent. The K-Ar data are used to interpret metamorphic and paleotectonic history.—T.W.S.

188-35. Faul, H[enry]. Some Paleozoic dates in Maine, western Europe, and southern United States: New York Acad. Sci. Annals, v. 91, art. 2, p. 369-371, 1961.

Isotopic dates for granitic intrusions in Maine fall into two groups, one at 405 m.y. and the other at 360 m.y. Biotite from gabbro at Mount Katadhin, Maine, was dated at 460 m.y. (K-Ar). Some Rb-Sr and K-Ar ages for granites from Europe are as follows: four granites from the Vosges and four from the Schwarzwald, 320 m.y.; a Mississippian (?) granite from the Massif Central in France, 320 m.y.; and granite at Baveno on Lago Maggiore, Italy, 270 m.y. Biotite from bentonite in the Late Devonian Chattanooga shale near Sligo Bridge, Tenn., gave 340 m.y. (K-Ar), and biotite from bentonite in the Middle Ordovician Carters Limestone near Bessemer, Ala. gave 419 m.y. (K-Ar). The Rb-Sr age by Tilton on this biotite is 450 m.y. Discordant U-Pb ages on zircon from the bentonite by Tilton range from 445 to 545 m.y.—B.R.D.

188-36. Pinson, W[illiam] H., Jr. Some points on the geological time scale from Nova Scotia and New England: New York Acad. Sci. Annals, v. 91, art. 2, p. 372-377, 1961.

Potassium-argon and rubidium-strontium ages on rocks from Nova Scotia and Maine indicate a post-Lower Devonian metamorphism at 360 m.y. Measurements on biotite concentrates from granites and schist as well as whole rock K-Ar determinations on slates suggest a 245 m.y. date for the post-Pennsylvanian metamorphism in the Narragansett basin in Rhode Island.—T.W.S.

188-37. Long, Leon E. Isotopic ages from northern New Jersey and southeastern New York: New York Acad. Sci. Annals, v. 91, art. 2, p. 400-406, 1961.

Potassium-argon age determinations on 14 micas from the Manhattan prong indicate a metamorphic event at 365 m.y. The western border of the prong yields older metamorphic ages—up to 475 m.y., and the Cortlandt complex is correlated with the older metamorphism. Eleven Rb-Sr and K-Ar mica ages from the Reading prong are about 830 m.y. In the Highlands Transition zone K-Ar and Rb-Sr ages decrease from NW to SE. In Dutchess County biotite K-Ar and Rb-Sr ages and muscovite K-Ar ages are 360 m.y. A Rb-Sr muscovite age of 460±20 m.y. may indicate a prior metamorphic event.—T.W.S.

188-38. Erickson, G. P., and Kulp, J. Laurence. Potassium-argon dates on basaltic rocks: New York Acad. Sci. Annals, v. 91, art. 2, p. 321-323, 1961.

Potassium-argon dates of whole rock samples of the Palisade diabase sill, New Jersey, range from 142 to 202 m.y. compared to 190 m.y. on biotite separated from the diabase. Fine-grained rock at or near the contact gave higher ages than medium to coarse-grained phases from the center of the sill. A sample of baked shale below the sill was dated at 193 m.y. A whole rock de-

termination on the Watchung basalt gave an age of 79 m.y., indicating a retention of approximately 40 percent of radiogenic argon (see also Geophys. Abs. 185-16).—S.S.G.

188-39. Overstreet, W[illiam] C., Bell, Henry, III, Rose, H[arry] J., Jr., and Stern, T[homas] W. Recent lead-alpha age determinations on zircon from the Carolina Piedmont: U.S. Geol. Survey Prof. Paper, 424-B, p. B-103-B-107, 1961.

A series of twenty-one lead-alpha ages, with the exception of four, yielded ages that fall into three episodes and correspond to the position of their host rocks in the three episodes. Ages from 565±65 to 380±100 m.y. were determined for rocks of the oldest episode. Rocks of the next youngest episode gave ages from 300±35 to 445±50 m.y., and the rocks of the youngest episode yielded ages from 245±30 to 280±30 m.y. The determined ages for the rocks of the older episodes are believed to be modified by lead loss.— T.W.S.

188-40. Kulp, J. Laurence, and Eckelmann, F. Donald. Potassium-argon isotopic ages on micas from the southern Appalachians: New York Acad. Sci. Annals, v. 91, art. 2, p. 408-416, 1961.

Potassium-argon ages from the Blue Ridge and Piedmont Provinces of North Carolina, South Carolina, and Georgia identify three metamorphic belts, which have northeast trends. The eastern or 250-m.y. belt gives ages ranging from 240 to 265 m.y. In the central belt, the ages range from 250 to 350 m.y. West of the Blue Ridge front in North Carolina the sequence continues with ages from 350 to 850 m.y.

The basement of the southern Appalachians was formed at least 850 m.y. ago and metamorphosed at intervals 450-550; 350; and 250 m.y. ago.— H.T.

188-41. Adams, John A. S., and Rogers, John J. W. Bentonites as absolute time-stratigraphic calibration points: New York Acad. Sci. Annals, v. 91, art. 2, p. 390-394, 1961.

Five samples of zircon from the Middle Ordovician bentonites of Tennessee and Alabama give an average age of 447 m.y. The U-238/Pb-206 age on zircons appears to be the most reproducible. Biotite and sanidine are potential minerals for K-Ar and Rb-Sr dating.—S.S.G.

188-42. McCormick, George R. Petrology of Precambrian rocks of Ohio: Ohio Div. Geol. Survey Rept. Inv., no. 41, 60 p., 1961.

Descriptions and modal analyses are given of rocks from the Precambrian basement of Ohio penetrated in 21 drill holes. Rubidium-strontium ages on biotite and muscovite from six wells range from 920 to 980 m.y. No analytical data are given for these age determinations.— R.M.G.

188-43. Hurley, P[atrick] M., Brookins, D. G., Pinson, W[illiam] H., [Jr.], Hart, S. R., and Fairbairn, H[arold] W. K-Ar age studies of Mississippi and other river sediments: Geol. Soc. America Bull., v. 72, no. 12, p. 1807-1816, 1961.

Potassium-argon age relationships can be used in investigating the source or origin of recent sediments. Seemingly, the age value of rapidly deposited, unconsolidated sediments is an average of the age values of the various K-bearing mineral detritus; authigenic K-bearing minerals are probably lacking in such sediments. Age values of samples of the commonly gray, recently deposited, dominantly silt-sized material of the Mississippi Delta average 280 m.y. with little horizontal or vertical variation. The clay-size fractions of the same samples average only 166 m.y. Ages of reddish-brown sediments, believed to have been deposited by the Red River on the Mississippi Delta, are

690 m.y. for the dominantly silt-sized whole samples and 650 m.y. for the clay fractions. These older ages suggest a source area of Precambrian rocks as opposed to the dominantly Paleozoic, Cretaceous, and Tertiary source areas for Mississippi River sediments. Measured ages of the clay fractions from samples of the bottom sediments of the Rappahannock River in Virginia are similar to the ages of the crystalline rocks of the source regions.— R.F.M.

188-44. Tyler, S. A., and Bailey, S. W. Secondary glauconite in the Biwabic iron-formation of Minnesota: Econ. Geology, v. 56, no. 6, p. 1033-1044, 1961.

Glauconite has been identified in the Precambrian Biwabic iron formation of the Mesabi range. Field occurrence suggests a secondary origin, which is confirmed by K-Ar dates of 100 and 150 m. y. for specimens from two localities. It is suggested that the glauconite formed when the Cretaceous sea covered the Precambrian terrane. Glauconite-bearing Cretaceous sediments lie directly on the Biwabic iron formation at several localities.— R.S.C.

188-45. Curtis, G[arniss] H., Savage, D. E., and Evernden, J[ack] F. Critical points in the Cenozoic: New York Acad. Sci. Annals, v. 91, art. 2, p. 342-346, 1961.

Biotite and sanidine concentrates from volcanic tuff beds containing vertebrate faunas were dated by the K-Ar method as follows (in million years): Lower Hemphillian, Nev., 9.1; Clarendonian, Calif., and Nev., 10.6-12.0; Barstovian, Calif., 15.2; Hemingfordian, Calif., 17.3; Arikareean, Neb., 21.6; Whitneyan, Ore., 25.7; and Chadronian, Tex., 33.1.— T.W.S.

188-46. Damon, Paul E., and Giletti, Bruno J. The age of the basement rocks of the Colorado Plateau and adjacent areas: New York Acad. Sci. Annals, v. 91, art. 2, p. 443-452, 1961.

Rubidium-strontium ages (half life=50 b.y.) indicate that the Mazatzal orogeny occurred about 1,200-1,500 m.y. ago. Evidence for pre-existing basement older than 1,550 m.y. is lacking. This area was stable during the Paleozoic but became active again during the Mesozoic and Tertiary.— T.W.S.

188-47. Giletti, B[runo] J., and Gast, P[aul] W. Absolute age of pre-Cambrian rocks in Wyoming and Montana: New York Acad. Sci. Annals, v. 91, art. 2, p. 454-458, 1961.

A series of Rb-Sr ages (Rb-87 half life=50 b.y.) indicates a group of 2,300 to 2,700 m.y. old rocks in western and central Wyoming. Evidence for a metamorphic event at 1,550-1,700 m.y. in several areas bordering the older Precambrian rocks is presented.— T.W.S.

188-48. Houser, F. N., and Poole, F. G. Age relations of the Climax composite stock, Nevada Test Site, Nye County, Nevada: U.S. Geol. Survey Prof. Paper 424-B, p. B-176-B-177, 1961.

Field relations and a lead-alpha age determination suggest a Permian (?) to early Mesozoic age for the Climax composite stock.— T.W.S.

188-49. Bateman, Paul C. Granitic formations in the east-central Sierra Nevada near Bishop, California: Geol. Soc. America Bull., v. 72, no. 10, p. 1521-1538, 1961.

The Sierra Nevada batholith near Bishop, Calif., has been divided into six formal lithologic units (formations) and seven informal units on the basis of composition, texture, and intrusive relations. Granodiorite and quartz monzonite are the dominant rock types and are nearly equal in areal extent. The

rocks are Cretaceous in age. Eight age determinations by the lead-alpha (Larsen) method range from 88 to 116 m.y. but show little relation to observed intrusive relationships. More recent age determinations by the K-Ar method on a similar suite of granitic rocks from nearby Yosemite National Park range from 76.9 to 95.3 m.y. and agree with field relations.— R.M.G.

188-50. Lowdon, J. A., compiler. Geological age determinations: Canada Geol. Survey, Dept. of Mines and Tech. Surveys, Paper 61-17, p. 5-86, 1961.

Potassium-argon dates obtained by the Canadian Geological Survey during 1960 are given for samples from British Columbia, Yukon Territory, Alaska, District of Mackenzie, District of Keewatin, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, and Newfoundland.— R.M.G.

188-51. Rose, Edward R. Iron and titanium in the anorthosite of St. Urbain, Quebec: Canada Geol. Survey, Dept. of Mines and Tech. Surveys, Paper 61-7, 25 p., 1961.

The anorthosite massif at St. Urbain consists of a central core of anorthosite surrounded by a broad zone of more strongly magnetic dioritic, gabbroic, and granitic rocks emplaced in gneiss of the basement complex as a composite igneous intrusion. The outer zone of gabbroic and dioritic rocks carries more ferromagnesian minerals and iron-titanium oxide minerals than does the true anorthosite. Massive ilmenite deposits occur as vein-dikes in the anorthosite. A K-Ar age determination on biotite that formed at the time of ore emplacement in what is now the Bignell pit gives an age of 890 m.y. or late Precambrian; the anorthosite host rock is presumably only slightly greater in age. Remanent magnetization measurements on both ilmenite-hematite and anorthosite samples indicate that the remanent and induced magnetism components may be directed along widely different directions and may act to oppose or augment one another, thus affecting the intensity of the resulting magnetic anomaly. Remanent magnetism is thus an important factor in interpretation of aeromagnetic maps over this area. Strong aeromagnetic anomalies surrounding the anorthosite indicate that the massif (including its marginal phases) still has considerable potential as a future source of ilmenite-hematite and titanomagnetite ore.— V.S.N.

188-52. Stockwell, C. H., and Wanless, R. K. Canadian shield age program of the Geological Survey of Canada: New York Acad. Sci. Annals, v. 91, art. 2, p. 433-440, 1961.

Potassium-argon ages on phlogopite and biotite from six samples agree within approximately 5 percent with the U-Pb and Th-Pb ages for coeval uraninite and thorianite. Ages on micas from the Preissac-Lacorne batholith of western Quebec show a considerable range. Lepidolite and muscovite give ages of 2,600-2,700 m.y.; however, the biotite ages are at about 2,400 m.y. A program for geochronological studies of the Precambrian of Canada is outlined.— S.S.G.

188-53. Wetherill, G[eorge] W. Age measurements on the Cutler batholith, Ontario, Canada: New York Acad. Sci. Annals, v. 91, art. 2, p. 423-427, 1961.

This is virtually the same as the paper published in Jour. Geophys. Research, v. 65, no. 8, p. 2461-2466, 1960 (see Geophys. Abs. 182-37).— T.W.S.

188-54. Folinsbee, R. E., Baadsgaard, H[alfdan], and Lipson, J[oseph I.]. Potassium-argon dates of Upper Cretaceous ash falls, Alberta, Canada: New York Acad. Sci. Annals, v. 91, art. 2, p. 352-359, 1961.

Comparable K-Ar ages were obtained on biotite and sanidine from Cretaceous bentonites of Alberta and British Columbia, Canada. The middle Albian (Harmon) is dated at 116 m.y.; Cenomanian (Crowsnest), 95 m.y.; upper Campanian (Bearpaw), 75 m.y.; and upper Maestrichtian (Kneehills), 66 m.y. The end of Cretaceous time is estimated at 63 m.y. ago.— T.W.S.

188-55. Muller, J. E. Notes on age determinations made on Cordilleran rocks: Canada Geol. Survey, Dept. of Mines and Tech. Surveys, Paper 61-17, p. 98-107, 1961.

Potassium-argon dates, measured by the [Canada] Geological Survey on Cordilleran crystalline rocks, range from 765 to 11 m.y. and contain only a minority older than 100 m.y.

Using Holmes' latest time-scale, basic sills and a granitic stock intruding Proterozoic Purcell strata are late Precambrian to early Cambrian, and alkaline stocks intruding Rocky Mountain Paleozoic strata are Mississippian. The existence of Jurassic, and perhaps also Triassic, granitic intrusions is corroborated by some other dates of more than 100 m.y.

Major intrusive and migmatic activity in late Cretaceous to Tertiary time is indicated; most dates in the Mesozoic-Tertiary transition period are between 70 and 50 m.y.

In metamorphic rocks, the oldest dates—Mesozoic according to Holmes' time-scale—were found in mica schist, whereas gneissic terranes have so far yielded only dates younger than 70 m.y. A Mesozoic to Tertiary origin of Cordilleran metamorphic complexes is thus indicated by available dates, in contrast to the current concept of their Precambrian or Paleozoic age. This problem deserves close geological and physical study in the immediate future.— Author's abstract

188-56. Lipson, J[oseph I.], Folinsbee, R. E., and Baadsgaard, H[alfdan]. Periods of orogeny in the western Cordillera: New York Acad. Sci. Annals, v. 91, art. 2, p. 459-462, 1961.

A potassium-argon date of 17 m.y. on biotite from granodiorite indicates that the Snoqualmie batholith in Washington was emplaced during the Miocene, as has been suggested by Buddington and others. The Chilliwack batholith of Washington and British Columbia may be part of the same intrusion in the Cascade Range. Two samples of biotite from the Chilliwack granodiorite give K-Ar ages of 17 m.y. The lead-alpha method gives an older age of approximately 60 m.y. for the Snoqualmie granite.— S.S.G.

188-57. Reesor, J. E. White Creek Batholith: Canada Geol. Survey, Dept. of Mines and Tech. Surveys, Paper 61-17, p. 87-91, 1961.

Five age determinations by the K-Ar method on biotites from the White Creek batholith in southern British Columbia range from 79 to 18 m.y. They show a remarkably regular gradation from boundary to core and from ridge-top to valley-bottom. The possibility is considered that during cooling from the boundary inward and from the top downward, there was a regularly retreating critical isotherm above which there was a loss of argon and below which no argon was lost. The temperature of this isotherm would be below the temperature of consolidation of the granitic intrusion.— Author's abstract

181-58. Reesor, J. E. Valhalla complex: Canada Geol. Survey, Dept. of Mines and Tech. Surveys, Paper 61-17, p. 92-97, 1961.

Thirteen age determinations on biotite from the Valhalla complex (southern British Columbia) range from 62 to 11 m.y. From the present preliminary study these variations show no apparent relation to the structural or chemical pattern of this complex. The tentative conclusion is that there has been differential loss of argon during the cooling of a high-grade metamorphic complex.— Author's abstract

188-59. Baadsgaard, H[alfdan], Folinsbee, R. E., and Lipson, J[oseph I.]. Caledonian or Acadian granites of the northern Yukon Territory, in Geology of the Arctic, v. 1: Internat. Symposium on Arctic Geology, 1st, Calgary, Alberta, 1960, Proc., p. 458-465, 1961.

Biotite from a granite on Mount Fitton, northern Yukon Territory, returns a potassium-argon age of 353 m.y. Evidence, mainly from the Appalachian area of eastern North America and the Caledonian orogenic belt of Europe, suggests that extensive orogeny and granite emplacement occurred about 350 m.y. ago, probably during the Devonian period. The implications of the presence of mid-Devonian granites in the Canadian Arctic are obvious both with respect to trans-Arctic correlations, and, more locally, oil accumulation and mineral deposits.— Authors' abstract

188-60. Ruiz, Carlos; Aguirre, Luis; Corvalán, José; Rose, H[arry] J., Jr.; Segerstrom, Kenneth; and Stern, T[homas] W. Ages of batholithic intrusions of northern and central Chile: Geol. Soc. America Bull., v. 72, no. 10, p. 1551-1559, 1961.

Geologic field relations alone show that batholithic intrusions occurred in northern and central Chile during pre-Jurassic, Jurassic, and Cretaceous times. Seven age determinations by the lead-alpha (Larsen) method indicate that intrusions occurred during the early Permian, Late Jurassic, and Middle Cretaceous (Kulp's time scale), corresponding to the Hercynian, Late Jurassic, and mid-Cretaceous orogenic cycles. These orogenic cycles had previously been recognized in Chile on stratigraphic evidence.— R.M.G.

188-61. Nicolaysen, L. O., Burger, A. J., and Liebenberg, W. R. Evidence for the extreme age of certain minerals from the Dominion Reef conglomerates and the underlying granite in the Western Transvaal: Geochim. et Cosmochim. Acta, v. 26, p. 15-23, 1962.

Uranium-lead and thorium-lead isotope age determinations on three samples of "total conglomerate" and a monozite concentrate from the Dominion Reef conglomerates strongly suggest that the radioactive minerals crystallized about 3,100 m.y. ago and that the conglomerate was deposited less than 3,100 m.y. ago. Muscovite from a pegmatitic granite which is structurally below the sedimentary contact of the Dominion Reef sequence with the "Old Granite" basement gave a rubidium-strontium age of about 2,900 m.y.

Veinlets of galena are common within the uraninite and along the borders of uraninite grains. The lead in this galena was probably generated in the uraninite. When this galena is mechanically separated from the uraninite prior to chemical analysis a lower age results. The "total rock" analyses reported here contain the galena lead generated by the uraninite.— T.W.S.

188-62. Hales, A. L. An upper limit to the age of the Witwatersrand system: New York Acad. Sci. Annals, v. 91, art. 2, p. 524-528, 1961.

A plot of the ratio Sr-87/Sr-86 against Rb-87/Sr-87 for "total rock" samples of four granites from the Central Rand area near Johannesburg shows a linearity of points suggesting a closed system. The initial Sr-87/Sr-86 is indicated as 0.716, and the age as 3,100 m.y. Rb-Sr age determinations on feldspar and biotite from pegmatite support the conclusion that the granites crystallized 3,100 m.y. ago. The Witwatersrand system lies directly on the granite, the age of which is an important point in South African geochronology.— S.S.G.

Burger, A. J., Nicolaysen, L. O., and de Villiers, J. W. L. Lead isotopic compositions of galenas from the Witwatersrand and Orange Free State, and their relation to the Witwatersrand and Dominion Reef uraninites. See Geophys. Abs. 188-383.

188-63. McBurney, C. B. M. Absolute age of Pleistocene and Holocene deposits in the Haua Fteah: Nature, v. 192, no. 4803, p. 685-686, 1961.

The cave site of Haua Fteah in northeast Libya offers a nearly continuous cultural succession from pre-Mousterian up to the present. Carbon-14 determinations give an age for the earliest occupation horizon within the limits of 100,000-150,000 yr. An age of 38,000 yr is indicated for the Mousterian-Upper Paleolithic interface at the Haua Fteah, which compares favorably with previous estimates for the corresponding horizon at Shanidar (Kurdistan), Kara Kamar (Afghanistan), and Istallöskö (Hungary). The chronology suggested by the C-14 ages and stratigraphy at the Haua Fteah is in general agreement with available C-14 dates for the corresponding cultural events in nearby areas.— P.C.I.

188-64. Gheith, Mohamed A. Age of basement rocks in eastern United Arab Republic and northern Sudan: New York Acad. Sci. Annals, v. 91, art. 2, p. 530-534, 1961.

Potassium-argon ages of biotite from six crystalline rocks range from 435 to 540 m.y. A seventh sample of chloritized biotite from a mica schist was dated at 308 m.y., but the results are not considered reliable. A Paleozoic age is thus indicated for the basement of the Eastern Desert of Egypt, which has been considered to be Precambrian.— T.W.S.

188-65. Olausson, Eric. Studies of deep-sea cores: Swedish Deep-Sea Exped., 1947-48, Repts., v. 8, pt. 4, no. 6, p. 337-391, 1961.

The classification of deep-sea deposits is reviewed, and the following aspects of the problem of cores from the eastern Mediterranean basin are discussed: correlation between cores, remarks on certain types of deposits, and abnormal accumulations of foraminifera. The correlation of the core sequences (5 paleontological stages) with the Pleistocene chronology is made on the basis of radiocarbon datings; radiocarbon results together with earlier determinations are given in a table. The I/II stage boundary (Postglacial/Würm) is considerably older than 8,330 yr and somewhat younger than 17,200 yr, II/III (Würm/Riss-Würm) may be not less than 38,000 yr, and III/IV (Riss-Würm/Riss) greater than 40,000 yr.— V.S.N.

188-66. Grünenfelder, M., and Stern, T[homas] W. Das Zirkon-Alter des Bergeller Massivs [The zircon age of the Bergell massif]: Schweizer. Mineralog. Petrog. Mitt., v. 40, no. 2, p. 253-259, 1960.

Lead alpha age determinations were obtained on two zircon samples from the Bergell granite, an intrusive body crosscutting the penninic nappe systems of the southeastern Swiss Alps. Zircon concentrates of -30+100 and -100+200 mesh size gave ages of 25±10 and 30±10 m.y., respectively. These data are well supported by the tectonic and stratigraphic control of the area and are within the accepted age limits for the intrusion of the batholith in late Oligocene time.— Authors' abstract

188-67. Jäger, Emilie; Geiss, Johannes; Niggli, Ernst; Streckeisen, Albert; Wenk, Eduard; and Wüthrich, Hans. Rb-Sr-Alter an Gesteinsglimmern der Schweizer Alpen [Rb-Sr age of rock-forming micas of the Swiss Alps (with English summary)]: Schweizer. Mineralog. Petrog. Mitt., v. 41, no. 2, p. 255-272, 1961.

Five Rb-Sr ages on Alpine rock-forming micas are reported. Biotite from the quartz dioritic Cocco gneiss (Ticino, Lepontic region) gave an age of 16±1 m.y. Biotite from a paragneiss at 306±13 m.y. and a muscovite from an orthogneiss at 293±12 m.y. in the Silvretta nappe indicate that these rocks were

formed during the Hercynian orogeny. Further, these ages confirm that the Silvretta mass has been overthrust in Alpine time, because it overlies Mesozoic fossil-bearing strata.

Pegmatite muscovite from the small Tavetsch massif gave an age of 295±14 m.y.; this rock underwent an epizonal Alpine metamorphism, which apparently did not affect the Rb-Sr age. Biotite from a garnet gneiss of the Gotthard massif gave an age of 42±5 m.y., which may represent an older metamorphic phase during the Alpine orogeny or, more probably, a mixed age due to argon loss during the Alpine epizonal metamorphism at 16 m.y. ago.—J.W.C.

188-68. Ovchinnikov, L. N., Panova, M. V., and Shangareyev, F. L. Absolyutnyy vozrast nekotorykh geologicheskikh obrazovaniy Vengrii [Absolute age of some rocks from Hungary]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 228-234, 1961.

Potassium-argon ages of biotite, glauconite, feldspar, and whole-rock samples are given for various localities in Hungary as follows: Mecsek Mountains-biotite from rose granite, 335 m.y., whole rock and feldspar (4 samples), 260-285 m.y., post-granite trachydolerite dike rock, 110 m.y., and phonolite, 61 m.y.; Velence Hills - biotite from granite, 360 m.y., feldspar, 280 m.y., beresitized [sic] whole granite, 175 m.y., and andesite from dike in beresitized granite, 38 m.y.; Urkút manganese deposit - glauconite, 160 and 168 m.y.; Káráz trachydolerite, 31 m.y.; Egér rhyolite, 20 m.y.; Telkibánya trachyte, 24 m.y.; and Gyöngyössolymos (47°49' N., 19°56' E.) rhyolite, 15 m.y.—H.F.

188-69. Giletti, B[runo] J.; Lambert, R[ichard] St. J[ohn], and Moorbath, S[tephen]. The basement rocks of Scotland and Ireland: New York Acad. Sci. Annals, v. 91, art. 2, p. 464-468, 1961.

This is virtually the same as the paper published in Geol. Soc. London Quart. Jour., v. 117, pt. 3, no. 467, p. 233-272, 1961 (see Geophys. Abs. 187-22).—S.S.G.

188-70. Kulp, J. Laurence, and Neumann, Henrich. Some potassium-argon ages on rocks from the Norwegian basement: New York Acad. Sci. Annals, v. 91, art. 2, p. 469-473, 1961.

Potassium-argon dates on micas from rocks of the basement complex in northern and western Norway range from 385 to 575 m.y. The isotopic dates are interpreted to indicate varying degrees of argon loss as a result of heating or recrystallization of the rocks during the Caledonian orogeny. In southern Norway the K-Ar ages range from 815 to 1,345 m.y. with possible clusters at 900 and 1,100 m.y.—S.S.G.

188-71. Gerling, E[rik] K[arlovich], Yashchenko, M. L., Varshavskaya, E. S., and Matveyeva, I. I. Sravnitel'noye izucheniye argonovogo i strontsiyevogo metodov opredeleniya absolyutnogo vozrasta geologicheskikh formatsiy [Comparative study of the argon and strontium methods of absolute geologic age determination]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 296-302, 1961.

Potassium-argon and rubidium-strontium ages of 25 mica samples from Norway, Sweden, and the U.S.S.R. are compared and discussed briefly.—H.F.

188-72. Wetherill, G[eorge] W., Kouvo, O[lavi], Tilton, G[eorge] R., and Gast P[aul] W. Age measurements on rocks from the Finnish Precambrian: Jour. Geology, v. 70, no. 1, p. 74-88, 1962.

New mineral age measurements are reported from several subdivisions of the Finnish Precambrian. Samples of zircon, feldspar, and muscovite collected from the gneissose pre-Karelian basement area in eastern Finland indicate an age of about 2,700 m.y. for these rocks. In contrast, biotite ages from the same rocks agree at 1,800 m.y., presumably representing the effect of the orogeny at this time. Measurements on samples of mantled gneiss domes within the Karelian belt give feldspar and zircon ages supporting the correlation of these rocks with the pre-Karelian basement to the east, while again the biotite ages represent the time of the 1,800 m.y. orogeny. These results are very analogous to data previously reported for mantled gneiss domes near Baltimore, Md., [see Geophys. Abs. 175-13]. Additional measurements on the younger Precambrian rocks of Finland confirm earlier data indicating an age of around 1,800 m.y. for plutonic rocks associated with both the Svecofennian and Karelian orogenic belts.— Authors' abstract

188-73. Kouvo, Olavi, and Kulp, J. Laurence. Isotopic composition of Finnish galenas: New York Acad. Sci. Annals, v. 91, art. 2, p. 476-490, 1961.

The isotopic compositions of lead in 32 galena samples of the Precambrian rocks of Finland indicate a uniform model age of about 1,800 m.y. for the Svecofennian province, including the Savo schist belt. Two types of lead occur in the Karelian province. Galena from small veinlets gives a model age of 1,800 m.y., whereas galena from large ore bodies averages about 2,100 m.y. Galena samples from the basement rocks give model ages from 2,300 to 2,800 m.y. The sulfur isotopes of the ores in the Svecofennian and Karelian zones suggest derivation from metasedimentary sources rather than from the mantle or the deep crust. Correlation of galena model ages with zircon, feldspar, and mica ages by the U-Pb, Rb-Sr, and K-Ar methods indicates that the basement rocks may be about 2,800 m.y. old, that the Svecofennidic geosynclinal rocks were folded at approximately 1,800 m.y., and that the Karelian rocks may possibly have had an earlier history before 1,800 m.y. (See also Geophys. Abs. 177-11).—S.S.G.

188-74. Blake, Weston, Jr. Radiocarbon dating of raised beaches in Nordaustlandet, Spitsbergen, in Geology of the Arctic, v. 1: Internat. Symposium on Arctic Geology, 1st, Calgary, Alberta, 1960, Proc., p. 133-145, 1961.

Radiocarbon determinations on imbedded driftwood, shells, and whale bones, as well as the tentative correlation of pumice fragments with dated pumice in Denmark and Norway have provided a means of dating some of the well-developed raised beaches in the coastal zone of Nordaustlandet, Spitsbergen. Carbon-14 dates (4,000-7,000 yr B.P.) on driftwood from the uppermost of the three pumice-bearing levels and pumice dated elsewhere at 4,000 yr B.P. indicate that the beach formed in the Hypsithermal Interval (Tapes Sea). Two higher levels (8-44 m and 44-47 m) were dated at 9,000-10,000 yr B.P. and 35,000-40,000 yr B.P., respectively. The absence of material between 10,000 and 35,000 yr in age is probably the result of a more extensive ice cover during that time.— V.S.N.

188-75. Starik, I. Ye., and Arslanov, Kh. A. Vozrast po radiouglerodu nekotorykh obraztsov chetvertichnogo perioda [Age according to radiocarbon of some samples from the Quaternary period]: Akad. Nauk SSSR Doklady, v. 138, no. 1, p. 102-105, 1961.

Carbon-14 age determinations on 14 Quaternary samples from the European part of the U.S.S.R. are tabulated; they range from 1,170±150 to 42,700±2,000 yr. The most interesting results concern interglacial deposits near Ribinsk. The section ranges from 30,000 to 42,000 years old and, therefore, it is too young to be referred to the Mikulino interglacial (usually correlated with the

Eemian of western Europe); it should be correlated with the Göttweiger deposits of western Europe.— D.B.V.

188-76. Gerling, E[rik] K[arlovich], and Ovchinnikova, G. V. Ob anomal'nykh znacheniyakh vozrasta, poluchennykh po rubidiyevo-strontsiyevomu metodu [Anomalous ages obtained by the rubidium-strontium method]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 303-305, 1961.

Five out of six samples of mica from the Kola Peninsula give K/Ar ages around 3,600 m.y. and Rb/Sr ages about half as great. The discordance is tentatively ascribed to ion exchange of a small part of the potassium for rubidium. Microcline from one of the localities gives a Rb/Sr age of 2,730 m.y.— H.F.

188-77. Vinogradov, A. P., and Tugarinov, A. I. The geologic age of pre-Cambrian rocks of the Ukrainian and Baltic shields: New York Acad. Sci. Annals, v. 91, art. 2, p. 500-513, 1961.

The four-fold subdivision of the Precambrian of western U.S.S.R. is discussed. Part of the present area of the Ukrainian and Baltic shields existed 3,500 m.y. ago. Growth of the shields occurred during periods of igneous activity, approximately 3,200, 2,600, and 1,900 m.y. ago. These growth periods constitute orogenic megacycles, each having a 600 m.y. span. Following completion of the Ukrainian and Baltic shield formation approximately 1,900 m.y. ago, magmatic activity shifted to the region between and east of the shields and continued until 100 m.y. ago. This magmatic activity was associated with large-scale crustal warping, which resulted in large sedimentary basins.— R.F.M.

188-78. Filippov, M. S., Komlev, L. V., and Kuchina, G. N. Vozrastnyye dannyye argonovogo metoda dlya porod severo-zapada Ukrainskogo shchita [Age data of the argon method for rocks of the northwest Ukrainian shield]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 41-51, 1961.

Potassium-argon measurements on micas from the Osnitsky complex give values from 1,460 to 1,850 m.y. The highest figure is on muscovite from a pegmatite and is presumably closest to the true age of the complex. Ages of 1,450 and 1,560 m.y. are obtained for metamorphic rocks of the Ovruchskaya series and indicate the approximate time of the regional metamorphism of parts of the Ukrainian shield. The Korostensky intrusive complex gives ages around 1,850 m.y. and is probably coeval with the Osnitsky complex.— H.F.

188-79. Komlev, L. V., and Gorokhov, I. M. Vozrast nekotorykh slyud Ukrainy po dannym strontsiyevogo metoda [Age of some Ukrainian micas by the strontium method]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 52-55, 1961.

Parallel age determinations by the Rb/Sr and K/Ar methods, using Rb-87 $\lambda = 1.39 \times 10^{-11}$ per yr, give respectively 3,210 and 2,940 m.y. for biotite from pegmatite in the Yamburg quarry on the Mokraya Sura River, 3,020 and 2,850 m.y. for muscovite from a pegmatite near Zaporozhe, and 1,830 and 2,100 m.y. for biotite from another pegmatite near Zaporozhe. Isotope dilution was used in the Rb/Sr analyses with Rb-87 and Sr-84 as tracers.— H.F.

188-80. Semenenko, N. P. O vozraste metamorfizma porod Rakhovskogo massiva [Age of metamorphism of the rocks of the Rakhov massif]: Akad. Nauk Ukrain. SSR. Materialy Karpato-Balkan. Assots. no. 1, p. 188-189, 1960.

Potassium-argon ages of micas from schists of the Rakhov massif in the Carpathians are presented. Two epochs of metamorphism are recorded. An age group at 136-178 m.y. corresponds to a Mesozoic cycle, and an age group at 548-590 m.y. is related to the Precambrian Riphean cycle.— J.W.C.

188-81. Shirinyan, K. G., Karapatyan, G. A., and Gykasyan, P. Kh. Petrografiya i absolyutnyy vozrast Subatanskogo intruziva [Petrography and absolute age of the Subatan intrusive]: Akad. Nauk Armyan. SSR Izv., v. 12, no. 4, p. 63-68, 1959.

The Subatan intrusive is located on the southeast shore of Lake Sevan in the Armenian S.S.R. It ranges in composition from gabbro to quartz diorite. Potassium-argon age determinations on two specimens yielded ages of 52 and 57 m.y., which indicates that the intrusive was emplaced at the beginning of the Middle Eocene.— J.W.C.

188-82. Rubinstein [Rubinshteyn], M. M. Some critical points on the post-Cryptozoic geological time scale: New York Acad. Sci. Annals, v. 91, art. 2, p. 364-368, 1961.

Biotite from intrusive rocks in the Caucasus region was dated by the K-Ar method for three critical points on the geological time scale as follows: Post-Bojocian and Pre-Cretaceous (Bathonian), 167±9 m.y.; Post-Turonian and Pre-Eocene, 57±8 m.y.; and Late Eocene, 37±4 m.y. The beginning of Ordovician time is suggested as not less than 500-510 m.y. ago on the basis of a minimum age of 496±9 m.y. on glauconite. (Ages given above must be reduced by approximately 4 percent for K-Ar constants now in use in the United States.)—S.S.G.

188-83. Ovchinnikov, L. N., Panova, M. V., and Dunayev, V. A. Sopostavlyeniye absolyutnogo vozrasta paleozoyskikh effuzivov Urala s biostratigraficheskimi dannymi [Correlation of the absolute age of Paleozoic effusives of the Urals with biostratigraphic positions]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 92-100, 1961.

Of 14 K/Ar ages of whole effusive rocks, only one approximates the "presumed correct" age obtained by stratigraphic means. All other ages are on the average about 20 percent lower.— H.F.

188-84. Vistelius, A. B., and Krylov, A. Ya. Ob absolyutnom vozraste oblomochnoy chasti peschano-alevritovykh otlozheniy yugo-zapada Sredney Azii [On the absolute age of the clastic part of the sandy-silty deposits of southwest central Asia]: Akad. Nauk SSSR Doklady, v. 138, no. 2, p. 422-425, 1961.

Clastic fragments in the sandy-silty deposits of the southwest part of central Asia have been dated by the K-Ar method; results of 25 measurements on rocks ranging from Jurassic to Quaternary (alluvium) are tabulated. The fragments are derived mainly from rocks of two different age groups. The provenance of the material as indicated by the age of the fragments confirms that deduced from the mineral associations.— D.B.V.

188-85. Chernov, G. A. Restavratsiya geologicheskikh sobytiy po dannym strukturnogo analiza i opredeleniy absolyutnogo vozrasta argonovym metodom na primere Byelokurikhinskogo massiva na Altaye [Reconstruction of geologic events by structural analysis and absolute age determination by the argon method on the Byelokurikhin massif in the Altay]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 101-115, 1961.

Twenty K/Ar ages that scatter from 220 to 780 m.y. are analyzed.— H.F.

188-86. Ivanov, A. I., Lyapichev, G. F., and Zamyatin, N. I. K voprosu ob absolyutnom vozraste kaledonskikh intruziy khrebta Chingiz (Vostochnyy Kazakhstan) [Absolute age of Caledonian intrusives of the Chingiz Range (Eastern Kazakhstan)]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 116-128, 1961.

Eight large granitic bodies were mapped in a belt about 100 miles long near the eastern end of the Chingiz anticlinorium. The oldest (granodioritic) intrusions cut and metamorphose fossiliferous rocks of Wenlockian (Early Silurian) age and are overlain by Lower to Middle Devonian effusive rocks. Later granitic intrusions cut the granodiorites. Biotite from the granodiorites of the Kryk-Kuduk complex in the Chingiz Range (3 samples) and one muscovite from a greisen in the Terskey Ala-Tau range give K/Ar ages very near 500 m.y., regardless of the degree of chloritization. Biotite from granites of the Chingiz complex (3 samples) gives K/Ar ages very near 470 m.y. and biotite from granites of the Borovskoy complex gives ages very near 450 m.y. (2 samples).—H.F.

188-87. Ivanov, A. I., Monich, V. K., Zamyatin, N. I., and Nurlybayev, A. N. Absolyutnyy vozrast shchelochnykh porod Ishimskogo kompleksa v tsentral'nom Kazakhstane [Absolute age of the alkalic rocks of the Ishim complex in central Kazakhstan]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 129-136, 1961.

This is virtually the same as the paper published in Akad. Nauk Kazakh. SSR Izv. Ser. Geol., no. 1 (42), p. 15-20, 1961 (see Geophys. Abs. 186-44).—H.F.

188-88. Ivanov, A. I., Lyapichev, G. F., and Zamyatin, N. I. Absolyutnyy vozrast anortoklazovykh granit-porfirov iz Teniz-Korzhunkul'skoy muldy (Tsentral'nyy Kazakhstan) [Absolute age of the anorthoclase granite porphyries from the Teniz-Korzhunkulsky basin (Central Kazakhstan)]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 137-139, 1961.

The porphyries of the Teniz-Korzhunkulsky coal basin east of Akmolinsk are among the youngest crystalline rocks in central Kazakh S.S.R. Potassium-argon ages of biotite from two samples (Gora Saryadyr and Bol'shoy Koytas) are 250 m.y.—H.F.

188-89. Ravich, M. G., and Krylov, A. Ya. O vozraste metamorficheskikh kompleksov Taymyra [Age of the metamorphic complexes of the Taymyr]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 140-145, 1961.

The Proterozoic complex of metamorphic rocks covers an area of about 70,000 sq km in the Gorny Taymyr and overlies an older gneiss complex more than 8 km thick. Potassium-argon ages on whole-rock samples and one biotite are scattered between 650 and 230 m.y., but most are at about 250 m.y. The ages presumably indicate the effect of late Paleozoic tectonic processes.—H.F.

188-90. Mikheyenko, V. N., and Nenashev, N. I. Absolyutnyy vozrast obrazovaniya i otnositel'nyy vozrast vnedreniya kimberlitov Yakutii [Absolute age of formation and relative age of intrusion of the Yakutsk kimberlites]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 146-164, 1961.

Phlogopites from the kimberlite pipes "Chomur" and "Flogopitovaya" in the Olenek River basin in the eastern part of the Aldan shield give K/Ar ages of 635-695 m.y. (5 samples). The kimberlite intrudes limestones of the Llandovery stage (Lower Silurian). The measured ages date the formation of the kimberlite itself and not the time of intrusion, which occurred considerably later. It is proposed that the kimberlite intruded in a plastic but cold condition by a process not too different from that of formation of salt domes.—H.F.

188-91. Klyarovskiy, V. M., Dmitriyev, A. N., Kozhevnikov, V. S., and Belous, N. Kh. Absolyutnyy vozrast melovykh i tretichnykh otlozheniy Zapadnosibirskogo zhelezorudnogo basseyna po glaukonitam [Absolute age of Cretaceous and Tertiary sediments of the western Siberian iron ore basin according to glauconites]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 216-227, 1961.

Potassium-argon ages of 7 glauconites from drill cores in the Bakcharskaya area and 1 from a drill core in the Kolpashyevskaya area range from 56 to 132 m.y. Stratigraphic columns are given, and rates of sedimentation ranging from 0.3 to 1.2 cm per 1,000 yr are calculated.— H.F.

188-92. Sobotovich, E. V. O vozmozhnosti opredeleniya absolyutnogo vozrasta granitov Terskey Ala-Tau po zaklyuchennomu v nikh svintsu [Possibility of determining the absolute age of the granites of the Terskey Ala-Tau by the lead included in them]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 269-280, 1961.

The U, Th, and Pb contents and Pb isotopic composition of 10 granite samples from the Terskey Ala-Tau are reported. A new method of age calculation, based on the "null" content of radiogenic lead, permits not only the determination of the age but also gives insight into the history of formation of the granites. These granites separated from their parent material more than 500 m.y. ago when this material was already 3,100 m.y. old. A similar calculation applied to stony meteorites gives a value of 4,500 m.y., in agreement with the literature (Patterson).— H.F.

188-93. Zhirov, K. K.; Artyomov [Artemov], Yu. M.; Volobuyev, M. I.; Zhirova, V. V.; Knorre, K. G.; Krizhansky, L. M.; Mochalov, Yu. Z., and Tikhonov, V. Ye. The age of the Taraksky granite massif and other formations of the Yenisey Ridge: New York Acad. Sci. Annals, v. 91, art. 2, p. 284-293, 1961.

The Pb-207/Pb-206 and Pb-U ages as determined from the isotopic composition of lead in 10 galenas, 3 microclines, and 13 accessory minerals indicate that the granites, ore deposits, and metamorphic rocks of the Tarak massif in the Yenisey Range, U.S.S.R., formed during 3 periods at approximately 1,850; 1,000-1,300; and 400 m.y. ago. (See also Geophys. Abs. 184-63.)— R.F.M.

188-94. Yel'yanov, A. A., and Moralev, V. M. Novyye dannyye o vozraste ul'traosnovnykh i shchelochnykh porod Aldanskogo shchita [New data on the age of the ultrabasic and alkaline rocks of the Aldan shield]: Akad. Nauk SSSR Doklady, v. 141, no. 3, p. 687-689, 1961.

Eighteen new age determinations on different igneous rocks from the Ingiliy, Gorno-ozer, Arbarastakh, Konder, and Inaglin massifs in the Aldan shield made by the K/Ar and U/Pb—Th/Pb methods are tabulated. The results suggest that the ultrabasic and alkaline rocks are genetically related and formed 650±50 m.y. ago (late Sinian), and that the Inaglin and Konder massifs are composite

plutons consisting of both intrusive and metasomatic rocks belonging to two distinctly different complexes of Precambrian and post-Jurassic age.—D.B.V.

188-95. Desio, Ardito, and Longinelli, Antonio. Sull'età dei graniti del Baltoro (Karakorum-Himalaya) [On the age of the Baltoro granites (Karakorum-Himalaya)]: Accad. Naz. Lincei Atti, Cl. Sci. Fis., Mat. e Nat. Rend., v. 30, no. 4, p. 437-448, 1961.

Three granites from the Baltoro region of the Karakorum Range of the Himalayas (leucogranite from Urdukas, leucogranite from the Muztagh valley, and a diorite from moraine on Falchan Kangri) have been studied chemically and petrographically and their ages determined by the pleochroic halo method (relative to the dated Elba granite). The Urdukas granite is found to be the youngest (6±2 m.y., middle Pliocene). The granite from the Muztagh valley is at least 30 m.y. old (Oligocene) and also shows the effects of partial metamorphism at the time of intrusion of the Urdukas granite. Results on the diorite were not conclusive.— D.B.V.

188-96. Bobrov, V. A., Polevaya, N. I., and Sprintsson, V. D. Predvaritel'nyye dannyye o vozraste nekotorykh magmatogennykh porod vostochnykh rayonov Mongol'skoy Narodnoy Respubliki [Preliminary data on ages of some magmatogenic rocks of the eastern regions of the Mongolian National Republic]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 235-255, 1961.

Potassium-argon ages of 4 whole-rock and 3 biotite samples from the Yugodzyr region fall in two groups, one at 150-183 m.y. and the other at 419-450 m.y. One sample gives 315 m.y. Ages from 133 to 295 m.y. are observed on six biotite and one whole-rock samples from eastern Mongolia. Sample localities are shown on a tectonic map, 1:10,000,000.— H.F.

188-97. Polevaya, N. I., Putintsev, V. K., and Sprintsson, V. D. O vozraste nekotorykh magmaticheskikh i metamorficheskikh porod Severnoy Korei [The age of some magmatic and metamorphic rocks of North Korea]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, 9th sess., p. 256-268, 1961; also in Sovetskaya Geologiya, no. 6, p. 119-124, 1961.

Potassium-argon age reconnaissance of Northeastern Korea shows 5 biotite samples 1,646-2,020 m.y. old in the Changjin River area, 12 biotite and whole-rock samples 190-225 m.y. old in the Hyesan complex northeast of Changjin, 6 biotite samples 148-191 m.y. old in the Tanchion complex, and 5 volcanic rocks about 5-10 m.y. old near Kilchu. Localities are shown on a tectonic map, 1:5,000,000.— H.F.

188-98. Evernden, J[ack] F[oord], and Richards, J. R. Potassium-argon ages at Broken Hill, Australia: Nature, v. 192, no. 4801, p. 446, 1961.

Potassium-argon ages of 504 and 526 m.y. on gneisses at Broken Hill and of 457 m.y. on granite from Encounter Bay have been measured. The 457 m.y. is considered as a possible upper limit to the time of any movement of the Torrowangee series at Broken Hill. Sufficient evidence does not exist to relate the K-Ar results to the lead model ages of Russell and Farquhar (see Geophys. Abs. 185-393).— T.W.S.

188-99. Wilson, A[llan] F., Compston, W., and Jeffery, P. M. Radioactive ages from the Pre-Cambrian rocks of Australia: New York Acad. Sci. Annals, v. 91, art. 2, p. 514-520, 1961.

This is virtually the same as the paper published in Geol. Soc. Australia Jour., v. 6, pt. 2, p. 179-195, 1960 (see Geophys. Abs. 185-72).— S.S.G.

188-100. Mason, Brian. Potassium-argon ages of metamorphic rocks and granites from Westland, New Zealand: New Zealand Jour. Geology and Geophysics, v. 4, no. 4, p. 352-356, 1961.

Potassium-argon age determinations on 5 samples of schist and gneiss from the southern Alps, Westland, New Zealand, gave ages of less than 10 m.y. except for one sample with an age of 76 m.y. Biotite from a syngenetic pegmatite gave an age of 25 m.y. Geological evidence indicates that the rocks were formed either during the Early Cretaceous or earlier. The anomalously-low K-Ar ages suggest that these rocks remained deeply buried at a high temperature until the late Tertiary; then they were uplifted along the Alpine Fault. The age of a slightly metamorphosed argillite from the eastern edge of the metamorphic region was determined as 166 m.y. Two granites from west of the Alpine Fault gave ages of 70 and 286 m.y.; the latter granite intrudes the Greenland series.— R.F.M.

188-101. Starik, I. Ye., Krylov, A. Ya., Ravich, M. G., and Silin, Yu. I. The absolute ages of east Antarctic rocks: New York Acad. Sci. Annals, v. 91, art. 2, p. 576-582, 1961.

This is virtually the same as the paper published in Internat. Geol. Cong., 21st, Copenhagen 1960, Doklady Sovet. Geologov, Problema 3, p. 149-157, 1960 (see Geophys. Abs. 185-75).—S.S.G.

Geiss, Johannes, Oeschger, Hans, and Signer, Peter. Radiation ages of chondrites. See Geophys. Abs. 188-118.

Vilczek, Else, and Wänke, H. Sodium-22 in the Breitscheid meteorite. See Geophys. Abs. 188-117.

Fireman, E. L., and Fisher, D[avid] E. Uranium in the Sikhote-Alin meteorite and its relation to the lead method of age determination. See Geophys. Abs. 188-116.

COSMOGONY

188-102. Grundland, I. Vitesse de la combustion des éléments dans le cours de la nucléosynthese et age des elements—fonctions de la masse initiale ou prend lieu la nucléosynthese. Essai d'évaluation de la proportion des éléments plus lourds que H et He sur la planète Jupiter [Speed of combustion of the elements in the course of nucleosynthesis and age of the elements—functions of the initial mass in which nucleosynthesis takes place. Attempt at evaluation of the proportion of elements heavier than H and He on the planet Jupiter]: Experientia, v. 17, no. 12, p. 539, 1961.

The speed of combustion of the elements is expressed as an inverse function of the initial mass of hydrogen from which the other elements successively formed. Considering the solar system to be a homogeneous unit, the proportion of elements heavier than hydrogen and helium in a planet such as Jupiter is calculated to be 99.8 percent. This calculation is based on a linear relationship established from data concerning the sun and earth.— D.B.V.

188-103. Utech, Karl. Frequency of meteorite falls throughout the ages: Nature, v. 193, no. 4810, p. 56-57, 1962.

The finding of large numbers of cosmic spherules in Lower Triassic mud and core samples from oil wells in northwest Germany supports Pettersson's view that meteors reached the atmosphere of the earth long before Quaternary times, and contradicts Paneth's view, supported by Dingle, that meteorites did

not fall before late Tertiary time (see Geophys. Abs. 186-56). The investigation also indicates that the fall of spherules was fairly constant in early Triassic times.— D.B.V.

188-104. Levin, B. Yu. Meteority [Meteorites]: Moscow, Izdatel'stvo "Znaniye," 46 p., 1961.

The history of scientific study of meteorites is reviewed. The subjects treated are fall, orbits, and physical processes during flight in the atmosphere; meteoritic craters on the surface of the earth; the Tungus and Sikhote-Alin meteorites; the purpose of meteorite study; and the composition, structure, age, and origin of meteorites.— A.J.S.

188-105. Wong, Wen-Po. The chemical genesis of the earth [in Chinese with English abstract]: Acta Geophys. Sinica, v. 9, no. 1, p. 25-37, 1960.

A crude thermodynamic analysis was made for the chemical composition of the silicate and metallic phases of a meteorite, and the relation between the chemical composition and free energy of several elements is illustrated in a graph. The equilibrium temperature is at 5,800-7,500°K, and the concentration of oxygen-carrying ion is on the order of 10^{-3}-10^{-4}. Such conditions are found on the surface of the sun.

A similar analysis was made of the silicate phase of cosmic spherules and igneous rocks. The relationship between the composition, free energy, and molar volume for some elements is shown in a table. Equilibrium occurs at 3,300-4,500°K under pressures of 8,000-22,000 atm.— V.S.N.

188-106. Green, Ronald. Thermoelectric currents in meteorites: Jour. Geophys. Research, v. 67, no. 2, p. 908-909, 1962.
Stacey, F. D., Lovering, J. F., and Parry, L. G. Reply to preceding discussion: ibid., p. 910-911, 1962.

The entry of a meteorite into the earth's atmosphere has been shown by Lovering, Parry, and Jaeger (1960) to result in temperatures sufficient to fuse and ablate the surface while at a depth of 3 cm the temperature does not rise above 100°C. Green points out that under such high thermal gradients strong magnetic fields will be generated, and it is difficult to find the conditions whereby a meteorite can arrive on the earth's surface and not be magnetized. Consequently, there can be little justification for advocating a disrupted planet that had a magnetic field of terrestrial type to account for magnetized meteorites (see Stacey and others, Geophys. Abs. 185-81).

In reply, Stacey, Lovering, and Parry dismiss Green's postulated mechanism, giving reasons why it is inapplicable to chondrites, on which their measurements were made. They reassert their conclusion that the thermoremanence of certain chondrites originated in the parent body.— D.B.V.

188-107. Öpik, Ernst J. The survival of stray bodies in the solar system: Acad. Sci. Fennicae Annales, Ser. A, III, no. 61, p. 185-195, 1961.

Formulas are derived and applied to the calculation of probabilities of collision, ejection, and orbital change in random close encounters of stray bodies with the planets. For Pluto, the interplay of commensurable periods with perturbation leads to an elimination of close encounters, so that its orbit is metastable indefinitely.— Author's abstract

188-108. Orsini, C. Q. On the relative abundance of carbon, nitrogen, and oxygen in the cosmic rays: Nuovo Cimento, v. 16, no. 6, p. 1040-1045, 1960.

Measurements made with balloon-carried emulsions, exposed at an atmospheric depth of approximately 6 g per sq m, of the relative abundances of car-

bon, nitrogen, and oxygen in cosmic rays yielded values that could not be made to agree with Suess and Urey's cosmic abundances (1956). These results indicate that the chemical composition of the sources of cosmic rays is different from the mean composition of the Universe.— D.B.V.

188-109. Adler, I[sidore], and Dwornik, E[dward] J. Electronprobe analysis of schreibersite (rhabdite) in the Canyon Diablo meteorite, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-B, p. B-263-B-265, 1961.

The electronprobe can be used to provide point by point analysis of microscopic volumes of the order of several cubic microns of a metallic meteorite. Moreover, the electronprobe is a nondestructive technique that allows reexamination of the specimen in the light of the compositional data obtained. The technique and results of an analysis of a 1/4"×1/8" fragment of the Canyon Diablo meteorite are described and discussed. The study demonstrates the variation in content of iron and nickel in rhabdites in one single meteorite specimen. In this case, the nickel ranges from 22 percent in grain A to 48 percent in grain D, the Ni/Fe ratios range from 0.34 to 1.33, and the sum of the weight percents of nickel and iron ranges from 79 to 87 percent. Eleven analyses of the kamacite phase show average contents of 7.3 percent nickel and 89 percent iron; the range in composition is strikingly less than that in the rhabdites.— V.S.N.

188-110. Grigor'yev, D. P., Kolomenskiy, V. D., and Kuznetsova, V. G. O sostavlenii mineralogii meteoritov [On the constitution of meteorite mineralogy]: Akad. Nauk SSSR Meteoritika, no. 20, p. 172-177, 1961.

A compilation of data on the mineralogy of meteorites as a branch of cosmic mineralogy is proposed. A survey of the history of this proposal, the mineralogical characteristics of each cosmic mineral and their comparison with similar terrestrial minerals, and the mineralogy of all types of meteorites are to be included in a volume, which would also contain analyses, constants, morphological characteristics, parageneses, and available literature.— A.J.S.

188-111. Zadorozhnyy, I. K. Mass-spektral'noye opredeleniye soderzhaniya inertnykh gazov v zheleze [Mass-spectrometric determination of the content of inert gases in iron]: Akad. Nauk SSSR Meteoritika, no. 18, p. 141-143, 1960.

A method of mass spectrographic analysis of the isotopic composition of ert gases in iron meteorites using an isotopic dilution technique is discussed. The contents of Ar and Ne in three samples of Sikhote-Alin meteorite were determined separately for atmospheric and cosmic argon. The error of measuring the isotopes was 5-7 percent for Ar and ±12 percent for Ne.— A.J.S.

188-112. Umemoto, Shunji. Isotopic composition of barium and cerium in stone meteorites: Jour. Geophys. Research, v. 67, no. 1, p. 375-379, 1962.

The isotopic composition of barium from three stone meteorites differs from a sample of terrestrial barium by an apparent enrichment in the low mass isotopes. The variations are approximately linear with the mass and are believed to be outside of the variations attributed to analytical errors. Cerium from the Bruderheim meteorite has an isotopic composition similar to terrestrial cerium within the limits of the analytical method.— C.E.H.

188-113. Reynolds, J[ohn] H. Isotopic composition of xenon from enstatite chondrites: Zeitschr. Naturforschung, v. 15a, no. 12, p. 1112-1114, 1960.

It is reported that enstatite chondrites exhibit a uniform xenon spectrum with a very prominent excess of Xe-129 and with secondary anomalies similar to those found in Richardton and the carbonaceous chondrites (see Geophys. Abs. 183-66, -67, -68, -70). The Xe-129/I-129 ratios in Abee, Indarch, and St. Mark's and the secondary anomalies (expressed as values of δ M) are tabulated.— D.B.V.

188-114. Zähringer, J., and Gentner, W. Zum Xe-129 in dem Meteoriten Abee [On the Xe-129 in the Abee meteorite (with English abstract)]: Zeitschr. Naturforschung, v. 16a, no. 3, p. 239-242, 1961.

A degassing experiment in steps at different temperatures shows that radiogenic Ar-40 and primordial Ar-36 are trapped differentially in the Abee enstatite chondrite. Ar-40 diffuses out easily at low temperatures; Ar-36 is released essentially at temperatures higher than 1,000°C. Xe-129 follows the amount of primordial Ar-36 and the Xe-129/Xe-132 ratio is 5.5 at all temperatures. This may indicate that all xenon isotopes have been included as primordial gas, and care should be taken to relate it to the iodine content of the present meteorite sample or to add the I-Xe age to the K-Ar age of the meteorite.— Authors' abstract

188-115. Jeffery, P. M., and Reynolds, J[ohn] H. Concerning Xe-129 in meteorite Abee: Zeitschr. Naturforschung, v. 16a, no. 4, p. 431-432, 1961.

Because of the importance of the experiment by Zähringer and Gentner (see Geophys. Abs. 188-114) and the far-reaching conclusions based on it, Jeffery and Reynolds undertook to repeat the experiment, using a larger sample. The curves obtained for Ar and Xe-132 evolution are in general agreement with those obtained by the Heidelberg group, but the Xe-129/Xe-132 ratio is strikingly different; in that case, temperature variations far beyond the limits of experimental error were found. It is clear that there are phases of the meteorite in which there is a marked excess of Xe-129, probably the iodine-bearing phases; there is no need to doubt that the Xe-129 was formed from I-129-decay in place.— D.B.V.

188-116. Fireman, E. L., and Fisher, D[avid] E. Uranium in the Sikhote-Alin meteorite and its relation to the lead method of age determination: Nature, v. 192, no. 4803, p. 644-645, 1961.

Samples of the Sikhote-Alin meteorite and a uranium standard were irradiated. Less than 1.4×10^{-13} g/g of U-235 was found. This amount of uranium is more than 100 times too small to account for the excess of Pb-207 in the meteorite in 5 b.y. The U and Pb contents of the meteorite are inconsistent with the common assumptions made in determining lead ages for the earth and for meteorites.— T.W.S.

188-117. Vilczek, Else, and Wänke, H. Natrium 22 im Meteorit Breitscheid [Sodium-22 in the Breitscheid meteorite]: Zeitschr. Naturforschung, v. 15a, no. 11, p. 1004-1007, 1960.

Sodium-22 has been measured for the first time in a meteorite, in Breitscheid which fell on August 11, 1956. Because of its relatively short half life of 2.6 yr, Na-22 appears to be particularly suitable for measuring fluctuations of cosmic radiation in relation to sunspot periods. A cosmic-ray age of about 30 m.y. is calculated for this meteorite from the decay rate of Na-22 and the amount of the disintegration product Ne-22.— D.B.V.

188-118. Geiss, Johannes, Oeschger, Hans, and Signer, Peter. Radiation ages of chondrites: Zeitschr. Naturforschung, v. 15a, no. 11, p. 1016-1017, 1960.

The concentrations of tritium and of all the isotopes of helium, neon, and argon have been determined in some chondrites, using techniques that are described elsewhere (see Geophys. Abs. 183-60, -72). Radiation ages are calculated from the He-3/He-4 ratios, assuming equal direct production rates for tritium and He-3. He-4 and K/Ar ages are estimated on the basis of the average contents of uranium, thorium, and potassium in chondrites.

Those chondrites with high radioactive He-4 and K/Ar ages all give He-3/He-4 radiation ages of 22±2 m.y.; this strongly implies that many of the chondrites arriving at the earth were created in a single break-up about 22 m.y. ago. A strong correlation between low radioactive ages and low radiation ages can best be explained by loss of gases during the time between the break-up and collision with the earth; the low radiation ages, therefore, do not necessarily represent break-up times.— D.B.V.

188-119. Donati, G[emmarosa] R. Levi, and Chapman, C. A. Meteorites in the University of Illinois Natural History Museum—A descriptive catalog: Urbana, University of Illinois, 28 p., 1960.

The meteorite collection of the University of Illinois consists of 30 specimens totaling 9304.93 g and representing 20 different falls from various parts of the world. The specimens are classified by type (aerolite, siderolite, and siderite) and described. The meteoritic data are presented in a table in accordance with the three standard meteorite classifications—the Brezina, Prior, and Leonard. A bibliography of more than 100 references is included.— V.S.N.

188-120. Krinov, E. L. Nekotoryye soobrazheniya o sbore meteoritnogo veshchestva v polyarnykh stranakh [Some considerations on collection of meteoritic matter in polar countries]: Akad. Nauk SSSR Meteoritika, no. 18, p. 136-140, 1960.

This is a proposal for collecting meteoritic material in polar areas. The paucity or absence of industrial dust should permit effective collection of meteoric and cosmic dust. The scientific value of such collection is discussed, and general suggestions on the method of collection given.— A.J.S.

188-121. Penchev, N. P., Pencheva, Y. N., and Bonchev, P. R. O khimicheskom sostave meteorita Gumoshnik (Bolgariya) [On the chemical composition of meteorite Gumoshnik (Bulgaria)]: Akad. Nauk SSSR Meteoritika, no. 18, p. 144-146, 1960.

The Gumoshnik meteorite, which fell on April 28, 1904 near the village of the same name in Troyansk Okoliya, Bulgaria is described and discussed. The weights of the two largest fragments are 3,815 and 1,475 g. Mineralogical, chemical, and spectral analyses of the meteorite are given.— A.J.S.

188-122. Yudin, I. A. Mineragraficheskoye issledovaniye kamennogo meteorita Nikol'skoye [Mineralographic investigation of stone meteorite Nikol'skoye]: Akad. Nauk SSSR Meteoritika, no. 18, p. 147-154, 1960.

A mineralographic analysis was made of the nontransparent minerals of the meteorite Nikol'skoye, which fell March 6, 1954 (see Geophys. Abs. 188-123). The meteorite is a chondrite and consists of the following minerals (weight percent): olivine 70.8, bronzite 16.0, kamacite plus taenite 9.7, troilite 3.4, chromite 0.1, and small percentages of sodic plagioclase, apatite, and merrilite.— A.J.S.

188-123. Kolomenskiy, V. D. Rezul'taty rentgenometricheskogo issledovaniya kamennogo meteorita Nikol'skoye [Results of the X-ray investigation of the stone meteorite Nikol'skoye]: Akad. Nauk SSSR Meteoritika, no. 18, p. 155-161, 1960.

X-ray data on the composition and structure of the Nikol'skoye chondrite of March 6, 1954 are presented in a table and discussed. Some differences were found in the accepted crystallographic relationship between the edge of the cell of nickel-iron alloy and the percentage of nickel present.— A.J.S.

188-124. Zolotov, A. V. Novyye dannyye o Tungusskoy katastrofe 1908 g. [New data on the Tungus catastrophe of 1908]: Akad. Nauk SSSR Doklady, v. 136, no. 1, p. 84-87, 1961.

Study of the Tunguska area indicates that the total energy of the Tungus cosmic body was $(1.1\text{-}2.8)\cdot10^{23}$ ergs. The explosion took place at not less than 5 km altitude, and the final velocity of the body was not greater than 3-4 kmps. In this case, transformation of kinetic energy into thermal energy is impossible, because this can happen only when the impact velocity of the body is about 5 kmps. These data and the fact that the estimated ratio of light energy to total energy is about 30 percent, that is, of the same order of magnitude as in a nuclear explosion, suggest that the explosion of the cosmic body was caused by its internal energy.— A.J.S.

188-125. Isakovich, M. A., and Roy, N. A. Acoustic method of measuring the dynamical parameters of meteorites: Internat. Geophys. Year Annals, v. 12, pt. 2, p. 484-485, 1961.
Komissarov, O. D., Nazarova, T. N., Neugodov, L. N., Poloskov, S. M., and Rusakov, L. S. Rocket and satellite investigation of micrometeorites: ibid., p. 460-465, 1961.

An acoustic pickup that reacts just to the impact received on incidence of a micrometeorite particle—that is, a ballistic pickup—is proposed for use in rockets and satellites. By measuring the momentum received, such a pickup should measure the kinetic energy of the particle. The theoretical characteristics of an instrument of this type are outlined.

Apparatus constructed according to this suggestion is described, with wiring diagrams, and some results of preliminary measurements are presented by Komissarov and others.— D.B.V.

188-126. LaGow, H. E., Schaefer, D. H., and Schaffert, J. C. Micrometeorite impact measurements on a 20 in. diameter sphere at 700-2,500 km altitude: Internat. Geophys. Year Annals, v. 12, pt. 2, p. 465-472, 1961.

Crystal microphones were used to detect the impacts of micrometeorites on a 20-inch diameter sphere during an attempted launching of an earth satellite. This International Geophysical Year satellite was carried on a Vanguard launching vehicle to altitudes about 2,500 km on May 27, 1958. A total of 17 impacts were recorded during a 590-sec period after the satellite was separated from the launching vehicle. This gave an average period between counts of 35 sec and an average flux 3.6×10^{-2} impacts per sq m per sec. Laboratory calibrations indicated that the system was sensitive enough to detect all micrometeorites large enough to stay in the solar radiation field.— Authors' abstract

188-127. Dubin, Maurice. Meteoritic dust measured from Explorer I: Internat. Geophys. Year Annals, v. 12, pt. 2, p. 472-484, 1961.

Results of measurements of micrometeorite impacts on the cylindrical shell of the satellite 1958α, monitored by a calibrated piezo-electric detector, are presented. During 12 days, 153 impacts were detected; this is the equivalent of 1.7×10^{-2} impacts per sq m per sec on the earth. For a mean impact velocity of 30 kmps the particles had a mass of 8×10^{-10} g or larger; thus, the accretion rate of terrestrial dust may be estimated at 10,000 tons per day during February 1958. A day-to-day variation of the influx rate as large as an order

of magnitude is evident from the data. A "shower" of dust particles was recorded on the third day in orbit. A variation in particle influx may also be attributed to a diurnal effect from the earth's rotation and its heliocentric velocity.— D.B.V.

188-128. Skolnick, H. Ancient meteoritic dust: Geol. Soc. America Bull., v. 72, no. 12, p. 1837-1841, 1961.

Dominantly magnetic, spherical, and spheroidal microscopic particles (50-850μ) observed in well cuttings and cores of sedimentary rocks of Cretaceous, Miocene, and Pleistocene age from the Sacramento, San Joaquin, and Ventura basins of California, respectively, are similar, when particulate in drill cuttings, to weld spatter, material not unexpected at a well site. It is concluded that much of the California material is meteoritic in origin and dates back to the Late Cretaceous.— Author's abstract

188-129. Dickey, D. D., and Johnson, Ross B. Influence of natural fractures on the shape of explosion-produced craters, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-361-C-363, 1961.

The influence of pre-existing fractures on the form of craters and pattern of ejecta produced at the Nevada Test Site (Buckboard Mesa), Nye County, Nev., is discussed and demonstrated. This is also shown to be true of Meteor Crater where the shape was apparently controlled by two strong regional joint sets.— V.S.N.

188-130. Shoemaker, E[ugene] M., Gault, D. E., and Lugn, R. V. Shatter cones formed by high speed impact in dolomite, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-365-D-368, 1961.

A laboratory demonstration of the mechanisms and conditions under which shatter cones are formed was undertaken to evaluate shatter cones as a criterion for the recognition of ancient large-scale impact structures. A 3/16-inch aluminum sphere, launched at high speed from a light-gas gun, struck the machined surface of a block of fine-grained sandy dolomite (Alpha member of the Kaibab limestone) at a speed of 5.61 kmps. The resulting crater and the three shatter cones produced in the bottom are described and discussed.— V.S.N.

188-131. Jones, R. V. Sub-acoustic waves from large explosions: Nature, v. 193, no. 4812, p. 229-232, 1962.

As in the case of the Krakatoa explosion of 1883, the disturbance that originated in Siberia on June 30, 1908 and the Russian nuclear explosion of October 30, 1961 gave rise to strong atmospheric waves which were recorded on microbarographs in many parts of the world. The records obtained from the 1961 explosion at Aberdeen, Scotland, are discussed in some detail. Comparison of their wave form with that observed after the 1908 incident shows that the latter had an extra train of short-period waves at the tail of the main train; Whipple has suggested that the main train was due to the bow wave of a meteorite as it fell through the atmosphere and that the later train was caused by the impact with the ground. Assuming that the Siberian incident was due to a meteorite and that the air waves were caused by its kinetic energy alone, the mass of the meteorite is calculated to have been at least 30,000 tons.— D.B.V.

188-132. Barnes, Virgil E. Tektites: Sci. American, v. 205, no. 5, p. 58-65, 1961.

Today tektites are thought to belong to the accumulating body of physical evidence for immense catastrophes caused in ages past by the impact of large

meteorites on the earth. As such, they are regarded as droplets of molten rock thrown high into the air and outward over long distances from the impact site. Tektites are closely related chemically to crustal rock of the earth and more specifically to the sedimentary rocks. This weighs against both a meteoritic origin and a lunar origin. Evidence that tektites were formed at temperatures higher than 1,710°C and were molten for only a few mintues at most is discussed. The internal structure of some Australian tektites presents particularly impressive evidence for high temperature and rapidity of cooling. The Australian tektites are a special problem because they show evidence of partial remelting; tektites from other parts of the world, however, show no evidence of entry or re-entry into the atmosphere from outside. Tektites of the various regional groups are widely scattered, but the members of each group have distinctive characteristics associating them with others of their kind. From evidence of the associated geology the various groups are identified as belonging to single showers, and no tektite has been shown to be younger or older than the members of its group. Ages range from about 45 m.y. in the case of the Texas bediasites and about 20 m.y. for moldavites to as little as a few thousand years for the australites. Possible impact sites that could have provided a source for the tektites are discussed.— V.S.N.

188-133. Vorob'yev, G. G. Metod kolichestvennogo spektral'nogo analiza tektitov i silikatnoy fazy meteoritov [A method of quantitative spectral analysis of tektites and the silicate phase of meteorites]: Akad. Nauk SSSR Meteoritika, no. 20, p. 185-192, 1961.

A comparative study of the chemical composition of tektites and of various volcanic glasses similar in composition to that of tektites is discussed. Tables of chemical parameters of tektites and obsidians were prepared from the data available in special literature, and a vector diagram according to the Zavaritskiy method was constructed. It was found that tektites are not a product of terrestrial lavas but, similar to achondrites, were generated in a massive celestial body on which volcanic processes similar to those on the earth occurred.— A.J.S.

188-134. Starik, I. Ye., Sobotovich, E. V., Shats, M. M., and Lovtsyus, G. P. Uran i svinets v tektitakh [Uranium and lead in tektites]: Akad. Nauk SSSR Meteoritika, no. 20, p. 204-207, 1961.

An attempt is made to determine the origin of tektites by the content of uranium and lead and the isotopic composition of the lead. Moldavites, indochinites, one philippinite, and one sample of glass from the desert of Libya, each weighing 10-20 g, were analyzed by the luminescence method for uranium and by the pyrochemical method for lead. The preparation of the samples and the method of analysis are described briefly. The results of the analysis are presented in a table, on the basis of which no definite preference can be given either to the cosmic or terrestrial hypotheses of origin, although their purely terrestrial origin was found doubtful.— A.J.S.

188-135. Grannis, P. D. Electrostatic erosion mechanisms on the moon: Jour. Geophys. Research, v. 66, no. 12, p. 4293-4299, 1961.

The electrostatic processes suggested by Gold (1959, 1961) as being responsible for erosion of the lunar features are evaluated. The electrostatic hopping effect caused by charge build-up on the dust grains due to solar gas streams is calculated to be lower by a factor of at least 100 than the rate indicated by observations of the moon. Owing to the supporting action of the electronic space charge, however, positively charged dust grains may be levitated above the surface, and the mass transport resulting from the downhill gliding of such levitated grains may be sufficient to explain observed lunar erosion.— D.B.V.

188-136. Miyamoto, S. Magmatic boiling and underground structure of the moon: Kyoto Univ. Inst. of Astrophysics and Kwasan Observatory Contr., no. 96, 6 p., 1960.

Lunar craters were formed as a result of degassing process at a time when cooling of the moon allowed a crust to form. Further cooling caused the subcrustal magmas to boil and either explode and blow off the crustal cover or form a cavern filled with gases below the crust. The occasional gas ejection observed from lunar craters is attributed to the leakage of gases from such underground caverns.— V.S.N.

188-137. Warner, Brian, and Fielder, Gilbert. Stresses around lunar craters: Nature, v. 193, no. 4817, p. 762-763, 1962.

An immediate conclusion of the newly proposed theory of the formation of lunar craters (see Geophys. Abs. 188-138) is that the general lunar surface stresses were tensions, on which were superimposed the tensile stresses indigenous to the craters themselves. By considering that the tensile stress S_r, perpendicular to the radius vector centered in a crater and introduced by the growth of the crater, is proportional to an inverse power of the distance r from the center, it can be shown from measurements made on photographs of the fracture systems around the craters Aristillus and Bullialdus that the following obtains: $S_r \approx r^{-1/3}$. It would be of interest to know whether a similar relationship can be found for some terrestrial rocks.

It is further found that the general tensile stress in the lunar surface layers must have been approximately constant over the entire surface, and that the process of lunar crater formation was a slow one.— D.B.V.

188-138. Fielder, Gilbert. Origin of the Mare Imbrium: Nature, v. 193, no. 4812, p. 258, 1962.

When details of the lunar surface are considered, there is no clear evidence that a large-scale collision ever occurred to produce the Mare Imbrium. Evidence has been assembled that is strongly against the collision hypothesis. Lunar craters are divided into different size groups and into two or three age groups. It was found that in a given area of the moon the mean percentage ellipticities of the craters generally increase with the age of the craters, and that craters of a given group generally show higher ellipticities in the Vaporum region than in the Hipparchus region. It is concluded that the craters were distorted from their original nearly circular shape by certain stresses in the moon's crust, and that these stresses acted for a longer time on an old crater than on a young one. As the Vaporum region is closer to Mare Imbrium than the Hipparchus region, the crustal stresses that produced these distortions of the craters are in some way associated with the formation of the Mare Imbrium. It therefore appears plausible to assume that Mare Imbrium itself formed over a very long interval of time.— D.B.V.

188-139. Arthur, D. W. G., and Whitaker, E. A. Orthographic atlas of the moon, pt. 2, Limb areas: Tucson, The University of Arizona Press, 31 plates and index diagram, 1961.

Standard orthographic grid coordinates are superposed on 31 photographs covering the limb areas of the moon.— J.W.C.

188-140. Miyamoto, S., and Matsui, M. Photographic atlas of the moon: Kyoto Univ. Inst. of Astrophysics and Kwasan Observatory Contr., no. 95, 3 p., 85 plates, 1960.

Eighty-five pictures of the moon are reproduced from a series photographed during the period 1958-60 at Kwasan Observatory, Kyoto University, Japan, for geological study of the lunar surface. Most of the regions of the moon included

in this compilation are shown under several different phases of illumination. The 30 cm Cooke refractor used to make the photographs is described.— V.S.N.

188-141. Marshall, C. H. Thickness of the Procellarian system, Letronne region of the moon, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-208-D-211, 1961.

The Procellarian system is the most extensively exposed stratigraphic unit in the Letronne region of the Moon. It is characterized by low albedo and underlies extensive areas of generally low relief that occupy 82 percent of the region. The system underlies 240,000 sq km in the Letronne region and has a calculated average thickness of 1.1 km and a volume of 265,000 cu km. The method of estimating the thickness of the formation by reconstruction of the buried pre-Procellarian topography is described in detail.— V.S.N.

188-142. Chenoweth, P. A. Comparison of the ocean floor with the lunar surface: Geol. Soc. America Bull., v. 73, no. 2, p. 199-210, 1962.

Both the volcanic and meteoritic theories of the origin of the lunar surface features lead to the conclusion that the agent that produced the larger lunar features (maria, mountains, clefts, and the larger craters) was more active in the past and may have been essentially dormant since the Archeozoic era. The most likely place on earth to look for similar features, therefore, is in areas that have changed little since that time.

The Atlantic Ocean floor resembles the moon's surface in many ways. The Maderia Abyssal Plain is comparable in size and shape to Mare Crisium, and the Sohm Abyssal Plain resembles Oceanus Procellarum or Mare Frigoris. The Mid-Atlantic Ridge is reminiscent of the lunar uplands, the mid-oceanic canyons recall the clefts of the moon, and the seamounts are like the isolated peaks and mountains of the Mare Imbrium district. East of Bermuda there is a range of low abyssal hills very similar to the lunar Haenus Mountains. Two gashes across the Mid-Atlantic Ridge, one at lat 30° N. and one at the equator, are much like the Alpine Valley of the moon. Steep slopes are characteristic of both the lunar mountains and the submarine slopes of the Atlantic. Both the Atlantic floor and the low areas of the moon are thought to be blanketed with dust-sized material.— D.B.V.

EARTH CURRENTS

188-143. Deniskin, N. A., Nikiforova, N. N., and Lomakina, Z. D. Ob elektromagnitnom zondirovanii glubokikh sloyev Zemli [On electromagnetic sounding of the earth's deep layers]: Akad. Nauk SSSR Doklady, v. 140, no. 3, p. 587-590, 1961.

On the basis of earth current and magnetic records obtained at stations at Alushta, Shatsk, and Moscow in the U.S.S.R., it is calculated that the earth consists of an upper layer 4-5 km thick with an electrical resistance of 30-40 ohms, a second layer 150 km thick with a resistance of 1,500 ohms, and a third layer 350 km thick with a resistance of 250 ohms; these are underlain by highly conducting material with a resistance of 1 ohm.— D.B.V.

188-144. Verö, J[osef]. Ein Versuch zur Trennung der einzelnen Frequenzbänder der Erdstromvariationen [An attempt at separation of the individual frequency bands of earth current variations (with English summary)]: Geofisica Pura e Appl., v. 49, p. 83-118, 1961.

Results of a study of earth current variations recorded near Nagycenk, Hungary, are presented. Variations with periods of 1 sec to 1 hr were divided into 7 frequency bands: (1) first band of nighttime pulsations (1-10 sec); (2) storm pulsations (10-20 sec); (3) daytime pulsations (20-60 sec); (4) second

band of nighttime pulsations (1-2 min); (5) first band of primary variations (2-6 min); (6) secondary variations (6-24 min); and (7) second band of primary variations (24-60 min).

The behavior, form, and daily and annual variations of each band and variations of the ratios of the amplitudes of the north and east components are discussed.— D.B.V.

188-145. Kavin, A. V. Electrical exploration operations by the telluric current method in the Chinese Peoples Republic [in Chinese with Russian abstract]: Acta Geophys. Sinica, v. 8, no. 2, p. 138-158, 1959.

A short review is given of methods of carrying out field work by the telluric current method and of working up tellurograms in connection with tests in various parts of China. The most effective method is that of combined ellipses; however, for completeness of the geologic interpretation of telluric current anomalies, supplemental field measurements are necessary. Several methods of simplified treatment are examined for provisional interpretation in the field. Examples are presented of telluric current operations both for solution of regional problems and for exploration of local structures in Tsaydam, Dzhungarii, and Ordosa.— Author's abstract, J.W.C.

188-146. Academia Sinica. A direct current amplifier of the modulation type for the telluric current method of geophysical prospecting [in Chinese with English abstract]: Acta Geophys. Sinica, v. 8, no. 2, p. 175-186, 1959.

A recently constructed two-channel direct-current amplifier of the modulation type for telluric current exploration is described, and the results of laboratory and field tests are discussed. The methods used to reduce the noise level are emphasized. The amplifier is suitable for measurement of very weak and low frequency signals because it has a relatively low amplitude and phase distortion to wave signals, a noise level less than 0.5 microvolt, and a zero-point drift or less than 5 microvolt per hr. A schematic diagram is given.— V.S.N.

EARTHQUAKES AND EARTHQUAKE WAVES

188-147. Hofmann, Renner B. Aftershock-energy release versus tidal effects, Hebgen Lake Earthquake, Montana, in Geological Survey Research 1961: U. S. Geol. Survey Prof. Paper 424-C, p. C-267-C-270, 1961.

The distance, magnitude, and energy of aftershocks that followed the Hebgen Lake, Mont., earthquake of 1959 were calculated from 876 seismograms. Two portable seismic stations, approximately 40 km southwest and 130 km south of the epicentral area, recorded the aftershocks for 2 1/2 days. Only shocks of magnitude greater than or equal to 2.2 were used. Times of station operation and energy-release data for the shocks are given in a table. The methods of calculation are described. Corrections for tidal acceleration are discussed, and a comparison of aftershock-energy release with barometric pressure and components of tidal acceleration caused by the sun and moon is illustrated in a graph. Changes in atmospheric loading were found to have had no obvious relation to the variation of aftershock-energy release.— V.S.N.

188-148. Witkind, Irving J. Deformation of the epicentral area, Hebgen Lake, Montana, earthquake of August 17, 1959—Dual basin concept, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-165-D-168, 1961.

Detailed data on the relative and absolute ground movement produced by the Hebgen Lake earthquake of August 17, 1959, suggest as a possible inter-

pretation the unequal subsidence of two independent basins, one on each side of the core of the Madison Range. The dual-basin concept holds that the West Yellowstone and Missouri Flats basins, to the east and west of the Madison Range, respectively, subsided during the earthquake but that the core of the Madison Range remained fairly stable. The axes of these two basins are subparallel but not connected. This subsidence of local crustal blocks is believed to be a direct result of the broad epeirogenic uplift and arching characteristic of this region since late Cenozoic. Available geologic and geodetic data and the preliminary seismic solution for the earthquake fault suggest that the Hebgen-Red Canyon fault zone is fundamental and that deformation everywhere in the area is most extreme near faults. On this basis, subsidence of two basins seems reasonable. (See also Geophys. Abs. 188-149).— V.S.N.

188-149. Myers, W. Bradley, and Hamilton, Warren. Deformation accompanying the Hebgen Lake, Montana, earthquake of August 17, 1959—Single-basin concept, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-168-D-170, 1961.

A second possible interpretation (see Geophys. Abs. 188-) of the geologic and geodetic data on the relative and absolute ground movement produced by the Hebgen Lake earthquake of August 17, 1959, is that a single broad basin of subsidence plunges gently eastward across Madison Valley, Madison Range, and West Yellowstone basin to Hebgen Lake and ends abruptly against three southeast-trending reactivated fault scarps on the northeast side of Hebgen Lake. Evidence in the Madison River Canyon is interpreted as demonstrating subsidence of the Madison Range, and subsidence is inferred south of the canyon. Madison Valley south of the Madison River Canyon has been deformed by Quaternary tilting and subordinate faulting along structures oblique to the northwest-trending and generally older basin-and-range structures of Madison Valley and Madison Range, which are continuous with the major east-trending structures of the tectonically very active Centennial Range and Centennial Valley. It is suggested that the northwest-trending Madison structures are being progressively modified and distorted as structures of the Centennial system are extended across them.— V.S.N.

188-150. Bailey, Reed W. Madison River-Hebgen Lake earthquake and highway problems, in Symposium, 12th, On geology as applied to highway engineering: Tennessee Univ. Eng. Expt. Sta. Bull., no. 24, p. 38-50, 1961.

A general description is given of the Madison River-Hebgen Lake, Mont., earthquake of August 1959 and of the damage to highways and dams resulting from faulting and landslides.— V.S.N.

188-151. Bateman, Paul C. Willard D. Johnson and the strike-slip component of fault movement in the Owens Valley, California, earthquake of 1872: Seismol. Soc. America Bull., v. 51, no. 4, p. 483-493, 1961.

Maps and photographs made by W. D. Johnson in 1907 show that the faulting that took place near Lone Pine, Calif., in the 1872 earthquake involved both dip-slip and right-lateral components of movement. This pattern is opposed to the postulate of regionally systematic left-lateral movement along the east side of the Sierra Nevada during the Cenozoic, but does not prove systematic regional right-lateral movement. Detailed geologic mapping is necessary to describe fully the Cenozoic regional movement pattern.— D.B.V.

188-152. Figueroa Abarca, Jesús. "Macrosismo de Jaltipan" [Earthquake of Jaltipan]: Anales Inst. Geofisica, v. 6, p. 55-69, 1960.

The seismicity of the Isthmus of Tehuantepec is summarized. The alinement of earthquake epicenters from north to south across the isthmus and ex-

tending into the Pacific Ocean and Gulf of Mexico at either end suggests the presence of a fault. The location, distance from the Tacubaya seismological station, frequency of earthquake occurrence between 1927 and 1958, depth of focus, and other observations for each epicenter are given in a table. Jaltipan on the Gulf Coast was destroyed by an earthquake on August 26, 1959 that occurred at one of the previously known epicenters, lat 18°27' N., long 94°16' W. The magnitude at Veracruz 200 km from the epicenter was 7.1. A brief analysis is given of the instrumental effects at various stations and the destructive effects. Magnitude in relation to the intensity and acceleration, and the periods in relation to distance from epicenter are discussed. A map of the isthmus shows five magnitude zones for the 1959 earthquake, the location of important epicenters of other earthquakes, and the location of the postulated fault. Pertinent data for the Jaltipan earthquake as recorded at 11 seismic stations in Mexico are given in a table.— V.S.N.

188-153. Merino y Coronado, J. El terremoto de Jaltipan, Ver. del 26 de Agosto de 1959 [The earthquake of Jaltipan, Veracruz on August 26, 1959]: Anales Inst. Geofisica, v. 6, p. 89-137, 1960.

The earthquake that destroyed Jaltipan, Veracruz, on August 26, 1959 is described. Damage to buildings is analyzed and accelerations are computed by simple formulas, which are not exact but may be useful to engineers working in the field. Isoacceleration lines that agree closely with those determined instrumentally are given where possible. The area of observed damage was 2,200 sq km, and the felt area was 450,000 sq km. Damage to buildings was due primarily to poor design and workmanship. A series of pictures that shows damage to buildings is discussed.— V.S.N.

188-154. Lomnitz, C[inna]. A study of the Maipo Valley earthquakes of September 4, 1958: World Conf. on Earthquake Eng., 2d, Tokyo and Kyoto 1960, Proc., v. 1, p. 501-520, 1960.

Some of the difficulties of earthquake research in regions where few reliable seismic stations are in operation are illustrated by a discussion of the Maipo Valley (central Chile) earthquakes of September 4, 1958. In 1958 Chile had one first-class seismic station at Santiago, and aside from field investigations most of the instrumental data for study of the earthquakes came from stations outside Chile. A series of 13 foreshocks that occurred throughout August 1958 preceded the series of 3 main shocks of September 4, 1958. The magnitudes of these main shocks were 6.9, 6.7, and 6.8. The epicenters were at lat 33°50'15" S. (±15"), long 70°10'15" W. (±15") at a depth of 10 km; the estimated epicentral area was 700 sq km. A fault-plane solution indicates a fault striking N. 13° E. and dipping 77°32' W. Instrumental data, fault plane solutions, and historical data for the area are illustrated in tables and graphs.— V.S.N.

Blot, C., and Tazieff, H[aroun]. Some results of volcanic seismology at the volcano on Tanna, New Hebrides. See Geophys. Abs. 188-597.

Shimozuru, D[aisuke]. Seismologic study of Nyiragongo Volcano. See Geophys. Abs. 188-595.

188-155. Sawarenski, E. F. [Savarenskiy, Ye. F.], and Kirnos, D. P. Elemente der Seismologie und Seismometrie [Elements of seismology and seismometry]: Berlin, Akademie-Verlag, 512 p., 1960.

This is a German translation of the Russian book Elementy seysmologii i seysmometrii (see Geophys. Abs. 167-40).— J.W.C.

188-156. Wood, H[arry] O., Heck, N. H., and Eppley, R. A. Earthquake history of the United States, Part 2: Stronger earthquakes of California and western Nevada: U.S. Coast and Geod. Survey Spec. Pub., no. 41-1 revised (1960) ed., 55 p., 1961.

This edition of part 2 (California and western Nevada) of the Earthquake history of the United States is a revision through 1960 by Eppley of the 1951 edition by Wood and Heck (see Geophys. Abs. 148-13347). Intensities have been re-evaluated in terms of the Modified Mercalli Intensity Scale of 1931; magnitude is given in terms of the Gutenberg-Richter scale. In general, the lower limit of earthquakes included in this publication is intensity VI. The earthquakes from 1769 through 1960 are listed in a table giving date, time, location, area affected, and intensity. Finally, each earthquake is described briefly.— V.S.N.

188-157. Milne, W. G., and Lucas, K. A. Seismic activity in western Canada 1955 to 1959 inclusive: Dominion Observatory Ottawa Pubs., v. 26, no. 1, 23 p., 1961.

The 766 earthquakes that occurred during the period 1955-59 in Canada west of the 113th meridian are listed. The seismic data were gathered from a network of five seismograph stations reporting to the Dominion Astrophysical Observatory at Victoria, B. C. Earthquakes whose epicenters have been determined are plotted on yearly maps, and all earthquakes in excess of magnitude 4 for which data are available are plotted on a separate map. Richter magnitudes for local tremors are included.— V.S.N.

188-158. Gajardo, E., and Lomnitz, C[inna]. Seismic provinces of Chile: World Conf. on Earthquake Eng., 2d, Tokyo and Kyoto, 1960, Proc., v. 3, p. 1529-1539, 1960.

Four major seismic provinces are defined for Chile by using the statistical method of Tsuboi (1958): Pampa del Tamarugal, lat 19°-22°S.; Atacama, lat 26°-29° S.; Central Chile, lat 31°-35° S.; and Chile Sur, lat 37°-40° S. Data of several thousand shocks over a period of 15 yr were used in the computation. Tables and maps showing the relative seismicity of the regions are given.— V.S.N.

188-159. de Bremaecker, J. Cl. Séismicité du graben de l'Afrique centrale [Seismicity of the graben of central Africa]: Louvain Univ. Inst. Géol. Mém., v. 22, p. 101-116, 1961.

The epicenters of a few hundred earthquakes for the period 1955 to mid-1958 in the central part of the West African Rift Valley are plotted on a map; most of the shocks are found to be clearly related to the Rift Valley. The magnitudes of the earthquakes were determined. The most interesting discovery is that of a transverse seismic zone that extends westward from Lake Kivu to the Congo River. At its intersection with the Rift Valley, this zone is marked by both active and extinct volcanoes. The amount of seismic energy liberated within 500 km of Lwiro (the site of one of the modern seismographs in the Rift Valley area) has been computed for ten day periods and summarized for each year. The average energy is 3.5×10^{20} ergs per yr or about 0.03 percent of that of the whole earth. This figure confirms that the seismic activity of the graben area, an exception in the extremely stable continent of Africa south of the Sahara, is moderate.— V.S.N.

188-160. Atanasiu, Ion. Cutremurele de pămînt din Romînia [Earthquakes in Rumania]: Bucharest, Akad. Republicii Populare Romîne, 194 p., 1961.

A comprehensive review is presented of earthquakes that have occurred in Rumania from A.D. 170 to 1942; about 400 are described. A chapter is devoted to each of the large subdivisions of the country, and these are in turn divided into sections in which smaller areas are described. Date, hour, intensity, and felt-area are given along with numerous maps showing epicenters and isoseismic lines.— J.W.C.

188-161. Bagdasarova, A. M., Islamov, K. Sh., Koridalin, Ye. [E.] A., Kuznetsov, V. P., Kuz'mina, N. V., Nenilina, V. S., Nersesov, I. L., Sultanova, Z. Z., and Kharin, D. A. Seysmichnost' vostochnoy chasti yuzhnykh otrogov Glavnogo Kavkazskogokhrebta i nekotoryye metodicheskiye voprosy izucheniya seysmichnosti otdel'nykh rayonov. So. 1 [Seismicity of the eastern part of the south foothills of the main Caucasus Range and some methodological problems of study of the seismicity of individual regions, Pt. 1]: Akad. Nauk Azerbaydzhan. SSR Izv., no. 6, p. 121-131, 1959.

The eastern part of the south flank of the Caucasus is a seismically active area where earthquakes of 7-8 points intensity have occurred repeatedly. One of the most active seismic zones of this area is the Shemakha region, where destructive earthquakes have been of intensity up to 9. A second seismically active zone lies to the west of Shemakha in the Zakataly-Nukha region. Farther to the west is the Kakhetia-Kazbeka seismic zone, where a large number of earthquakes of intensity 6-7 have occurred. The seismic zones of this part of the Caucasus are characteristically separated by areas of complete calm. Detailed descriptions are given of earthquakes in the Vartashen, Kutkashena, and Marazy regions.— J.W.C.

188-162. Bagdasarova, A. M., Islamov, K. Sh., Koridalin, Ye. [E.] A., Kuznetsov, V. P., Kuz'mina, N. V., Nenilina, V. S., Nersesov, I. L., Sultanova, Z. Z., and Kharin, D. A. Seysmichnost' vostochnoy chasti yuzhnykh otrogov glavnogo Kavkazskogo khrebta i nekotoryye metodicheskiye voprosy izucheniya seysmichnosti otdel'nykh rayonov. So. 3 [Seismicity of the east part of the south spurs of the main Caucasus Range and some methodological problems of study of the seismicity of individual regions. Pt. 3]: Akad. Nauk Azerbaydzhan. SSR Izv., no. 4, p. 13-24, 1961.

A seismic expedition in 1953 determined that seismic activity is relatively high in the east part of the south slope of the Main Caucasus Range. Epicenters and focal depths were determined for 213 earthquakes. Most of the epicenters were located in a belt along the south flank of the Caucasus, forming individual concentrations separated by areas of relative calm. This entire belt extending from the Kazberg region to the Apsheron Peninsula is potentially seismic. Traveltime data are given for P- and S-waves, and several diagrams are presented to illustrate epicenter determinations.— J.W.C.

188-163. Fedotov, S. A. Seismicity of the south of the Kuril Islands: World Conf. on Earthquake Eng., 2d, Tokyo and Kyoto 1960, Proc., v. 3, p. 1643-1648, 1960.

A network of highly sensitive seismic stations was established in the southern Kuril Islands in 1957 as a part of the larger program of the International Geophysical Year. The type of equipment installed at the four stations is described briefly; each station is designed to record a great number of weak near earthquakes and thus to obtain data on the seismicity of the area within short periods of time. Study of this recent data and of data for the last 50 years shows that strong surface earthquakes are unlikely in the southern Kuril Islands. At hypocentral distances from 120 to 200 km earthquake intensity, on the average, does not exceed 9 points even in the case of earthquakes of magnitude greater than 8.—V.S.N.

188-164. Savarenskiy, Ye. F., and Mey, Shi-yun. Investigation of seismic activity of the territory of China [in Chinese]: Acta Geophys. Sinica, v. 8, no. 1, p. 1-6, 1959.

Intensity, magnitude, and depth of earthquakes are treated mathematically, and data for these parameters are given for several earthquakes that originated in China between 1918 and 1924. (See also Geophys. Abs. 182-103.)— J.W.C.

188-165. Van, Guan'-Yuan'. On the new Chinese seismic scale [in Chinese with Russian abstract]: Acta Geophys. Sinica, v. 8, no. 1, p. 7-14, 1959.

The new seismic scale is based on damage to buildings and constructions. According to its description of damage to residential buildings and industrial smokestacks, however, the intensity of earthquakes on the new scale is lower than on other scales used in the world. The new scale gives inaccurate estimates of the resistivity of several types of buildings. For example, it states incorrectly that an industrial smokestack and a Chinese pagoda behave similarly during earthquakes. The indices of intensity on the new scale do not correspond to those used in compilation of the seismic regionalization maps of China. Descriptions of damage to conventional type structures should supplement the seismic scale, and quantitative indices of intensity should be included.— J.W.C.

188-166. Petrushevskiy, B. A. On the geologic setting of the Khayyuan earthquake of 1920 [in Chinese with Russian abstract]: Acta Geophys. Sinica, v. 8, no. 2, p. 105-108, 1959.

The Khayyuan earthquake of 1920 took place in an area where the most recent deforming movements are not clearly expressed at the surface. Several earthquakes of low intensity have occurred in this area in the past, but their epicenters were dispersed and did not form a linear belt. The area is one of intersection of two different tectonic zones: the epi-Hercynian platform and the Kholanshan-Lyubanshan. Very recent differential movements here may be masked by the continuous loess cover. (See also Geophys. Abs. 185-122.)— J.W.C.

188-167. Hirono, Takuzo. Seismicity of Japan: World Conf. on Earthquake Eng., 2d, Tokyo and Kyoto 1960, Proc., v. 3, p. 1511-1521, 1960.

Japan, in the circumpacific seismic zone, experienced perceptible earthquakes on an average of 1,497 times per year over the period 1923-59. The earthquakes vary in number from year to year becoming numerous after any big earthquake or occurring in occasional swarms in association with volcanic activity. A study of the geographical distribution of the number of earthquakes indicates that the most frequently felt region is along the Pacific coast of east and north Japan (the outer seismic zone), and the quietest region is north Hokkaido. An inner seismic zone of less frequent activity than the outer zone occurs along the Japan Sea coast. About 18 percent of the total felt earthquakes in Japan occur at Tsukuba on the east at focal depths of 30-60 km and at Wakayama on the west at depths less than 30 km. There is no record of damage from earthquakes with epicenters deeper than 80 km, and the records discussed here are for the most part for earthquakes of epicenters less than 60 km.

The Pacific coast region shows a yearly average of 142 earthquakes of magnitude 4 (felt area greater than 200 km) and 23 of magnitude greater than 5 3/4 (felt area greater than 600 km). Over the 31-yr period earthquakes of magnitude 7 occurred occasionally on land, but those of magnitude 8 occurred only 4 times and all were centered under the Pacific Ocean. Earthquakes of magnitude 8 also have been known to occur off the west coast of Japan. One of the outstanding features of the epicentral regions of large Japanese earthquakes is the repetition of earthquake occurrence. In the last 2,000 yr destructive earthquakes have occurred 7 or more times in almost the same place off the east Pacific coast of Japan.

The Japanese intensity scale is discussed, and the various statistics for the period are illustrated by maps and graphs.— V.S.N.

Miyamura, Setumi, and Okada, Atusi. Results of levelling resurvey between Wakayama and Gobo, Wakayama Prefecture. See Geophys. Abs. 188-316.

188-168. Tárczy-Hornoch, A[ntal]. Zur Herdbestimmung von Erdbeben [On the determination of earthquake focuses (with English summary)]: Geofisica Pura e Appl., v. 49, p. 43-60, 1961.

This paper is in five parts. In the first, a simple method of determining the epicenter of a near earthquake, developed from the work of Ben-Menahem and Båth (see Geophys. Abs. 186-155) is presented. Corrections for distance and accuracies, taking into account the earth's curvature, are discussed in the second and third sections. When station distances are too great for the epicentral coordinates to be suitable for reference to a plane, spherical relationships can be applied, further members of which can be obtained by series expansion; this is treated in part 4. Part 5 concerns the calculation of the geographic coordinates of the epicenter, which are often useful for adjustment of the results.— D.B.V.

188-169. Stelzer, Johannes. Bestimmung der Magnitudengleichungen für die seismische Station Potsdam [Determination of the magnitude equations for the Potsdam seismic station (with English and Russian summaries)]: Gerlands Beitr. Geophysik, v. 70, no. 3, p. 152-161, 1961.

Formulas have been developed for determining earthquake magnitudes from body waves (PH, PPH, and SH) and surface waves (MH) registered at Potsdam, extending the uniform determination of magnitudes in the central European seismological network. The Prague values of the calibration functions β are used, and the typical station constants S for Potsdam are determined. The necessity for a second approximation of the calibration functions is again apparent. The relationships between the body wave magnitudes and the MH-wave magnitudes, and the striking difference in periods observed at Potsdam, are investigated. Potsdam, Prague, Jena, and Collmberg now can determine magnitudes uniformly, and on the basis of the abundant and uniformly reduced observational data, the calibration functions can be approximated more closely.— D.B.V.

188-170. Savarenskiy, Ye. F., and Obukhov, G. G. Ob ustoychivosti opredeleniya intensivnosti zemletryaseniy po poverkhnostnym volnam [On the stability of determination of earthquake intensities according to surface waves]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 9, p. 1346-1348, 1961.

The seismic energy scale M is widely used in determining earthquake magnitude. The energy flux of a surface wave is considered proportional to the squared ratio of its amplitude to its period at the maximum phase. Although it has been found that the value of M determined at seismic stations is sufficiently stable, the observed error of observation in ΔM is 0.2-0.3 on the logarithmic scale, that is, it reaches 100 percent. This error is due to the dispersion of surface waves, resulting in different values of M at different stations. The effects of dispersion of seismic surface waves and the formation of the maximum oscillation phase are discussed. Suggestions are given for methods of compensation of the dispersion error when the M scale is used.— A.J.S.

188-171. Ikegami, Ryohei. Intensity-frequency relation for felt earthquakes in Japan [in Japanese with English abstract]: Zisin, ser. 2, v. 14, no. 2, p. 94-101, 1961.

The relation between the seismic intensity (I) and the mean annual number (N) of earthquakes of that intensity recorded at Japanese seismological stations was found to be expressed by the formula $\log N=\alpha-\beta I$. The constants α and β differ from area to area; but for any one area, the value of β is nearly proportional to the value of α. This is similar to the magnitude-frequency relation-

ship found by Tsuboi for earthquakes in and near Japan (see Geophys. Abs. 157-89). The total and mean annual number of earthquakes of various seismic intensity as observed at each station in three areas, the values of α and β for each area, and the value of the constant m in the Ishimoto-Iida law of earthquake occurrence for the various areas are given in tables. All tables and figures are in English.— V.S.N.

188-172. Matsushima, Shogo. On the strength distribution of the earth's crust and the upper mantle, and the distribution of the great earthquakes with depth: Kyoto Univ. Disaster Prevention Research Inst. Bull., no. 43, 12 p., 1961.

The relationship between the strength of the earth's crust and upper mantle and the magnitude of earthquakes is investigated. An estimate is made of the strength and of its distribution with depth of rocks in the crust and upper mantle from laboratory experiments on rocks under high pressure and temperature using a simple earth model with a granite crust and dunite mantle; results are given in a table. A study of the distribution with depth of the great earthquakes that have occurred in and near Japan from 1926 to 1956 shows (1) that in northeast Japan earthquakes have occurred mainly near the coast and under the Pacific Ocean with deep hypocenters located mostly in the upper mantle, and (2) that in southwestern Japan earthquakes have occurred mainly under land with shallow hypocenters located in the crust. A comparison of the graphs for depth distribution of great earthquakes with those for depth distribution of strength of granite and dunite supports the thesis that an earthquake that occurs in a region of great rock strength has a much larger volume than one that occurs in a region of less strength.— V.S.N.

188-173. Kanai, Kiyoshi. An empirical formula for the spectrum of strong earthquake motion: World Conf. on Earthquake Eng., 2d, Tokyo and Kyoto 1960, Proc., v. 3, p. 1541-1551, 1960.

This is virtually the same as the paper published in Tokyo Univ. Earthquake Research Inst. Bull., v. 39, pt. 1, p. 85-95, 1961 (see Geophys. Abs. 186-172).— V.S.N.

188-174. Teisseyre, R[oman]. A dislocation theory of the earthquake processes: Acad. Polonaise Sci. Bull., Ser. Math., Astron. Phys., v. 9, no. 5, p. 423-428, 1961.

The dislocation theory of elastic mediums is again applied to problems of earthquake mechanism and energy release (see also Geophs. Abs. 180-53, 181-114), this time assuming that there exists in each medium a certain dislocation density which depends on the degree of inhomogeneity, the history of the body, and the value of the external stresses acting on the body. A formula is obtained for radiation energy in edge and screw dislocations. Comparison of Byerly and DeNoyer's (see Geophys. Abs. 177-56) empirical formula for deformation energy with the displacement field of a dislocation pair at the surface leads to a direct method of computing focal depth from geodetic data. An expression is derived for the relation between aftershock times and their displacement vector. Two coefficients in this expression must be determined from observational data, and a further difficulty is caused by the fact that only those dislocations that are apparent in the earthquake are known, not the full dislocation series. Preliminary comparison with observational data gives a viscosity value of the order of 10^{12} cgs.— D.B.V.

188-175. Ritsema, A. R., and Scholte, J. G. J. Note on the determination of the best-fitting plane for a given set of directions: Geofisica Pura e Appl., v. 49, p. 13-14, 1961.

Using Lagrange's multiplicator, a least-square solution for the position of the plane that is in best accord with a finite number of directions is derived. This solution is applicable to earthquake fault-plane solutions.— D.B.V.

188-176. Kuo, Tseng-Chien. Fault-plane determination by means of S-waves recorded at two stations [in Chinese with English abstract]: Acta Geophys. Sinica, v. 9, no. 1, p. 20-24, 1960.

A formula is derived for finding the direction of displacement of the S-wave on leaving the focus in terms of the angle β. From the value of β at two stations, it is possible to determine the planes of vibration of two S-waves, whose intersection gives the direction of movement of the rock masses. This method is based on the assumption that (1) at the focus the direction of movement of the rock masses, the displacement of the S-waves, and the direction of the rays of the S-waves all lie in one plane; and (2) the variation of the angle β in the course of propagation is very small. The application of the method by the use of Wulff's projection is also discussed.— V.S.N.

188-177. Dobrovolny, Ernest, and Lemke, Richard W. Engineering geology and the Chilean earthquakes of 1960, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-357-C-359, 1961.

A brief summary is given of the ground effects of the 1960 Chilean earthquakes on the artificial fill, alluvium, colluvium, outwash deposits, and moraines that underlie the cities of Concepción, Valdivia, and Puerto Montt. The relationship between ground material and damage to man-made structures, and between damage and the kind of material used in construction is discussed.— V.S.N.

188-178. Science Council of Japan. Proceedings of the second world conference on earthquake engineering, v. 1-3: Tokyo, Gakujutsu Bunken Fukyu-Kai, 2,225 p., 1960.

Approximately 200 papers in these three volumes cover the following five major subjects related to earthquake engineering problems: soil and foundation conditions relative to earthquake problems; analysis of structural response and instruments; seismicity and earthquake ground motion; earthquake-resistant design, construction, and regulations; and recent strong motion earthquakes and resulting damage.— V.S.N.

188-179. Neret, Lucien. Can earthquakes be predicted? South African Jour. Sci., v. 56, no. 11, p. 261-262, 1960.

Neither the causes nor the mechanism of earthquakes are understood fully enough at present to predict disastrous earthquakes, but more is being learned about the earth every day. In the meantime, earthquake-proof structures can be built, and efforts to find safety rules for seismic areas are being intensified.— D.B.V.

188-180. Nishimura, Eiichi; Nakagawa, Ichiro; Hosoyama, Kennosuke; Saito, Masanori; and Takeuchi, Hitoshi. Free oscillations of the earth observed on gravimeters [in Japanese with English abstract]: Zisin, ser. 2, v. 14, no. 2, p. 102-112, 1961; reprinted in Tokyo Univ. Geophys. Inst. Geophys. Notes, v. 14, no. 1, Contr. no. 9, 1961.

Gravimeter records of the Chilean earthquake of May 22, 1960 obtained in Kyoto were read at 2-min intervals, and the 1,500 numerical data thus obtained were high-pass filtered and analyzed by Fourier equations. The resulting power spectrums are illustrated in figures. The 53.4 and 35.8 min oscillations of the earth seem to be detected by this analysis. The 53.4 min gravity variation is about 0.57 mgal in amplitude and attains its negative maximum at the origin

time of the earthquake. The corresponding displacement amplitude is estimated to be 0.28 cm. — V.S.N.

188-181. Stewart, S[amuel] W., and Diment, W[illiam] H. Frequency content of seismograms of nuclear explosions and aftershocks, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-B, p. B-243-B-246, 1961.

The frequency content of seismic waves is a fundamental part of the data obtained from seismograms. The technique of presenting a continuously changing frequency sprectrum as a function of time is called here the moving-spectrum method, it is essentially a method of calculating the frequency spectrum of relatively small parts of the seismogram and presenting the frequency spectra so calculated as a function of time. Moving-spectrum data calculated by digital methods are given. The seismograms used in this study were from records of nuclear explosions in Nevada and of aftershocks of the Hebgen Lake, Mont., earthquake of August 1959. The chief merit of the method is that it separates the various frequency components in a way that calls attention to events that might be overlooked by the observer, and provides quantitative information on amplitudes, frequencies, and phase angles that should be helpful in describing and studying the seismograms. Whether the methods will provide useful information not derived directly from the seismograms remains to be seen.— V.S.N.

188-182. Figueroa Abarca, Jesús. Nota sobre periodos sismicos [Note on seismic periods (with English abstract)]: Anales Inst. Geofisica, v. 6, p. 71-77, 1960.

The period of the shear waves responsible for maximum destructiveness has been measured from the seismograms of four stations (Mazatlan, Guadalajara, Tacubaya, and Veracruz), each of which is located on different geological terrane. The predominant and most dangerous periods for macroseism of magnitude greater than or equal to 7 (taking into account the epicentral distances from origin to limit of perceptibility) were 0.75 to 1.25 sec and particularly those of 1 sec. A study of focal depths shows that with increase in the dimensions of the shaken block destruction can occur in soft ground far from the epicenter. Calculated magnitudes are compared with grades of intensity felt in Mexico City. The predominant periods of normal microseisms related to meteorological phenomena and of local microseisms related to urban activity are discussed also.— V.S.N.

188-183. Phinney, Robert A. Propagation of leaking interface waves: Seismol. Soc. America Bull., v. 51, no. 4, p. 527-555, 1961.

With simple generalizations of the method due to Rosenbaum [see Geophys. Abs. 181-152] and Phinney [see Geophys. Abs. 185-148], single integral expressions may be written down for the long range pole contributions to the transient signal in a plane seismic waveguide. This method yields expressions for the leaking, or imperfectly trapped waves, and suffers from no restriction on the number of layers or the existence of coupling to one or two half-spaces. When it is applied to the simple interface wave problem of two halfspaces in contact, closed form expressions are obtained describing the propagation of pulses along the interface due to lower sheet poles. The theory is applied to the Lamb problem, the liquid/solid interface, and the solid/solid interface problems. The leaking wave generalizations of the Rayleigh and Stoneley waves are found and a new wave, coupled to the P-wave, is demonstrated. The physical importance of leaking interface pulses is shown to be in their coupling to the normal or leaking oscillations of layered structures.— Author's abstract

188-184. Kogan, S. Ya. K voprosy ob opredelenii energii ob'yemnykh seysmicheskikh voln [Problem of determination of the energy of body seismic waves]: Acta Geophys. Sinica, v. 8, no. 1, p. 40-47, 1959.

The dispersion of P-waves is calculated by two different methods; this permits a mutual check of the accuracy of the results. Simple approximate formulas are given for calculating the length of the arc of L. Similar calculations are made for P_cP. The results of these calculations are tabulated giving data for 5 degree increments of epicentral distance up to 100°.— J.W.C.

188-185. Oliver, Jack [E.], and Dorman, James. On the nature of oceanic seismic surface waves with predominant periods of 6 to 8 seconds: Seismol. Soc. America Bull., v. 51, no. 3, p. 437-455, 1961.

The train of normally dispersed, short-period, oceanic surface waves, commonly identified by the near-sinusoidal nature of all three components of ground motion, is shown to correspond to propagation in the first Love and first shear normal modes. Theoretical dispersion curves that agree with the ground motion, is shown to correspond to propagation in the first Love and first shear normal modes. Theoretical dispersion curves that agree with the observed dispersion of these waves as well as with dispersion of Rayleigh and Love waves of longer periods, are obtained for layered models of the oceanic crust that are consistent with results of seismic refraction studies. In order to obtain good quantitative agreement between theory and observation, the effect of the rigidity of the deep-sea sedimentary layer must be taken into account.— D.B.V.

188-186. Press, Frank, Harkrider, David, and Seafeldt, C. A. A fast, convenient program for computation of surface-wave dispersion curves in multilayered media: Seismol. Soc. America Bull., v. 51, no. 4, p. 495-502, 1961.

Surface wave analysis has become an important tool for exploration of crustal and mantle structure. The need exists for fast, convenient digital computer programs for computing theoretical dispersion curves and displacements for Rayleigh and Love waves. One such program for an IBM 7090 computer is described and made available to the scientific community. Among the conveniences are mail-order service, high speed, and choice of many options.— D.B.V.

188-187. Bose, Sujit Kumar. On low period sub-oceanic Rayleigh waves and their attenuation: Geofisica Pura e Appl., v. 49, p. 15-35, 1961.

To date no satisfactory explanation has been given of the fact that Rayleigh waves in the 1-12 sec period range fail in most cases to traverse appreciable oceanic paths. An attempt is made here to show mathematically that the attenuation of Rayleigh waves in the low-period range is due to their passage through a nonuniform crust; this nonuniformity is due to the presence of the ocean, which is assumed to be an indentation in a flat earth's crust with horizontal bottom and slanting sides. Approximate numerical calculations suggest that the vertical component of displacement is attenuated more than the horizontal.— D.B.V.

Aki, Keiiti, and Press, Frank. Upper mantle structure under oceans and continents from Rayleigh waves. See Geophys. Abs. 188-373.

Santo, Tetsuo A[kima]. Observation of surface waves by Columbia-type seismograph installed at Tsukuba Station, Japan. (Pt. 1)—Rayleigh wave dispersions across the oceanic basin. See Geophys. Abs. 188-371.

Santo, Tetsuo A[kima]. Rayleigh wave dispersions across the oceanic basin around Japan (Pt. 2). See Geophys. Abs. 188-372.

188-188. Romberg, Frederick E. An oscillating system for a long-period seismometer for horizontal motion: Seismol. Soc. America Bull., v. 51, no. 3, p. 373-379, 1961.

An oscillating system suitable for use in a long-period horizontal-motion seismometer is described. The system consists of a short vertical pendulum whose gravitational restoring torque is opposed by a vertical zero-length spring. By adjusting the spring constant with respect to the mass of the pendulum the net restoring torque can be reduced to almost zero, thus giving the system a long period. The period is less sensitive to tilt than that of the horizontal pendulums commonly used in seismometers for horizontal motion. The lateral dimensions of the system are small so that it is adaptable for use in a borehole and for easy transportation and setting up. A stable period of 30 seconds has been observed in a prototype model.— Author's abstract

188-189. Bogert, B. P. The transfer function of a short-period vertical seismograph: Seismol Soc. America Bull., v. 51, no. 4, p. 503-513, 1961.

This note gives an analytic expression for the transfer function of a short-period vertical seismograph consisting of the Geotech Model 1051 Benioff short-period vertical seismometer and the Geotech Model 4500 galvanometer-phototube amplifier with a 5 cycle-per-second galvanometer. The transfer function of the seismometer requires most consideration, and is determined from the manufacturer's experimental frequency response and damping data, rather than from the mechanical and electrical constants of the instrument. Adaption of these results to other seismographs using the same seismometer but having other galvanometer characteristics can readily be made.— D.B.V.

188-190. Bogert, B. P. Seismic data collection, reduction, and digitization: Seismol. Soc. America Bull., v. 51, no. 4, p. 515-525, 1961.

The Bell Telephone Laboratories facilities for seismic data collection, and the digitization and reduction to punch card form of such data (using existing equipment for processing speech and visual data) are described.— D.B.V.

188-191. Hsü, Shao-Hsien. Design, construction, and testing results of the type-581 seismograph [in Chinese with English abstract]: Acta Geophys. Sinica, v. 8, no. 2, p. 109-122, 1959.

The type-581 seismograph for recording small local earthquakes is described and a schematic diagram is given. The instrument has an electrodynamic type pendulum; a capacity-resistance coupled, push-pull type amplifier; and a recording system consisting of a recorder head with stylus for writing on smoked paper. Figures illustrate the frequency characteristic response curve and phase characteristics. The stability of the instrument is illustrated by a 9-month record of the small variation of the indicator magnification of the instrument at Station Peiping. Reproductions of actual seismograms are included.— V.S.N.

Balakrishna, S., and Johnson, P. V. Influence of earthquake shocks on the Askania gravimeter spring. See Geophys. Abs. 188-194.

EARTH TIDES AND RELATED PHENOMENA

188-192. Rigassi, Danilo A. Faults and earth tides: Geophysics, v. 26, no. 5, p. 643, 1961.

To test the assumption that the effect of lunisolar attraction depends to a certain extent on geologic structure, theodolite measurements were made across a vertical fault forming the southsouthwest boundary of the Mormont

Horst in Vaud, Switzerland. The fault separates Chattian (Oligocene) shales and sandstones from Urgonian (Lower Cretaceous) limestones; the density contrast is probably 0.1-0.2. Observations were made at 2-hr intervals over a 16-hr period; 6 readings were averaged for each observation. The results, which are tabulated, show measurable differences that are attributed to earth tides. If this is so, it suggests the possibility that measurements of earth tides might constitute a prospecting method, and that the theodolite can be used to detect them.— D.B.V.

188-193. Balakrishna, S. Earth tides: Current Sci. [India], v. 30, no. 11, p. 410-412, 1961.

The nature of earth tides, their measurement, and the importance of their study as a tool for understanding the structure of the interior of the earth are discussed briefly. An Askania gravimeter has been operating for 8 months at Osmania University in Hyderabad, India, to record continuously the gravity-time curve. It has been noticed that earthquakes occurring in different regions of the earth's crust have considerably disturbed the normal run of the curve (see also Geophys. Abs. 188-194). The extra stress energy released by an earthquake, added to the tide-generating forces, considerably increases the amplitude of the curve. The Russian nuclear tests caused remarkable and unprecedented disturbances of the curve; their duration, amplitude, and intensity were unusual. By comparing one month's experimental data with corresponding theoretical data, it is calculated that the rigidity of the earth at Hyderabad is 4.1×10^{-11}.— D.B.V.

188-194. Balakrishna, S., and Johnson, P. V. Influence of earthquake shocks on the Askania gravimeter spring: Current Sci. [India], v. 29, no. 12, p. 476-477, 1960.

A marked drift in the time-gravity variation curve recorded on August 4, 18, 23, and 27, 1960 at Osmania University in Hyderabad, India, with an Askania G-11 gravimeter can be correlated with earthquakes recorded at the Nizamiah Observatory some 3 miles west of the gravimeter station. It is concluded that earthquake shocks felt in the vicinity of the gravimeter station have considerable effect on the continuous time-gravity variation curve, suggesting that the gravimeter acts as an accelerometer. The direction of the shock with respect to the orientation of the gravimeter spring, its epicentral distance, and its magnitude have considerable effect on the behavior of the spring and thus on the resulting curve.— D.B.V.

188-195. Lennon, G. W. The deviation of the vertical at Bidston in response to the attraction of ocean tides: Royal Astron. Soc. Geophys. Jour., v. 6, no. 1, p. 64-84, 1961.

The periodic deflection of the vertical due to ocean tidal flux was evaluated for Bidston, England, in connection with earth tide studies being conducted at that station. The major lunar semidiurnal constituent (M_2) was obtained by direct computation from knowledge of tides in the vicinity. A method was devised for the inference of the principal solar semidiurnal constituent (S_2) and the larger lunar semidiurnal constituent (N_2), based on regional values of the relationships between the phases and amplitudes of the appropriate constituents in the ocean tide.

The results obtained indicate the lag upon the ocean tide of its loading effect operating on the crust. This value can be checked by arguments using the east-west component of M_2, and this in addition to solutions given for S_2 and N_2 are now available for geophysical interpretation of the continuing series of tilt observations at the Bidston station.— D.B.V.

188-196. Belyankin, F. P. Hravitatsiynyy vplyv Misyatsya i Sontsya na tektonichni protsesy v zemniy kori [Gravitational effects of the moon and sun on tectonic processes in the earth's crust (in Ukrainian with Russian summary)]: Akad. Nauk Ukrayin. RSR Heol. Zhur., v. 21, no. 1, p. 3-24, 1961.

The stresses produced in the earth as a result of earth tides are different for different latitudes; expansion, contraction, warping, or faulting can result. In some latitudes the crust is subjected to long-term stress and is deformed by creep; in other places intermittent asymmetrical stresses produce cycles of stress that lead to fatigue rupture under the gradual accumulation of small plastic deformations. The tectonic development of the crust is in turn influenced by the hydrosphere and atmosphere, for erosion and sedimentation redistribute its materials. The theoretically obtained location and form of the different tectonic features of the earth's surface, both as a whole and for different latitudes, are corroborated by the physical map of the earth.— D.B.V.

ELASTICITY

188-197. Gilbert, Freeman, and Knopoff, Leon. The directivity problem for a buried line source: Geophysics, v. 26, no. 5, p. 626-634, 1961.

A method based on the first motion approximation is presented for determining the radiation pattern of a buried line source. If measurements at the surface are used to obtain the P and S components of the source, the multipolar distribution of the source may be determined. The multipolar distribution is not unique since several distributions can have the same radiation pattern. Some examples are presented for simple sources. The method is applicable to real sources or virtual sources such as centers of diffraction or scattering.— Authors' abstract

188-198. Lockett, F. J. The reflection and refraction of waves at an interface between viscoelastic materials: Jour. Mechanics and Physics of Solids, v. 10, no. 1, p. 53-65, 1962.

The reflection and refraction of harmonic S- and P-type waves at the free boundary of a viscoelastic material or at an interface between two different materials are discussed. Mathematical analysis shows that two types of wave can be produced, one being damped according to the distance it travels and the other being damped in some other direction. The latter wave appears to be a new type not previously discussed, and the results of the analysis exhibit several features not obtained in an elastic solution.— V.S.N.

188-199. Tazime, Kyozi. Reflection and refraction coefficients of elastic plane waves on a plane boundary [in Japanese with English abstract]: Zisin, ser. 2, v. 14, no. 2, p. 77-88, 1961.

The reflection and refraction coefficients of elastic plane waves at a plane boundary are considered for three cases of a two-layer medium. In cases 1 and 2 the incident waves exist in medium 1 but the position of the two media are reversed; whereas in case 3 the position of the media are the same as in case 1 but the incident waves exist in medium 2. A formula is derived by means of which any coefficient in case 3 can be derived directly from that in case 1. Formal expressions for all coefficients in cases 1 and 3 are derived for programming in electronic calculations.— V.S.N.

188-200. Abubakar, Iya. Scattering of plane elastic waves at rough surfaces. I: Cambridge Philos. Soc. Proc., v. 58, pt. 1, p. 136-157, 1962.

An approximate solution of the two-dimensional problem of reflection of plane harmonic P and SV waves by an irregular boundary is obtained using a

modification of Rice's perturbation method of approximation on the assumption that the curvature of the surface is everywhere small. It is found that the reflected waves are composed of specularly reflected waves and various diffracted waves, propagating in both horizontal directions if the wavelength of the incident waves is long compared with that of the surface. If the wavelength of incident distortional waves is long compared with that of the surface, the amplitudes of some of the scattered waves decrease exponentially with depth. In general the phases of the waves change on reflection and the phase angles of the reflected waves are functions of the wavelength of the corrugation and the angle of incidence. It is verified, in the case of zero angle of incidence, that the energy going into the scattered radiation is obtained at the expense of the specularly reflected waves.— Author's abstract

188-201. Nagumo, Shozaburo. Elastic wave propagation in a liquid layer overlying a sloping rigid bottom [in Japanese with English abstract]: Zisin. ser. 2, v. 14, no. 3, p. 189-197, 1961.

The results of a study of 2-dimensional elastic wave propagation in a liquid layer overlying a sloping rigid bottom are reported. The wave propagation in the layer is described by superposing normal modes; the mode solutions take the form of a progressive wave in the range $h_r > |\xi| > 0$, namely $r(\theta_1 + \theta_2)/(2n-1)\lambda/4 > 1$. The normal mode wave has a dual dispersive property, and phase velocity varies not only with frequency but also with distance. When the interface is inclined, the apparent phase velocity at a certain station is generally different from the formal phase velocity; but in the special case of a sloping rigid bottom the apparent phase velocity becomes equal to the formal. The dispersion curve of the formal phase velocity corresponds to that of a parallel interface when $r(\theta_1+\theta_2)$ is understood as the depth at the station. The apparent phase velocity increases as the mode wave progresses toward a more shallow direction and decreases toward a deeper direction. The apparent phase velocity at a certain station, however, does not depend upon the direction of wave propagation. The apparent group velocity at a certain station depends upon the location of the source.— V.S.N.

188-202. Nag, Kanti Ranjan. On "SH" type of motion due to body forces in a semi-infinite elastic medium: Gerlands Beitr. Geophysik, v. 70, no. 4, p. 221-232, 1961.

The displacements of the surface of a homogeneous isotropic halfspace in SH motion are worked out for four different types of time-dependent body forces within the medium, using Garvin's (1956) method. The displacements due to a point torque which acts for a short time and then ceases have been calculated numerically for different values of the depth of the disturbance and for different distances on the surface.— D.B.V.

188-203. Dutta, Subhas. Motion in a non-homogeneous elastic medium by a twisting impulsive force on the surface of a spherical cavity: Geofisica Pura e Appl., v. 49, p. 36-42, 1961.

This paper investigates mathematically the propagation of disturbance due to a twisting impulsive force on the surface of a spherical cavity in a nonhomogeneous isotropic medium in which rigidity and density vary inversely with distance from the center.— D.B.V.

188-204. Ben-Menahem, Ari. Radiation of seismic body waves from a finite moving source in the earth: Jour. Geophys. Research, v. 67, no. 1, p. 345-350, 1962.

Body waves from a finite moving source are investigated, using ray theory to obtain a long-range approximation for the surface displacements from a buried horizontal force, and assuming a weak velocity gradient and replacing

the curvature of the earth by an equivalent additional velocity gradient. The displacements are then integrated over a finite line to simulate a disturbance moving with constant speed. Results indicate that the finiteness of the source is manifested in a factor of the form $e^{-iX}\sin X/X$, and that derivation of the fault length and the velocity of rupture of earthquakes from the spectrums of body waves is possible. These results are similar to those obtained earlier for surface waves (see Geophys. Abs. 187-116), except that for body waves X depends on both polar coordinates of the station with respect to the source. The method can be extended to other types of common faulting.— D.B.V.

188-205. Tazime, Kyozi, and Hamada, Kazuo. Transition from dispersive Rayleigh waves to sound waves in a layer overlying a liquid half space [in Japanese with English abstract]: Zisin, ser. 2, v. 14, no. 2, p. 63-76, 1961.

The transition from dispersive Rayleigh waves to sound waves in a layer overlying a liquid half space is somewhat like that of waves in a plate (see Geophys. Abs. 179-113) and of waves in a layer overlying an absolutely rigid half space (see Geophys. Abs. 185-156). Therefore, numerical calculations are carried out only for $\sigma_1=0.25$ and 0.48, where σ is Poisson's ratio in the superficial layer. If $v_{p2}/v_{p1}>1$, a large number of the higher order of $M_n^{(1)}$ nodes must be reduced again to odd orders of liquid-liquid waves, and those of $M_n^{(2)}$ nodes to even orders of liquid-liquid waves. The dispersion curves obtained are illustrated, and the elastic constants used are tabulated.— V.S.N.

188-206. Pod"yapol'skiy, G. S., and Vasil'yev, Yu. I. O volne releyevskogo tipa na nesvobodnoy poverkhnosti [The Rayleigh type wave on a free surface]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 9, p. 1289-1308, 1960.

As a result of theoretical and experimental studies, a specific type of head wave has been established that is generated at the interface of two half-spaces where there is an abrupt change in the seismic velocity or in density. The experimental data, presented in several seismograms, are analyzed mathematically and interpreted as being produced by a specific low-frequency wave analogous to a Rayleigh wave on the free boundary of a half-space.— A.J.S.

188-207. Nakamura, Kohei. Normal mode waves in an elastic plate, pt. 1: Tohoku Univ. Sci. Repts., ser. 5, v. 12, no. 1, p. 44-72, 1960.

Normal mode waves formed by SH waves generated from a line source in an elastic plate are investigated mathematically, including both steady state and transient cases. The ray solution is derived by the saddle point method, whereas the normal mode solution is derived by calculation of residuals. The results show that in steady state excitation, resonance occurs at cut-off frequencies. Variations of relative amplitude and frequency with time elapsed from the beginning of the record are shown in the case of an error-functional pulse; the first antisymmetric mode has an extremely large amplitude compared with other modes. The motions due to the first two modes are calculated for given horizontal distances, when both source and receiver lie in the median plane. It is concluded that superposition of the first few modes will give a fairly correct aspect of the record except at the beginning.— D.B.V.

188-208. Nakamura, Kohei. Normal mode waves in an elastic plate, pt. 3: Tohoku Univ. Sci. Repts., ser. 5, v. 12, no. 3, p. 214-251, 1961.

The generation of normal mode waves in an elastic plate with a Poisson's ratio of 1/4 is investigated theoretically using the method of superposition of plane wave solutions. The assumed sources are: an extraneous force applied vertically at a point on the surface, a compressional source with a uniform amplitude distribution, and a distortional source with the amplitude distribution

represented by sin w, where w is the angle made by the rays of S-waves and the vertical. Form solution for an internal point source with arbitrary amplitude distribution is given in the appendix. (See also Geophys. Abs. 187-161, 188-207.)— D.B.V.

188-209. Tazime, Kyozi. May M-waves be classified into two major branches? [in Japanese with English abstract]: Zisin, ser. 2, v. 14, no. 3, p. 138-149, 1961.

Equations are given that define the two major branches, $M^{(1)}$ and $M^{(2)}$, of M-waves, and calculated results are shown in figures. It is emphasized that no dispersion curves (except in the case of a plate) intersect each other on a $c/v_p \sim Tv_p/H$ plane if they correspond to a medium of specific structure. Any dispersion curve changes from $M^{(1)}$ to $M^{(2)}$ or from $M^{(2)}$ to $M^{(1)}$ when it crosses a chain line for which an equation is given. No criterion has been found for the classification of continuous dispersion curves; the best possible notation at the present stage of study is given.— V.S.N.

188-210. Takeuchi, Hitoshi, and Kobayashi, Naota. Torsional oscillations of the earth (pt. 3). Appendix: Torsional oscillations of the moon [in Japanese with English abstract]: Zisin, ser. 2, v. 14, no. 2, p. 89-93, 1961; reprinted in Tokyo Univ. Geophys. Inst. Geophys. Notes, v. 14, no. 1, contrib. no. 8, 1961.

Using the variational calculus method (see Geophys. Abs. 178-93), the free periods of the earth's torsional oscillations are calculated for wave numbers up to 11 and are found to be in good agreement with those observed in the Chilean earthquake of May 1960. The free torsional periods of the moon also are calculated on the assumption that the moon is a homogeneous sphere with a shear wave velocity of 4.7 kmps. The fundamental period obtained is about 15 min. (See also Geophys. Abs. 185-154.)— V.S.N.

188-211. Donato, R. J., O'Brien, P. N. S., and Usher, M. J. Absorption and dispersion of elastic energy in rocks: Nature, v. 193, no. 4817, p. 764-765, 1962.

Only one paper to date has presented results of measurements of absorption and dispersion of elastic energy over a wide frequency range for a single rock (see Geophys. Abs. 184-230). This paper gives results for three other rocks (an oolitic limestone, dolerite, and hard chalk from England), which show that their Young's moduli remain constant to within 5 percent over the range from 2 cycles per second to 90 kc and that their Q's do not vary by more than a factor of 2 over the same range. The constancy probably demands a nonlinear mechanism (for instance, hysteresis) for the absorption of elastic energy in rocks, although it is just possible that a linear mechanism with a flat spectrum of relaxation times would produce a sufficiently small amount of dispersion.— D.B.V.

188-212. Hayakawa, M[asami], and Balakrishna, S. Some theoretical considerations for the high ultrasonic velocities in Indian granites: Jour. Sci. Indus. Research [India], v. 20B, no. 9, p. 413-417, 1961.

It is suggested that the striking differences in ultrasonic velocities in Indian granites compared to granites from elsewhere (as high as 6.5 kmps in the former) can be explained in terms of their petrogenetic history. The initial internal pressure and initial internal velocity at the time of formation, together with the subsequent lapse of time, have been calculated theoretically. These are the factors that seem to control the velocities observed under atmospheric pressure. (See also Geophys. Abs. 186-270).— D.B.V.

188-213. Warrick, R[ichard] E., and Jackson, W[ayne] H. Poisson's ratio of rock salt and potash ore, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-B, p. B-241-B-242, 1961.

Measurements of elastic constants of rock salt and potash ore of the Salado formation (Permian) near Carlsbad, N. Mex., were made in place and in the laboratory. In-place measurements consisted of determining velocities of compressional and shear waves in a pillar of the potash rock and of the salt rock. Samples from the same pillars were sent to laboratories where contants were measured by uniaxial compression tests and by ultra-sonic pulse methods. Values of Poisson's ratio determined by the three methods are shown in a table. The in-place and ultrasonic methods yielded values in fairly good agreement for potash; the ultrasonic method gave lower values for salt probably because the salt pillar is older than the potash pillar and samples could not be taken as deep within the pillar. Unconfined uniaxial-compression determinations did not agree with in-place and ultrasonic determinations for potash; as stress increased for both potash and salt samples, however, the compression values approached the in-place values. The in-place method of determination of Poisson's ratio is preferable because the problem of altering properties through sampling is less severe.— V.S.N.

188-214. Shan'gin, N. V., and Vilenskaya, S. M. Izucheniye uprugikh svoystv i skorostey seysmicheskikh voln v nedrakh Zemli po kernu burovykh skvazhin [Study of elastic properties and seismic wave velocities in the interior of the earth from drill cores]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 275-283, 1960.

Apparatus designed for study of the elastic properties, pressure, temperature, density, moisture, and porosity of drill cores from the Turkmen S.S.R. is described. The method is discussed, and errors in determinations are analyzed. Anisotropy of rocks and seismic velocity variation as a function of geologic age are also discussed.— A.J.S.

Toporets, S. A. On the effect of metamorphism on the electrical and elastic properties of coals. See Geophys. Abs. 188-276.

188-215. Horibe, Tomio, and Kobayashi, Ryoji. Physical and mechanical properties of coal-measures rocks: Tohoku Univ. Tech. Repts., v. 25, no. 1, p. 77-87, 1960.

The variation in elastic coefficients under triaxial pressure, approximating actual conditions underground, was measured for two kinds of fine sandstone from the Joban Colliery in Fukushima Prefecture, Japan. It was found that the elastic constants are affected by confining pressure. Poisson's ratio decreases as both confining and axial pressures increase; this ratio can thus be taken as a function of the external forces acting on a rock. The rocks tested were extremely plastic, even at the low confining pressure. Both compressive and tensile strengths increased with increasing confining pressure. In the double shear test the regularity of the sheared surfaces increased with increasing confining pressure.— D.B.V.

188-216. Langleben, M. P. Young's modulus for sea ice: Canadian Jour. Physics, v. 40, no. 1, p. 1-8, 1962.

The dependence of Young's modulus (determined from the velocity of ultrasonic waves through small samples of sea ice) on brine content (determined from salinity and temperature) shows that Young's modulus decreases linearly with increasing brine content over a range of brine content of about 0.01-0.1 as a fraction of total volume. Its value is 10.0×10^{10} d cm^{-2} when the brine content is 0 and 6.5×10^{10} d cm^{-2} for a brine content of 0.1.— D.B.V.

188-217. Lombard, David B. The Hugoniot equation of state of rocks, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull., no. 76, p. 143-152, 1961.

This is the same as the paper published in Univ. California, Lawrence Radiation Lab. Pub., UCRL-6311, 28 p., 1961 (see Geophys. Abs. 185-164).— V.S.N.

188-218. Zablocki, C[harles] J., and Keller, G[eorge] V. Some observations of the seismic-electric effect, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-296-D-299, 1961.

A study of seismic-electric voltages developed by high-energy seismic waves was conducted during the underground nuclear detonations of the Hardtack II test series. Characteristics of the seismic-electric signals from a nuclear explosion of energy equivalent to 5,000 tons of TNT were: Seismic-electric voltages in the radial direction are always larger than voltages in transverse directions; frequencies of electric signals generally correlate with low frequencies recorded on seismic traces; and first seismic-electric voltages at the electrode spreads appear essentially at the same time as the seismic energy. The seismic-electric signals and the seismic waves from a chemical explosion that was also recorded persisted at significant levels for 90 sec, but the signals from the nuclear explosion (9 times larger) lasted for only 30 sec; this was probably the result of the difference between the alluvial medium of the chemical explosion and the volcanic rocks of the nuclear explosion.— V.S.N.

188-219. Press, Frank, and Archambeau, Charles. Release of tectonic strain by underground nuclear explosions: Jour. Geophys. Research, v. 67, no. 1, p. 337-343, 1962.

The strong excitation of SH waves and other phenomena associated with underground nuclear explosions suggest the hypothesis that pre-existing tectonic strain was released by the explosion. The pertinent evidence from the Rainier explosion is reviewed. A calculation of tectonic energy release is made for a simple model in which a spherical cavity is inserted in a prestrained medium. It is tentatively concluded that, although tectonic release does occur, its magnitude is probably too small to affect the character of seismograms. Experiments are suggested which could provide the basis for a better evaluation of the hypothesis.— Authors' abstract

188-220. Adams, W[illiam] M[ansfield], and Swift, L. M. The effect of shot-point medium on seismic coupling: Geophysics, v. 26, no. 6, p. 765-771, 1961.

Two experiments on the coupling of seismic waves to the surrounding medium have been conducted. One was performed at two different overburden depths in a tunnel complex at the Nevada Test Site in the Oak Spring Tuff. The other was done at a depth of 800 feet in the Carey Salt Mine at the Winnfield Salt Dome near Winnfield, La. Free-field measurements within 400 feet of the chemical charges indicate that three to four times more energy was propagated into the elastic zone in the tuff than in the salt. There is some indication that in tuff the amount of energy transmitted into the elastic zone was dependent upon the lithostatic overburden pressure. Increasing the overburden pressure by a factor of about five almost quadrupled the energy propagated into the elastic zone.— Authors' abstract

188-221. Adams, William M[ansfield], and Allen, DeWitt C[linton]. Seismic decoupling for explosions in spherical underground cavities: Geophysics, v. 26, no. 6, p. 772-799, 1961.

This is a more detailed version of the paper by Adams and Carder, published in Geofisica Pura e Appl., v. 47, p. 17-29, 1960 (see Geophys. Abs. 186-238).— D.B.V.

188-222. Bates, Charles C. VELA UNIFORM, the nation's quest for better detection of underground nuclear explosions: Geophysics, v. 26, no. 4, p. 499-507, 1961.

This paper summarizes key technical events that have occurred with reference to the creation of a system capable of detecting and identifying nuclear explosions, and describes the VELA UNIFORM program, a widespread research and development effort designed to improve this technical field markedly in the next two or three years.— D.B.V.

188-223. Pasechnik, I. P., Kogan, S. D., Sultanov, D. D., and Tsibul'skiy, V. I. Resul'taty seysmicheskikh nablyudeniy podzemnyk yadernykh i trotilovykh vzryvakh [The results of seismic observations of underground nuclear and TNT explosions]: Akad. Nauk SSSR, Inst. Fiziki Zemli Trudy, no. 15 (182), p. 3-52, 1960.

This paper describes the character of seismic records obtained in the United States and U.S.S.R. for the underground nuclear explosions conducted by the United States at the proving grounds in Nevada in 1957 and 1958 under the code names Rainier, Tamalpais, Logan, and Blanka. Data on values of traveltime of seismic waves, correlation between the oscillation amplitude of longitudinal waves and epicentral distance, and magnitude values are given. It is shown that the spatial distribution of the first arrival directions, as recorded by the stations that surround the epicenter, is substantially different from the analogous distribution for the overwhelming majority of earthquakes. A correlation method of the initial part of the record is proposed to facilitate recognition of the first arrival. The period values of body and surface waves due to explosions are given. The period difference of surface waves due to explosions and earthquakes of comparable energy levels should become one of the criteria for recognition of explosions. The energy of seismic waves initiated by underground nuclear and TNT detonations is evaluated.—Authors' abstract, A.J.S.

188-224. Riznichenko, Yu. V. O seysmicheskikh magnitudakh podzemnykh yadernykh vzryvov [On seismic magnitudes of underground nuclear explosions]: Akad. Nauk SSSR, Inst. Fiziki Zemli Trudy, no. 15 (182), p. 53-87, 1960.

The results of determination of seismic magnitudes of nuclear explosions at the proving grounds in Nevada (U.S.A.) in 1957-58 are discussed. The mean magnitude values of these explosions are calculated. The correlation between work capacity of a (nuclear) explosion, expressed in kilotons of TNT equivalent, and its mean magnitude is determined. The annual number of shallow focus earthquakes whose magnitudes exceed an explosion of a given work capacity is established. It is shown that the number is not above the values accepted by the conference of experts on the cessation of nuclear weapons tests held in Geneva in 1958.— Author's abstract, A.J.S.

Jones, R. V. Sub-acoustic waves from large explosions. See Geophys. Abs. 188-131.

ELECTRICAL EXPLORATION

188-225. Douloff, Artel A. The response of a disk in a dipole field: Geophysics, v. 26, no. 4, p. 452-464, 1961.

A mathematical solution is given for the quasi-static response of an infinitely conducting disk in a dipolar magnetic field. The solution, which emerges

as a series solution of Laplace's equation in oblate spheriodal coordinates, converges rapidly enough only in certain ranges of the disk. Sommerfeld's image method leads to an alternate solution that is exact. For finite conductivity the mathematics becomes rather unwieldy, so experimental modeling produced the type curves in this range. By using high frequencies and aluminum disks, "infinitely" conducting models were constructed to check the theoretical solutions. All computation was done on an IBM 650 computer.— D.B.V.

188-226. Yungul, S. H. Magneto-telluric sounding three-layer interpretation curves: Geophysics, v. 26, no. 4, p. 465-473, 1961.

A catalog of standard curves is presented for interpretation of three-layer cases in magnetotelluric surveying. These were calculated by incorporating Cagniard's formula (see Geophys. Abs. 154-14645) into a digital computer program. The catalog consists of 117 apparent-resistivity-vs-period curves representing 10 resistivity combinations. In each case the third, semi-infinite medium represents the "basement" with infinite resistivity. A set of two-layer curves for the total range of resistivity combinations is also given. The procedure for use of the curves is explained briefly.— D.B.V.

188-227. Paterson, Norman R. Experimental and field data for the dual-frequency phase-shift method of airborne electromagnetic prospecting: Geophysics, v. 26, no. 5, p. 601-617, 1961.

With the growing maturity in airborne electromagnetic instrumentation a transition has taken place from rule-of-thumb application and interpretation methods to a more sophisticated over-all approach. A greatly improved success rate in the location of massive sulfide bodies is illustrated by recent results with the dual-frequency phase-shift airborne electromagnetic method. Part of the sophistication process has been the improvement of quantitative methods of interpretation, based on both theoretical and model studies. A recent research program has been most useful in this regard. These studies have been carried out within the framework of an active exploration department and have been integrated with field results at various stages.— Author's abstract

188-228. Negi, Janardan G. Radiation resistance of a vertical magnetic dipole over an homogeneous earth: Geophysics, v. 26, no. 5, p. 635-642, 1961.

The expressions for the energy radiated per sec from an oscillating vertical magnetic dipole situated above a two-layer earth are derived. Of the three important cases to which particular attention has been given, the first and the second involve the presence of a conducting and insulating substratum, respectively. The third deals with a dipole placed over a thin conducting sheet of infinite extent. Appropriate approximations have been made such that the results may be useful for geoelectrical exploration.— Author's abstract

188-229. Kovtun, A. A., and Novoselova, S. M. Ustanovleniye peremennogo elektromagnitnogo polya nad sloisto-odnorodnoy sredoy [Build-up of an alternating electromagnetic field over a layered homogeneous medium]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 174-184, 1960.

The process of building up an alternating electromagnetic field in the earth when the time needed for the build-up can be expressed in e^{iwt} form is analyzed. The processes of building up the field at the air-ground interface are analyzed, and formulas relating the components H_y and E_x of the field, measured simultaneously at the surface of the earth, and the respective components H_y^0 and E_x^0 of the attenuating field are derived. The case of a two-layered

structure and the build-up process of the alternating field are considered, and the maximum time needed for the field to build up is determined.— A.J.S.

188-230. Gasanenko, L. B., and Sholpo, G. P. K teorii elektromagnitnykh zondirovaniy [On the theory of electromagnetic sounding]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 185-231. 1960.

A detailed mathematical analysis is given of formal solutions for the electromagnetic field of a harmonic dipole over a horizontally stratified earth, and asymptotic expressions are derived for the field components of a low frequency dipole over a horizontally stratified earth. This led to the numerical solution of the problem for the following cases: (1) The spread and wavelength of the electromagnetic field in the layers of the formation are considerably greater than the depth of the crystalline basement (S zone); (2) the product of the wave numbers by the spread is considerably less than unity (induction zone); and (3) the product of wave numbers by the spread is considerably greater than unity (the wave zone). The components of the magnetic field of a horizontal electric dipole are considered.— A.J.S.

188-231. Van'yan, L. L., Gasanenko, L. B., and Sholpo, G. P. Asimptoticheskoye predstavleniye elektromagnitnogo polya nizkochastotnogo dipolya [An asymptotic representation of a low frequency dipole electromagnetic field]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 232-235, 1960.

The parameters of a low frequency dipole magnetic field (see Geophys. Abs. 188-230) are further developed for a specific case where the spread is considerably greater than the depth to basement. The asymptotic equation derived holds for any wavelength and an arbitrary conductivity.— A.J.S.

188-232. Molochnov, G. V., Matveyeva, E. T., and Osokina, G. N. Elektromagnitnoye pole vertikal'nogo magnitnogo dipolya nad dvukhsloynoy strukturoy s granitsey v vide ustupa [Electromagnetic field of a vertical magnetic dipole over a two-layer formation having a boundary in the form of a bench]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 255-260, 1960.

Experimental curves of frequency electromagnetic sounding (the field of a vertical magnetic dipole over a step-shaped boundary) are analyzed. The results show that this method allows derivation of empirical formuals by which the thickness of the layer, its conductivity, and the location of the step can be determined.— A.J.S.

188-233. Molochnov, G. V. O vliyanii provodimosti pervogo sloya pri opredelenii glubiny zaleganiya provodyashchego osnovaniya dipol'nym elektromagnitnym metodom [On the effect of conductivity of the first layer in determination of the depth of the conducting basement by the dipole electromagnetic method]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 261-265, 1960.

The problem of correlation of electric conductivities of layers in the dipole electromagnetic method is discussed on the basis of a general solution of the problem of the vertical magnetic dipole field over a two-layered medium in which the conductivity $\rho_2 \gg \rho_1$. The case of a nonconducting first layer ($\rho_1 = 0$), and a good conducting second layer ρ_2, where the effective depth of electromagnetic field penetration can be expressed by the formula, $\Delta h = (\lambda/4\pi)$, is extended for the case when $\rho_1 > 0$. This results in a formula, $h_1(\rho_1/\rho_2)^{\frac{1}{2}} + \Delta h = (\lambda_2/4\pi)$, where h is the thickness of the first layer, λ_2 is the wavelength in the second layer, and Δh is the penetration depth into the second layer. In the model experiments for the depth of occurrence D of the second layer the theo-

retical curve obtained by the formula $D=h_1+\Delta h$ was found to agree satisfactorily with the experimental curve, thus confirming the formula derived for Δh.—A.J.S.

188-234. Molochnov, G. V. Dipol'nyy elektromagnitnyy metod opredeleniya glubiny zaleganiya provodyashchego sloya pri naklonnoy granitse razdela [The dipole electromagnetic method of determination of the depth of occurrence of a conducting layer with an inclined boundary]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 266-270, 1960.

This is a development of Molochnov's previous paper (see Geophys. Abs. 188-233) on determination of depth of occurrence of a layer of finite conductivity by the dipole electromagnetic method where the components of the field of a vertical magnetic dipole of horizontally limited structures behave as if the field were established over an infinite horizontal half-space (see Geophys. Abs. 178-123). The particular case of a conducting layer inclined to the horizontal is analyzed and discussed.— A.J.S.

188-235. Molochnov, G. V., and Spiridovich, G. N. O pogreshnosti nablyudeniy dipol'nym elektromagnitnym metodom [On the observational error of the dipole electromagnetic method]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 271-274, 1960.

Observational errors in determination of the depth of a conducting layer by the electromagnetic dipole method due to instrumental errors from the generating and receiving antennas are analyzed for the following four cases: (1) The normal to the plane of the generator frame is deflected from vertical; (2) the rotation axis of the receiving frame is not horizontal; (3) the rotation axis of the receiving frame is not perpendicular to the line connecting the centers of the frames; and (4) the generator and receiving frames are placed at different heights above a horizontal interface.— A.J.S.

188-236. Gasanenko, L. B. Interpretatsionnyye parametry elektromagnitnogo polya [Interpretation parameters of an electromagnetic field]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 236-254, 1960.

The parameters of an electromagnetic field derived from the amplitudes and the co-phase and out-of-phase components of the field are investigated for the case of a vertical magnetic dipole on the surface of a horizontally stratified formation. The elements of the polarization ellipse, impedances, and ratio of the field magnetic components are considered. The values of these auxiliary parameters are determined by the asymptotic representation of the electromagnetic numbers e_ϕ, h_z, and h_r for a two-layered medium having the diverse electric conductivity of the strata and the basement (see Geophys. Abs. 188-230, -231).— A.J.S.

188-237. Van'yan, L. L. Elementy teorii stanovleniya elektromagnitnogo polya [Elements of the theory of building up of an electromagnetic field]: Prikladnaya Geofizika, no. 25, p. 66-95, 1960.

This is a mathematical analysis of the transient and build-up state of an electromagnetic field in deep sounding of the earth and the application of these processes to interpretation of deep geological structures. An approximate theory of the build-up processes of dipole electromagnetic fields in multilayer profiles underlain by an insulator is developed. The calculating methods for the curves of the electric component E_x parallel to the feeding dipole and to the vertical component of magnetic induction B_z are given. The resolving power of the method is studied and discussed. The solution is based on the close relationship between the build-up processes of the electromagnetic field

and the processes observed in the frequency sounding method. The method of build-up electromagnetic field was found to have a higher resolving power than the vertical electrical sounding method and permits an interpretation of the tectonics of conducting strata shielded by insulating layers.— A.J.S.

188-238. Kukuruza, V. D. Tochechnyy metod interpretatsii krivykh VEZ [The point method of interpretation of VES curves]: Razvedochnaya i Promyslovaya Geofizika, no. 36, p. 31-39, 1960.

The point method of interpretation of vertical electrical sounding curves consists of finding a point on the curve that corresponds to that value of the apparent resistivity ρ_k having its abscissa equal to the depth of the underlying layer. The parameters of the profile of the electrical sounding curve can be obtained with the aid of a combination of two master charts given in the paper for two- and three-layer profiles. The process of interpretation of such profile curves for 2 and 3 layers is discussed, and the feasibility of interpretation of four- and five-layer curves is mentioned.— A.J.S.

188-239. Fomina, V. I. Opredeleniye parametrov razreza pri interpretatsii mnogosloynykh krivykh VEZ tipa H [Determination of the parameters of a section in interpretation of multilayered VES curves of type H]: Prikladnaya Geofizika, no. 25, p. 96-114, 1960.

Results are presented of vertical electric sounding (VES) on a profile where several layers are present, where resistivities decrease with depth to a certain value and then increase to the specific resistance of the basement of $\rho_{n=\infty}$. This type of geoelectric profile is studied theoretically and in the field in the Mongolian People's Republic for determination of the surface structure of the Paleozoic or the crystalline basement of the area. It was found that the mean longitudinal resistivity ρ_e on such a profile can be determined by the method proposed, and the character of the geologic layering can be established.— A.J.S.

188-240. Kőhsling, Juliusz. Graficzne metody interpretacji badań elektrooporowych w poszukiwaniach wody [Graphical method of interpretation of electrical exploration investigations in the search for water (with English summary)]: Przegląd Geol., v. 9, no. 2, p. 83-88, 1961.

The specific resistance of aquifers is not stable because it is dependent on the composition of both the rock and the water. The results of field electrical observations can be interpreted graphically with great precision by analyzing the form of the curves of vertical electrical sounding and the values of the apparent resistivity and by comparing the geologic conclusions with the general geology of the area. An example is given.— J.W.C.

188-241. Ştefănescu, Sabba S., and Nabighian, Misac N. Asupra liniilor de cîmp magnetic ale emiţătorului AB [Concerning lines of the magnetic field of an input line AB (with Russian and French summaries)]: Acad. Romîne, Probleme de Geofizică, v. 1, p. 181-186, 1961.

A numerical and graphical treatment is given for refining data on lines of the magnetic field of an input line AB.— J.W.C.

188-242. Ştefănescu, Sabba S., and Nabighian, Misac N. Asupra cîmpului magnetic perturbant provocat de o stratificaţie verticală în curent continuu [On the magnetic perturbation field generated by vertical beds in a direct current (with Russian and French summaries)]: Acad. Romîne, Probleme de Geofizică, v. 1, p. 187-204, 1961.

Results are presented of theoretical and numerical calculations for determination of the effect of vertical beds on a magnetic field generated by a direct-current in the ground. Calculations were made for all three components X, Y, and Z of the anomalous magnetic field for a vertical contact, a vertical bed, and a thin vertical bed. In most cases the vertical component is expressed by simple algebraic functions, but the expression of the horizontal components leads to elliptical integrals of the first, second, and third orders, which require use of computers.— Authors' abstract, J.W.C.

188-243. Shaub, Yu. B. Eksperimental'naya proverka osobennostey metoda vrashchayushchegosya magnitnogo polya [Experimental verification of features of the method of a rotating magnetic field]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 7, p. 1015-1021, 1961.

The results are given of a model study of the behavior of the secondary magnetic field in the method of a rotating magnetic field used for airborne electromagnetic prospecting. After presenting the basic theory of the rotating magnetic field method of prospecting, measuring apparatus of improved interference stability is described, and the results of measurements over a spherical disturbing body, over a vertical layer, and over a conducting half-space are given.— A.J.S.

188-244. Rokityanskiy, I. I. Dispersiya provodimosti zazemleniy i gornykh porod na nizkikh chastotakh [Dispersion of conductivity of groundings and rocks at low frequencies]: Akad. Nauk SSSR Izv., Ser. Geofiz., no. 2, p. 251-254, 1961.

It is observed that the resistance between two a-c grounded electrodes depends on the frequency of the field, and it has been assumed that this relationship is due to the induced polarization of the electrodes. Such a polarization may result from various processes: concentration polarization, overvoltage, electrochemical reactions, charge and discharge of double electric layers, formation of poorly conducting layers, and others. The potential discontinuity, $\phi_{\infty}=kJ/S$, established in such cases on the electrode (k is polarization coefficient, J—current, and S—area of the electrode) is investigated, and its relationship with the parameters of the field are analyzed. It was found that induced polarization reduces the polarization coefficient for all frequencies. This shows that the induced polarization prevents part of the electric energy from being transformed into heat energy.— A.J.S.

188-245. Terekhin, Ye. I., and Faradzhev, A. S. Modelirovaniye elektricheskikh zondirovaniy nad negorizontal'nymi granitsami razdela [Modeling of electric sounding over non-horizontal interfaces]: Razvedochnaya i Promyslovaya Geofizika, no. 34, p. 46-54, 1960.

Problems of interpretation and methods of determination of the total electric conductivity S in the profiles of strata overlying a marker horizon are discussed on the basis of empirical data obtained from modeling of electric sounding over nonhorizontal interfaces. Models of biplanar angles, step faults, anticlines of broad and sharp crests, inclined steps, and horizontally inclined contacts were tested. A formula for determination of S is proposed: $\bar{\rho}_{kmb}=\bar{\rho}_r+1/2\bar{\rho}_\theta$, where $\bar{\rho}_{kmb}$ is the combined apparent resistance of $\bar{\rho}_r$ and $\bar{\rho}_\theta$ measured by the axial and the equatorial arrays, respectively. Examples for various models are given (see also Geophys. Abs. 177-107).— A.J.S.

188-246. Rodionov, P. F. Elektrorazvedka kolchedannykh mestorozhdeniy Urala metodom zaryada [Electric prospecting for pyrite deposits of the Urals by the charge method]: Akad. Nauk SSSR Ural. Filial, Gorno-Geol. Inst. Trudy, Geofiz. no. 1, 148 p., 1959.

Electrical prospecting for pyrite by the charge method is discussed, giving the theory and laboratory experiments by which the theory was verified. The

first chapter describes the geology and gives certain electrical parameters of greenstone deposits and host rock in the Ural Mountains. Electric fields of conductors (pyrite deposits) are discussed in the second chapter. In the third chapter the methods and technique of the field work and processing of geophysical data obtained are reviewed. Typical examples of prospecting for pyrite by the charge method are given in the fourth chapter.— A.J.S.

188-247. Kunori, Shoichi. Historical review of the generation of S.P. current [in Japanese with English abstract]: Butsuri-Tanko, v. 14, no. 1, p. 2-8, 1961.

Theories of self potential from 1830 to the present are reviewed and classified according to geological, mineralogical, and electrochemical points of view. A bibliography of 93 items covering Japanese, English, French, German, and Russian literature is included.— V.S.N.

188-248. Ivanov, A. G. Electrical prospecting in China [in Chinese]: Acta Geophys. Sinica, v. 8, no. 1, p. 71-83, 1959.

The use of the telluric current and vertical electrical sounding methods of exploration in China is discussed.— J.W.C.

Moore, R. Woodward. Observations on subsurface exploration using direct procedures and geophysical techniques. See Geophys. Abs. 188-552.

Andreas, Dieter, and Hecht, Gunter. Induced polarization as a well logging method in nonferrous metal prospecting. See Geophys. Abs. 188-269.

188-249. Ivanov, M. A., and Enenshteyn, B. S. Bezynertsionnyy sposob izmereniya amplitud i faz elektricheskik kolebaniy [A noninertial method of measurement of amplitudes and phases of electric oscillations]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 2, p. 245-250, 1961.

A new electronic method of measuring the amplitudes and phases of electric oscillations of low and infralow frequencies is proposed and described with schematic diagrams of the instruments. The method is considered to have essential advantages over the regular visual and oscillographic methods, the advantages being due to the noninertial design of the apparatus and a facility for rapid reading of the metering data. The apparatus can measure signals complicated by nonperiodic interference and evaluate quickly and objectively the mean values of such signals. It contains no metering instruments sensitive to mechanical effects and is therefore suitable for field operation.— A.J.S.

188-250. Frischknecht, F[rank] C., and Ekren, E. B[artlett]. Electromagnetic studies in the Twin Buttes quadrangle, Arizona, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D 259-D-261, 1961.

Electromagnetic measurements were made of the Helmet fanglomerate (Tertiary) and surrounding rocks in the Twin Buttes quadrangle near Tucson, Ariz., to obtain information on the feasibility of prospecting for minerals in the older bedrock beneath the Helmet, and on the usefulness of the method for resolving structural problems in the area. Conventional turam and variable frequency measurements were made. Apparent resistivities of the Helmet fanglomerate as determined by electromagnetic measurement are somewhat lower than those determined previously by electric logs. Because of the low resistivity and local variations in resistivity of the Helmet, the formation would be a formidable obstacle in trying to locate possible underlying ore bodies by this method.— V.S.N.

188-251. Roller, J[ohn] C., and Black, R[udolph] A. Determination of thickness of a basalt flow by electrical resistivity method on Buckboard Mesa, Nevada Test Site, Nye County, Nevada, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-271-C-273, 1961.

An electrical survey was made to determine the thickness of a basalt flow on Buckboard Mesa in the immediate vicinity of the point of burst for a nuclear cratering experiment at the Nevada Test Site. The basalt is underlain by a low-resistivity layer of bedded tuff followed by a welded tuff of higher resistivity. The unweathered basalt was found to be about 210 feet thick. Resistivity depth curves are illustrated.— V.S.N.

188-252. Horon, Octave, Mégnien, Claude, and Soyer, Robert. Note sur les Fontaines salées de Saint-Père-sous-Vézelay (Yonne) [Note on the Salt Srings of Saint Père sous Vézelay (Yonne)]: Soc. Géol. France Bull., ser. 7, v. 1, no. 5, p. 461-466, 1959 (1960).

Resistivity surveys were made in connection with investigations reported here of the saline springs at Saint Père in Yonne, France, which were used by the Romans. The existence of a fault southwest of the springs was confirmed and its southwest-northeast course was traced precisely; an offset of the principal north-south fault along this fault was also detected.— D.B.V.

188-253. Alfano, L[uigi]. Geoelectrical explorations for natural steam near "Monte Amiata": Quaderni di Geofisica Applicata, v. 21, p. 3-17, 1960 (1961).

Electrical resistivity surveys were made near Monte Amiata, Tuscany, Italy, in the search for natural steam to be used in generation of electrical power. The surveys were designed to determine the configuration of the surface of the limestone beneath an impermeable shale cover. Such surveys are well suited for this region because of the high resistivity of the limestone. Maps and cross sections illustrate the results of this work.— J.W.C.

188-254. Fritsch, Volker. Die geoelektrische Untersuchung der Heilwässer in der Umgebung des Neusiedlersees im Burgenland [The geoelectric investigation of medicinal waters in the vicinity of Lake Neusiedler in Burgenland (with English summary)]: Zeitschr. Geophysik, v. 27, no. 3, p. 112-117, 1961; also in Boll. Geofisica Teor. ed Appl., v. 3, no. 9, p. 19-33, 1961.

The detection of highly mineralized ground waters in the vicinity of Lake Neusiedler in Burgenland, eastern Austria, by electrical resistivity measurements is reported. The method used is described briefly, and results are presented in an iso-ohm map. The electrical results were confirmed by drilling.— D.B.V.

Jaeger, Wolfgang. Geologic-geophysical investigation of the Hammerunterwiesenthal phonolite (Erzgebirge). See Geophys. Abs. 188-457.

188-255. Ristić, Vojislav, and Dorđević, Vojislav. Geofizička ispitivanja na grafitskim ležištima Donje Ljubate [Geophysical investigation for graphite bodies at Donja Ljubata (with English summary)]: Vesnik Primenjena Geofizika, ser. C, v. 1, no. 1, p. 57-64, 1960.

Graphite deposits in the vicinity of Donja Ljubata were investigated by the self potential, turam, potential-drop-ratio, geoelectric mapping and sounding, and "mise à la masse" methods. The shape and size of several bodies were determined. Maps are presented that show the general geology, isolines of

self potential, curves of phase variations, and isolines of potential "mise à la masse." A profile illustrates curves of potential-drop-ratio over an ore body.— J.W.C.

188-256. Krulc, Zvonimir, and Vidović, Nada. Primjena metode otpora kod istraživanja boksitnih ležišta pod pokrovom u Istri [Application of the resistivity method in investigation of bauxite deposits under a cover in Istria (with German summary)]: Vesnik Primenjena Geofizika, ser. C, v. 1, no. 1, p. 81-97, 1960.

Several geoelectrical surveys have been made recently of the bauxite deposits of Istria. The surveys are made in two stages: First, profiles are made of large areas to determine resistivity anomalies; then the areas of interest are investigated in detail by geoelectric sounding. Selection of arrays for detecting covered bauxite deposits and weathered zones is discussed.— J.W.C.

188-257. Mladenović, M. Lj. Geoelektrično sondiranje u nekim ugljenim basenima N. R. Srbije [Geoelectrical sounding in some coal basins in Serbia (with German summary)]: Jugoslovanski Geol. Kong., 2d, Sarajevo 1957, p. 400-407, 1957.

The results are presented of electrical surveys for determination of thickness of various sedimentary units in several coal basins of Serbia. Profiles are shown for the Vrška Čuka area, and maps are given for the Soko Banja and Ranovac area. The electrical investigations were confirmed by drilling.— J.W.C.

188-258. Vantsyan, G. M. K metodike geofizicheskikh issledovaniy rudnykh mestorozhdeniy Armyanskoy SSR [On the method of geophysical investigations of ore deposits of the Armenian S.S.R.]: Akad. Nauk Armyan. SSR Izv., v. 14, no. 1, p. 65-73, 1961.

Combined geophysical methods (magnetic and electrical prospecting and spectral metalometry) used in the systematic search for copper-molybdenum, polymetallic, and copper deposits are discussed. The method of hydroelectrometry in particular is discussed; it consists of determination of electrical resistivity of ground water. Low resistivity indicates higher relative salinity and higher content of sulfate ions, which in turn indicates a possible presence of chalcopyrite and molybdenite. Magnetic prospecting gives satisfactory results in geologic mapping.— A.J.S.

188-259. Nazarov, G. N. O nekotorykh rezul'tatakh elektrorazvedki solyanokupol'nnoy struktury Baskunchak [On some results of electrical prospecting of the salt dome structure of Baskunchak]: Razvedochnaya i Promyslovaya Geofizika, no. 36, p. 40-44, 1960.

Results are presented of a coordinated electrical prospecting, geologic surveying, and borehole logging expedition in the basin of Lake Baskunchak. The purpose of the expedition was to determine whether or not this basin represents the central part of a salt dome with no gypsum cap but covered with a thin layer of Quaternary salt. The Baskunchak basin was determined to be a compensation depression and not a salt dome.— A.J.S.

188-260. Kobayashi, Hajime. Electrical prospecting at Nawaji Mine, Shizuoka Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 5, p. 367-380, 1961.

Electrical resistivity and self-potential surveys were made of the Nawaji mine, Shizuoka Prefecture, Japan, to determine the applicability of these methods to prospecting for gold ore. Both methods gave good results over known ore bodies.— V.S.N.

ELECTRICAL LOGGING

188-261. Mirsalimov, R. M., and Mel'nikov, A. G. Vliyaniye emkostnogo effecta na elektrodakh zonda na rabotii geofizicheskoy apparatury [Capacitance effect of electric sounding electrodes on the performance of geophysical apparatus]: Vyssh. Ucheb. Zavedeniy, Izv. Neft' i Gaz, no. 8, p. 117-122, 1960.

The capacitance component of the resistance of a grounded electrode was found to effect the results of electrical measurements in boreholes, depending on the current density and frequency resistivity of the medium, surface condition of the electrodes, and other factors. Laboratory and field investigations were undertaken for establishing the cause of the capacitance and for finding methods to eliminate or reduce it.— A.J.S.

188-262. Sokhranov, N. N. Kolichestvennaya interpretatsiya dannykh elektricheskogo karotazha v perekhodnoy zone [Quantitative interpretation of electrical logging data in a transition zone]: Prikladnaya Geofizika, no. 27, p. 158-170, 1960.

The possibility of using electric resistivity in the transition zone of hydrophilic reservoir rocks is discussed. The pressure head of the water raised into an oil pool by capillary action depends on the radius of the pore canals and produces the so-called transition zone in which the water saturation coefficient changes from unity at the lower level to the value of the coefficient of residual water saturation. The position of the water-oil contact is determined as the level of critical resistivity at which the stratum yields practically water-free oil. Permeability determination by the resistance gradient and finding the proportion of pores of a given radius in the overall volume occupied by pores are discussed.— A.J.S.

188-263. Meyer, V. A. O faktorakh, vliyushchikh na rezul'taty izmereniy v metode elektrodnykh potentsialov [On the factors that influence measurements in the method of electrode potentials]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 278, p. 124-135, 1959.

This is a study of the application of the electrode potential method to differentiation of mineral conductors, sulfide ores in particular. Laboratory experiments and field tests with galena and pyrite are discussed, and curves of electrode potentials as affected by the metal of the electrodes and their surface area, the composition and concentration of the electrolyte (drilling mud), cathode polarization, and the residue of drilling shot metal on the borehole walls are illustrated.— A.J.S.

188-264. Johnson, Hamilton M. How different mud additives affect R_m-R_{mf}-R_{mc} ratios: World Oil, v. 152, no. 2, p. 49-66, 1961.

The complexity of muds used currently to overcome problems presented by the much higher temperatures and pressures of deeper drilling has introduced new problems in formation evaluating. Accurate measurements of the resistivity of the mud column (R_m), the mudcake (R_{mc}), and the filtrate from the mud (R_{mf}) are necessary for proper interpretation of electrical logs. Several graphs are presented that show the effect on resistivity exerted by temperature, disturbance of the mud cake, and concentration of additives. No definite relationship exists between R_m and either R_{mf} or R_{mc} for muds in general; these resistivity characteristics must be measured for each mud at the time of logging. Mud resistivities should be measured at temperatures approximating downhole conditions rather than at surface temperatures.— J.W.C.

188-265. Meyer, V. A. Vliyaniye drobi na character anomalii PS v rudnykh skvazhinakh [The effect of shot on the character of SP anomalies in ore boreholes]: Leningrad. Univ. Uchenyye Zapiski, no. 278, Voprosy Geofiziki, p. 119-123, 1959.

Sharp differences in amplitude and sign of the SP anomalies observed in different boreholes, or in the same borehole at different times, in sulfide deposits can to some extent be explained by the action of galvanic couples. The anode is formed by the steel drilling shot and other metal residue left in the walls of the borehole, and the cathode consists of natural conductors such as sulfide ores, magnetite, graphite, anthracite, and others.— A.J.S.

188-266. Zablocki, C[harles] J. Electrical properties of sulfide-mineralized gabbro, St. Louis County, Minnesota, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-256-C-258, 1961.

Self-potential, resistivity, conductivity, induced polarization, and magnetic susceptibility measurements were made in boreholes drilled in the Duluth gabbro in a search for sulfide ore. Sulfides, predominantly pyrrhotite, occur in an olivine-rich gabbro, in hornfels, and in a dense fine-grained gabbro containing hornfels. Typical logs obtained in the study are shown, and average values of the properties measured in each rock type are discussed and tabulated.— V.S.N.

188-267. Patchett, J. G. Log interpretation of the Tertiary and Upper Cretaceous of Wyoming and surrounding areas, in Symposium on Late Cretaceous rocks of Wyoming: Wyoming Geol. Assoc. 16th Annual Field Conf., 1961, Guidebook, p. 60-67, 1961.

Dependable formation evaluation data can be obtained from electric logs in the multiple sands of the Tertiary and Upper Cretaceous of Wyoming and surrounding areas by accurately measuring the flushed zone resistivity (Rxo) and true formation resistivity (Rt) and incorporating this with the self-potential curve in the form of a plot. Water zones can be determined to a high probability by plotting on semilog paper the logarithm of Rxo/Rt on the logarithmic axis against the self-potential deflection in millivolts on the linear scale. The method allows calculation of water saturation without knowledge of the chemistry of the drilling mud or formation water, consideration of mud filtrate resistivity, or temperature. The induction log gives the most consistently accurate values of Rt available as long as Rxo/Rt is not much less than one. The microlateralog is the only tool currently available to measure Rxo with sufficient accuracy; a mud cake 3/8 in. or less will give good results. At present the most serious limitation to the method is the mud cake requirement. Examples of the method are cited. The paper is well illustrated.— V.S.N.

188-268. Moston, R. P., and Johnson, A. I. Geophysical exploration of wells as an aid in location of salt-water leakage, Alameda Plain, California, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-262-D-264, 1961.

Geophysical logging was conducted in five experimental wells near Centerville, Calif., to detect leaks in well casings by which saline water could move from the upper to the lower aquifer. Gamma radiation logs were used to determine lithology and well construction, temperature logs to convert fluid-resistance measurements to conductivity, fluid-resistance logs to determine changes of water salinity with depth, and self-potential logs to locate perforations and leaks in the well casings. The methods aided in successfully identifying a source of salt-water intrusion into deeper aquifers.— V.S.N.

188-269. Andreas, Dieter, and Hecht, Günter. Die induzierte Polarisation als Bohrlochmessverfahren bei der Buntmetallerkundung [Induced polarization as a well logging method in nonferrous metal prospecting (with English and Russian summaries)]: Zeitschr. Angew. Geologie, v. 7, no. 10, p. 529-533, 1961.

Analysis of induced polarization curves obtained in boreholes in the Permian igneous rocks of the Thüringer Wald of Germany shows many distinct anomalies that can be attributed either to the presence of sulfide ore concentrations or to oxidized ores having good conductivity in melaphyre dikes. The sulfides and oxides can be distinguished from each other in these curves; thus electric logging can detect all essential polymetallic ore mineral concentrations, even when no core is recovered. As yet, concentrations cannot be evaluated qualitatively from electrical data.— D.B.V.

188-270. Perić, M., Damnjanović, K[onstantin], and Aleksić, D. Znacaj i mogućnosti karotaža bušotina pri istražnim radovima na ugliju [Possibility of the application of electrical logging methods in some coal basins (with English summary)]: Jugoslovenski Geol. Kong., 2d, Sarajevo 1957, p. 415-423, 1957.

As coal is very brittle, core recovery from drill holes is inadequate for determining position and thickness of coal seams. Resistivity and SP logging can be used, however, for complete documentation of borehole sections in coal basins. Coal beds show greater apparent resistivity than do adjacent clay beds. Examples are presented from the Ušće, Jarando, and Vrška Čuka areas.— J.W.C.

188-271. Nechay, A. M. Otsenka produktivnosti i kollektorskikh svoystv treshchinovatykh karbontanykh porod [Evaluation of the productivity and reservoir properties of fractured carbonate rocks]: Prikladnaya Geofizika, no. 26, p. 149-185, 1960.

Methods are described for determination of the productivity and for quantitative evaluation of the reservoir properties of Upper Cretaceous carbonate rocks in the northern Caucasus. Secondary porosity due to fracturing in nonargillaceous and slightly argillaceous rocks is estimated, and a value is then obtained for total porosity that has a relative error of less than 30 percent. The fractures are generally filled with calcite or clay; this explains the low gas permeability of the rock (0.03-0.04 millidarcy on the average). The porosity of cores ranges from 1.8 to 9.8 percent and decreases with depth.— A.J.S.

188-272. Dadashev, A. M. Karotazhnaya kharakteristika razreza produktivnoy tolshchi Kyanizadagskoy ploshchadi [Logging characteristics of the section of the productive unit of the Kyanizadag area]: Akad. Nauk Azerbaydzhan. SSR Doklady, v. 17, no. 7, p. 589-594, 1961.

The Neogene sediments on an anticline in the Kyanizadag area, Azerbaijan S.S.R., are traced and correlated on electrical logs made in 13 boreholes. The section of the productive unit is differentiated into 12 sandstone members, which are separated by shale beds.— J.W.C.

188-273. Boyarov, A. T. Opredeleniye kollektorskikh svoystv plastov po udel'nomu soprotivleniyu [Determination of reservoir properties of strata by specific resistance]: Prikladnaya Geofizika, no. 25, p. 216-222, 1960.

Correlation between electric resistivity, porosity, specific area, and permeability in the Volga River area near Kuybyshev is discussed. The resistivities plotted against specific areas and permeability of Devonian sandstone

and siltstone in the Mukhanovo oil-bearing formations were found not to have the direct proportionality proposed by Morozov (see Geophys. Abs. 180-136).— A.J.S.

188-274. Kamenev, S. P. Interpretatsiya diagramm elektricheskogo karotazha protiv glinistykh peskov na mestorozhdeniyakh severo-vostochnogo Sakhalina [Interpretation of diagrams of electrical logging opposite clayey sands in fields of northeast Sakhalin]: Razvedochnaya i Promyslovaya Geofizika, no. 36, p. 58-69, 1960.

Interpretation of electric logs in sandy and sandy-clayey sections of Tertiary oil fields in northeastern Sakhalin is discussed. The electrical potential of the productive horizon and the ratio of resistivity of the penetration zone to the resistivity of the layer investigated are used for construction of amplitude curves of deviation opposite an oil-bearing layer.— A.J.S.

Sano, Shun-Ichi; Takagi, Shin-Ichiro; and Nakai, Junji. Geophysical loggings at Higashi-Tagawa district, Yamagata Prefecture. See Geophys. Abs. 188-511.

ELECTRICAL PROPERTIES

188-275. Keller, G[eorge] V. Electrical properties of a part of the Portage Lake lava series, Houghton County, Michigan, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-272-D-274, 1961.

The electrical properties of rocks in the Michigan copper district along the south shore of Lake Superior are being investigated to determine electrical prospecting methods that may be useful in the search for additional ore. Investigations are made by borehole logging of rocks in place, and by laboratory measurements. Rock textures are determined from drill-core samples. Logs have been run in 10 regularly spaced drill holes along the strike of the Iroquois amygdaloid of the Portage Lake lava series, Keweenawan age, and samples taken at 5-ft intervals in two holes. The electrical conductivity of the rock, the capacity for induced electric polarization, and the magnetic susceptibility are measured. Measurements of the vertical component of the magnetic field and the spontaneous potential are also obtained. Results are given in tables and graphs.— V.S.N.

188-276. Toporets, S. A. O vliyanii metamorfizma na elektricheskiye i uprugiye svoystva iskopayemykh ugley [On the effect of metamorphism on the electrical and elastic properties of coals]: Akad. Nauk SSSR Doklady, v. 140, no. 2, p. 451-454, 1961.

Investigations on coals from the Donets, Kuznetsk, Tunguska, and Suchan basins show that there is a systematic relationship of specific electrical conductivity and elastic wave velocities (both normal and parallel to the bed) to the degree of metamorphism. The results, shown graphically, suggest that (1) the possibility of determining the rank of coal in the ground by means of electrical surveys and electrical logging is best in the case of thermally metamorphosed clarain-bearing coals, least in the case of regionally metamorphosed deposits; and (2) acoustic logging might be applied effectively to coal deposits, particularly for distinguishing coals that clinker with difficulty.— D.B.V.

188-277. Mikhaylova, N. P. Novi dani pro pytomyy opir Ukrains'kogo krystalichnogo shchyta [New data on the specific resistance of rocks of the Ukrainian crystalline shield]: Akad. Nauk Ukrayin. RSR Dopovīdī, no. 8, p. 1027-1029, 1961.

Data are presented on the resistivity of sedimentary and weathered rock measured by the electric microsounding method at 35 points on the Ukrainian

crystalline shield. Higher resistivities were found to be typical for the blanket of eroded crystalline rocks, loams, and sands. Under similar conditions the resistivity of kaolin was found to increase with an increase in the content of relic grains of the parent rock. The resistivities of manganese ores range from 5 to 14 ohms and show a definite correlation with mineralogical composition.— A.J.S.

188-278. Bukhnikashvili, A. V. Ustanovka dlya izmereniya yestestvennykh potentsialov rudnykh obraztsov [An apparatus for measuring natural potentials of ore samples]: Akad. Nauk Gruzin. SSR Soobshch., v. 21, no. 3, p. 281-284, 1958.

Laboratory experiments with ore samples of various composition using different electrolytes were performed on 200 samples from ore deposits of the Caucasus. It is assumed that the natural electric potentials of ore deposits are of a physical-chemical nature similar to that of contact potential of a metal and an electrolyte. Two graphs of natural electric potential against the time for which the sample and the electrolyte were in contact are given for samples of pyrite and polymetallic ore in a sulfuric acid solution. The two curves have completely different shapes.— A.J.S.

188-279. Sveshnikov, G. B., and Dorofeyeva, M. K. Nekotoryye elektrokhimicheskiye osobennosti sul'fidnykh mineralov [Certain electrochemical properties of sulfide minerals]: Leningrad. Univ. Uchenyye Zapiski, no. 278, Voprosy Geofiziki, p. 149-153, 1959.

The results of experimental investigations of electrode potentials as applied to the geophysics and geochemistry of ore deposits are discussed. The electrochemical properties of pyrite, galena, graphite, and magnetite were studied in terms of pH value and oxidation-reduction properties of the electrolyte. These properties were found to differ substantially in the minerals investigated.— A.J.S.

Zablocki, C[harles] J. Electrical properties of sulfide-mineralized gabbro, St. Louis County, Minnesota. See Geophys. Abs. 188-266.

EXPLORATION SUMMARIES AND STATISTICS

188-280. Griscom, Andrew, and Peterson, Donald L. Aeromagnetic, aeroradioactivity, and gravity investigations of Piedmont rocks in the Rockville quadrangle, Maryland, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-267-D-271, 1961.

Aeromagnetic, aeroradioactivity, and simple Bouguer gravity maps, all including generalized geology are presented for the Rockville quadrangle, Maryland. The bedrock in the area consists of Wissahickon schist intruded by large bodies of gabbro and serpentinized peridotite. The aeromagnetic map shows a linear magnetic grain associated with the structural trend of the Wissahickon that indicates various subunits of differing magnetizations; some subunits may be traced on the ground. Magnetic highs are located over serpentine; gabbro bodies are generally characterized by magnetic lows rimmed by highs that are associated with the contacts. Mafic intrusions are outlined by radiation lows and contacts can be located with considerable accuracy. Linear radiation trends over the Wissahickon correspond with the aeromagnetic trends. Gravity measurements outline a large positive closure, elongated northeast, and parallel to the aeromagnetic and aeroradioactivity anomaly trends. Local gravity highs coincide with the gabbro outcrops; theoretical values were computed for a hypothetical body.— V.S.N.

188-281. Boyum, Burton H. Subsidence case histories in Michigan mines, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Experiment Sta. Bull., no. 76, p. 19-57, 1961.

The methods employed in recent years to detect subsidence in the Michigan underground iron mines, particularly those in the Marquette Iron Range, are discussed in detail. The following methods are described: the use of instrumented diamond drill holes, application of the microseismic method, surface subsidence pin surveys, interval velocity studies, and reflection seismic surveys. Detailed tests on complete physical properties of selected earth materials are discussed with reference to geologic structures; these basic data are essential in order to apply any of the techniques of detection.— V.S.N.

188-282. Oil in Canada. Geophysical work almost holds own: Oil in Canada, v. 14, no. 8, p. 18, 1961.

Total geophysical activity in Canada for 1961 was 645 crew months. This was only 5 percent less than the 1960 total of 678 crew months and represents the lowest decrease since the slowing up trend started in the early fifties.— V.S.N.

188-283. Rigsby, George P., and Bushnell, Vivian C., eds. Proceedings of the third annual Arctic planning session, November 1960: U.S. Air Force Cambridge Research Center GRD Research Notes, no. 55, 148 p., 1961.

The results of field investigations and laboratory studies associated with the Arctic Terrain Research Program of the Terrestrial Sciences Laboratory are summarized in brief reports. The reports include research accomplished in the Arctic Ocean, studies of ice-free land, studies of ice shelves and ice islands, investigations of Arctic Lakes, and research into the engineering properties of ice. The complete record of a discussion by a panel of Arctic experts on problems of Arctic research is included.— V.S.N.

188-284. Hunkins, Kenneth, Herron, Thomas, Kutschale, Henry, and Peter, George. Geophysical studies of the Chukchi cap, Arctic Ocean: Jour. Geophys. Research, v. 67, no. 1, p. 235-247, 1962.

Echo-sounding, seismic-reflection, and magnetic measurements were made across the Chukchi cap in the Arctic Ocean from drifting station Charlie in 1959. The Chukchi cap is 130 km wide at the line of crossing and its minimum depth is 246 m. A microrelief of 5-30 m on the top is attributed to gouging by icebergs. Seismic reflection results indicate that the top of the Chukchi cap is thinly covered with unconsolidated sediment, but that small basins at the foot of the western margin may be filled to depths of 1 km. A magnetic anomaly with a maximum peak-to-trough amplitude of 1,600 gammas, associated with the western margin, is attributed to a large ridge in a basement rock of high susceptibility. Magnetic diurnal variations show a characteristic morning maximum at 1800 G.m.t. It is concluded that the Chukchi cap is a dissociated section of continental shelf.— Authors' abstract

188-285. Plouff, Donald, Keller, G[eorge] V., Frischknecht, F[rank] C., and Wahl, R. R. Geophysical studies on IGY drifting station Bravo, T-3, 1958 to 1959, in Geology of the Arctic, v. 1: Internat. Symposium on Arctic Geology, 1st, Calgary, Alberta, 1960, Proc., p. 709-716, 1961.

During 1958 and 1959, the U.S. Geological Survey conducted geophysical investigations on Ice Island T-3 while it was drifting southwestward along the Arctic coast of Canada. The water depths ranged from 200 to 2,500 m, as de-

termined by seismic measurements. From the surface down to 200 m the resistivity of the sea water decreases from 0.40 to 0.30 ohm-m, and below 200 m the resistivity is uniform at approximately 30 ohm-m. An electromagnetic profile across the center of Ice Island T-3 indicated an approximately uniform ice thickness of about 60 m.— J.W.C.

188-286. Gordienko, P. A. The Arctic Ocean: Sci. American, v. 204, no. 5, p. 88-98, 100-102, 1961.

A summary of U.S.S.R. scientific investigations in the Arctic seas is presented. The studies were initiated many years ago to find means of improving navigation in the Arctic seas. Meteorological findings, movement of currents and ice packs, types of Arctic waters and their relationship to the Atlantic and Pacific Oceans, the topography of the sea floor and the important effects of the Lomonosov Ridge, the form of the north magnetic pole as shown by recent studies, and fields for future investigation are discussed.— V.S.N.

188-287. Stenson, Harry R. Geophysical case history of the Alturitas concession, state of Zulia, western Venezuela: Geophysics, v. 26, no. 6, p. 691-705, 1961.

The geophysical case history of the Alturitas area in western Venezuela is unusual in that all the commonly used geophysical methods were employed. The Alturitas anomaly was discovered by the torsion balance in 1929. Subsequently, gravimeter, magnetometer, and seismic refraction and reflection surveys were made. These are discussed in chronological order. Although the results were generally good, an error in correlation led to a misinterpretation of stratigraphic relations, which in turn led to much deeper drilling depths than anticipated. Five wells were drilled, two of which were dry. Alturitas-1 and Alturitas-2 are two of the deepest wells outside the United States. Maps are presented for the key geophysical surveys.— D.B.V.

188-288. Mužijević, Ranko S. Rezultati geofizičkih ispitivanja izvedenih u cilju istraživanja ležišta nafte u Vojvodini [Results of geophysical research carried out for the purpose of exploration for oil deposits at Vojvodina (with French summary)]: Jugoslovanski Geol. Kong., 2d, Sarajevo 1957, p. 384-399, 1957.

Results are reported on geophysical exploration in 1948-56 in the Vojvodina area of Yugoslavia. The gravity maps show several maximums, which are due largely to the influence of the basement. The magnetic maps likewise show maximums and minimums due to the effect of the basement; however, the extreme values of the gravity anomalies do not coincide with those of the magnetic anomalies. This is explained by the rocks of the basement having a greater susceptibility at higher levels than at lower levels. Seismic reflection surveys have yielded data on depth, form, and mutual relations of several geologic structures.— J.W.C.

188-289. Aksin, Vladimir. Dosadašnji radovi na istraživanju nafte i gasa na teritoriji N. R. Srbije [Recent work in investigation of oil and gas in the territory of Serbia]: Jugoslovanski Geol. Kong. 2d, Sarajevo 1957, p. 469-480, 1957.

Geological exploration in Yugoslavia since 1950 is reviewed. Forty gravity maximums have been discovered. Two gravity maps are illustrated; one is of the region north of Belgrad, and the other is of the area around Jermenovci. The Greda gas field and the Jermenovci and Lokve oil fields were discovered.— J.W.C.

188-290. Khat'yanov, F. I. O perspektivakh poiskov neftegazonosnykh rifovykh massivov v zone Predural'skogo progiba [On the prospects of exploration of the oil-gas-bearing reef masses in the zone of the Cis-Ural downwarp]: Novosti Neftyanoy i Gazovoy Tekhniki, Geologiya, no. 2, p. 36-43, 1961.

Detailed gravity, electrical, and telluric current surveys were made during the period 1954-59 in a vast area in the south part of the Cis-Ural downwarp, and well-defined zones of oil-gas prospects were outlined. The method of search for reef masses in this region consists first of outlining the favorable zones with gravity and electrical exploration. Seismic surveys are then used to define more clearly the location of possible reefs. Next, exploration boreholes are drilled at 1.2-1.5 km along profiles. A characteristic feature of these reefs is that all of them that have been discovered until the present time have been oil- and gas-bearing.— J.W.C.

188-291. Babayants, S. P., and Zavarzin, G. N. Primeneniye geofizicheskikh metodov pri geologicheskoy s"emke masshtaba 1:200,000 v zakrytykh rayonakh [Application of geophysical methods in geological surveying on a scale of 1:200,000 in covered regions]: Razvedka i Okhrana Nedr, no. 8, p. 31-36, 1961.

The results are presented of electric, magnetic, and gravimetric surveys in the northwestern part of central Kazakh S.S.R., where there is a thick blanket (200 m) of Meso-Cenozoic sediments, and the geophysical data are interpreted in geological terms. This coordinated geophysical surveying was essential for studying the morphology of the Paleozoic basement of the area, differentiating it lithologically, discovering hidden intrusive and effusive bodies, establishing unrecorded faults, and outlining the eastern limits of the Jurassic coal deposits.— A.J.S.

GENERAL

188-292. Shuleshko, P. A method of integration over the boundary for solving boundary value problems: Australian Jour. Appl. Sci., v. 12, no. 4, p. 393-406, 1961.

The method of approximate solution of differential equations, based on a theory of general orthogonalization, is considered. A solution by this method is constructed as a series of functions, each of which satisfies the differential equation; boundary conditions are satisfied here by equating to zero some integrals taken along the border. Because it is not based on variational calculus, the method can be applied to any linear differential equation and can also be extended to nonlinear equations. Examples are presented to illustrate the fact that convergence is better than that of methods in which selected functions satisfy the boundary conditions.— D.B.V.

188-293. Bullerwell, W. Interpretation of geophysical surveys: Nature, v. 192, no. 4809, p. 1242-1244, 1961.

This is a report of a discussion on factors controlling the reasonable limits of interpretation of geophysical data, held by the Royal Astronomical Society in association with the Geological Society of London, on October 27, 1961.— D.B.V.

188-294. Toperczer, Max. Lehrbuch der allgemeinen Geophysik [Textbook on general geophysics]: Wien (Vienna), Springer-Verlag, 384 p., 1960.

This is a text on general geophysics based on lectures at the University of Vienna; there are five chapters. The first chapter is entitled statics and treats surfaces, the geoid, triangulation, leveling, gravity, and isostasy. The second

chapter is on dynamics and deals with precession, nutation, tectonics, and volcanism. The third chapter is devoted to earthquakes and microseisms; the fourth chapter to geomagnetism; and the fifth chapter to the age, thermal state, and internal constitution of the earth.— J.W.C.

188-295. Bubleynikov, F. D., and Ivanov, A. G. Geofizicheskiye metody poiskov poleznykh iskopayemykh [Geophysical methods of prospecting for mineral resources]: Moscow, Geotoptekhizdat, 176 p., 1961.

This is a textbook for students who have a background in physics and mathematics. Attention is given to understanding the physical principles that are the basis of geophysical exploration, the methods of observation, and the apparatus used in practice. The chapter headings are: Geologic structure and mineral deposits, geological prospecting and exploration, gravity surveying, magnetic surveying, electrical surveying, seismic methods of exploration, and logging geophysics.— J.W.C.

188-296. Skorupa, Jan. Geofizyczne aspekty narady RWPG w Pradze [Geophysical aspects of CMEA meeting in Prague]: Przegląd Geol., v. 9, no. 6, p. 319-323, 1961.

A summary of the geophysical papers given at the sessions of the Council of Mutual Economic Aid held in Prague on June 14-20, 1960, is presented. The theses of the papers are discussed briefly, especially those related to deep seismic sounding, magnetometric and gravimetric surveys, and wider application of electric logging and geoelectric exploration, which are of particular interest to Poland.— A.J.S.

188-297. Skorupa, Jan. Zastosowanie metod geofizycznych w poszukiwaniach złóż ropy i gazu w Polsce [Methods of geophysical work in exploration for oil and gas deposits in Poland]: Przegląd Geol., v. 9, no. 10, p. 512-518, 1961.

The methods of gravity, seismic, and electrical surveying as used in Poland in the search for oil and gas fields are described.— J.W.C.

188-298. Karpushin, D. M., Kudymov, B. Ya., and Shirokov, A. S. Voprosy metodiki opredeleniya ekonomicheskoy effektivnosti novoy geofizicheskoy tekhniki [Problems of the method of determination of the economic effectiveness of new geophysical technique]: Razvedka i Okhrana Nedr, no. 11, p. 34-40, 1961.

Four examples are given illustrating how new geophysical techniques can lower costs of exploration. Cost analyses are given for radio wave prospecting in boreholes, electrical logging of boreholes in coal fields, seismic surveying in structural studies, and proving reserves in iron deposits by magnetic surveying.— J.W.C.

188-299. Šumi, Franć. Geofizička ispitivanja na hromitima [Geophysical investigations for chromite (with German summary)]: Vesnik Primenjena Geofizika, ser. C, v. 1, no. 1, p. 67-79, 1960.

Study of chromite deposits by the magnetic, gravity, and induced polarization methods is reviewed; the Radusa and Krvenik deposits are used as examples. Selection of a prospecting method depends on the genesis of the deposit. If the ore occurs as streaks and not as a compact mass, the gravity method cannot be used. A graph shows the magnitude of gravity anomaly necessary in order to detect a compact mass of a given size and depth. The magnetic method can seldom be used because both the ore body and the host rock are generally magnetic. — J. W. C.

188-300. Dakhnov, V. N., D'yakonov, D. I., Kobranova, V. N., Latyshova, M. G., Pechernikov, V. F., Dobrynin, V. M., Vendel'shteyn, B. Yu., Larionov, V. V., Kholin, A. I., Neyman, Ye. A., Pozin, L. Z., and Lebedev, A. P. O terminologii i simvolakh primenyayemykh v promyslovoy geofizike [On the terminology and symbols used in logging geophysics]: Razvedochnaya i Promyslovaya Geofizika, no. 27, p. 223-235, 1960.

Terminology and symbols used in geophysical logging are tabulated and defined.— A.J.S.

GEODESY

188-301. Buchar, E. Determination of the flattening of the earth by means of the displacement of the node of the second Soviet satellite (1957β): Internat. Geophys. Year Annals, v. 12, pt. 1, p. 174-176, 1960.

The mean values of the coefficient K and of the flattening of the earth (α) are calculated from observations of satellite 1957β as K=0.0010852±0.0000013 and α=1/297.90±0.18.— D.B.V.

188-302. Whipple, Fred L. Oblateness of the earth by artificial satellites [Harvard College Observatory Announcement Card 1408]: Internat. Geophys. Year Annals, v. 12, pt. 1, p. 176, 1960.

Values calculated from orbits of the satellites 1958α and 1958β_2 are considerably lower than the international value of 1.297.0; therefore, they have been announced by the U.S. Army Map Service in spite of their very preliminary nature. For 1958α the node is 298.0±0.3 and the perigee is 297.8; for 1958β_2 the node is 298.38±0.07 and the perigee 298.3.— D.B.V.

188-303. Jacchia, Luigi G. The earth's gravitational potential as derived from satellite 1957β_1 and 1958β_2: Internat. Geophys. Year Annals, v. 12, pt. 1, p. 176-180, 1960.

The following geodetic values are calculated from data obtained from the satellites 1957β_1 and 1958β_2: J=0.001624±0.000001; K=9(±2)×10^{-6}; 1/α=298.28± 0.11; κ=3(±3)×10^{-7}. The value of 1/α is essentially in agreement with the values obtained by the U.S. Army Map Service reported by Whipple (see Geophys. Abs. 188-302).— D.B.V.

188-304. Lecar, Myron, Sorenson, John, and Eckels, Ann. A determination of the coefficient J of the second harmonic in the earth's gravitational potential from the orbit of satellite 1958β_2: Internat. Geophys. Year Annals, v. 12, pt. 1, p. 181-197, 1960.

From secular changes in longitude of the node and the argument of the perigee, the coefficient J of the second harmonic was determined to be (1.6232± 0.0005)×10^{-3}. If the bounding equigeopotential surface is assumed to be an ellipsoid of revolution, this value implies a flattening of 1.298.32±.05.— D.B.V.

188-305. Henriksen, S. W. The hydrostatic flattening of the earth: Internat. Geophys. Year Annals, v. 12, pt. 1, p. 197-198, 1960.

A value of ξ_h=3.333×10^{-3}=1/300.0 is calculated for the hydrostatic flattening of the earth, based on a value of J=1.6224×10^{-3}. The value for the "best-fitting ellipsoid," derived directly from J without considering the internal constitution of the earth, is ξ_e=1.298.4. Assuming that the hydrostatic and best-fitting ellipsoids are of equal volume, a crustal strength of the order of 1.5 million d

per sq cm is required to account for the difference. This is below the limit given by Jeffreys for the stress differences in the Himalayas, and would mean that a flattening value of 1.298.4 does not require an unreasonably large increase in crustal strength.— D.B.V.

188-306. O'Keefe, J[ohn] A., Eckels, Ann, and Squires, R. K[enneth]. Pear-shaped component of the geoid from the motion of Vanguard I: Internat. Geophys. Year Annals, v. 12, pt. 1, p. 199-200, 1960.

This paper was originally published in Science, v. 129, no. 3348, p. 565-566, 1959, and a detailed treatment appeared in the Astron. Jour., v. 64, no. 7, p. 245-253, 1959 (see Geophys. Abs. 176-159, 186-389).— D.B.V.

GEOTECTONICS

188-307. Lovejoy, Earl M. P. Comments on paper by V. V. Beloussov, "The origin of folding in the earth's crust": Jour. Geophys. Research, v. 66, no. 12, p. 4232-4233, 1961.
Beloussov [Belousov], V. V. Author's reply to the preceding discussion: ibid, p. 4234, 1961.

That contraction is no longer considered as a source of compression does not mean that compression is not causal, but rather that a better cause of compression must be sought. There is little in the Cordillera to convince a geologist familiar with it that Belousov's theory (see Geophys. Abs. 186-374) has been able "to meet the demands of modern scientific observations." If vertical faulting begets folding, the Basin and Range province should exhibit the finest examples of folds, but no such folds exist nor are there any unequivocal data indicating that they ever existed there. Gravitational sliding requires the presence of an elongate clay or salt dome, tens of miles long, erosion and breaching of which would initiate the sliding movement; there is no published evidence of such a dome, and furthermore this mechanism does not apply to "Laramide" thrusts in southwest Utah, southern Nevada, and southern California. Postulating vertical movements, moreover, is merely begging the question; what causes them?

Belousov replies that his conclusions were based on a study of real folding, not just conjecture. He has had no opportunity to study the Basin and Range structures but has seen many block structures which did not result in folding; where folding exists, however, it stands in the relation to faulting that he proposed. Folding requires the presence of appropriate material, which is not always available, and rate of displacement may also be important. Salt and clay diapirs of considerable length ("injection folding") are common; examples are given.— D.B.V.

188-308. Vening Meinesz, F. A. Convection currents in the mantle of the earth: Koninkl. Nederlandse Akad. Wetensch. Proc., v. 64, no. 4, p. 501-511, 1961.

This is the revised text of a lecture given at Princeton in 1958, in which Vening Meinesz reviews his convection current theory. Arguments are presented to show that convection currents exist in the mantle, that they occur episodically, that they are operating at present, and that their character is such as would be caused by cooling of the earth. Then the problem is discussed of how such currents can break through the transition layer where the density changes from a value of about 3.3 above 500 km depth to about 4.0 in the lower 2,000 km of the mantle.— D.B.V.

188-309. Legrand, R. L'épéirogenèse, source de tectonique. D'après des exemples choisis en Belgique [Epeirogeny, source of tectonics. According to some examples selected in Belgium]: Louvain Univ. Inst. Géol. Mém., v. 22, p. 5-66, 1961.

Study of the tectonic sequence of epeirogeny in Belgium and neighboring areas has led to the formation of a new theory: Epeirogeny is the result of two tension fields, opposite in sign and perpendicular to each other (a compression field crossing a traction field) applied to the crust of the earth. Hypothetical crustal drift, following the concept of Vening Meinesz, is proposed to explain the tension fields. Alpine uplifts and Rhenish subsidences are cited as examples of tectonic activities resulting from only one epeirogeny.— V.S.N.

188-310. Kropotkin, P. N. Paleomagnetizm, paleoklimaty i problema krupnykh gorizontal'nykh dvizheniy zemnoy kory [Paleomagnetism, paleoclimates, and the problem of great horizontal movements of the crust of the earth]: Sovetskaya Geologiya, no. 5, p. 16-38, 1961.

Variations of geomagnetic latitude estimated in various parts of the earth according to paleomagnetic data agree fully with paleoclimatic data. The differences in pole position established from the paleomagnetism of Paleozoic and Mesozoic rocks are explained by extensive horizontal displacements of the continents. A paleostructural map shows South America and Africa in juxtaposition; another shows North America, Greenland, and Europe in juxtaposition.— J.W.C.

188-311. Kawai, Naoto. Mountain-building movement in Japan and its vicinity: Royal Astron. Soc. Geophys. Jour., v. 6, no. 1, p. 1-8, 1961.

The depths of formation of plutonic rocks now exposed are estimated for Japan and the surrounding area on the basis of the pressure-temperature equilibrium relation of ferromagnetic minerals (see Geophys. Abs. 174-272). Results obtained for 28 localities are tabulated. The mountain-building mechanism of the Japanese islands is then inferred from these depths of formation. Upheaval has been very small in Korea but significantly large along the median line in Japan. Maximums (more than 20 km) occur at Kyushu Island, the Setouchi-Inland Sea area around Hiroshima, the Lake Biwa area, and the central mountain zone of the Japanese Alps; upheaval has also been great in the Hidaka Mountain zone of Hokkaido. As geologic evidence suggests that these rocks are late Paleozoic, contour lines showing equal upheaval represent the topography of crustal deformation since that time.

These upheavals as revealed by Curie-point measurements, together with subsidence inferred from Bouguer anomalies, provide support for the concept that the circumpacific mountain chain is the result of compression due to continental drift.— D.B.V.

188-312. Scheidegger, A[drain] E[ugen]. Underground stresses: Alberta Soc. Petroleum Geologists Jour., v. 9, no. 10, p. 287-308, 1961.

The manifestations of tectonic stresses are described and analyzed. Such manifestations occur in wells, mines, caves, and surface cuts. In addition, seismic phenomena as well as geologic and tectonic features are caused by ground stresses. An attempt is made to correlate the various features connected with ground stresses and to characterize the latter.— Author's abstract

Belyankin, F. P. Gravitational effects of the moon and sun on tectonic processes in the earth's crust. See Geophys. Abs. 188-196.

Egyed, L[ászló]. Palaeomagnetism and the ancient radii of the earth. See Geophys. Abs. 188-427.

188-313. Korhonen, Jorma. Adjustment of levellings in region of slow vertical movement: Acad. Sci. Fennicae Annales, ser. A, III, no. 61, p. 127-142, 1961.

Some of the problems concerning the execution of common adjustment of levelings made to detect slow vertical movements of the crust, and the choice of weights for the observations, are examined briefly.— D.B.V.

188-314. Reysner, G.I. Postroyeniye kart gradiyentov skorosti vertikal'nykh tektonicheskikh dvizheniy zemnoy kory na primere Severnogo Tyan'-Shanya [Preparation of maps of velocity gradients of vertical tectonic movements of the crust as exemplified in the northern Tien Shan]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 9, p. 1316-1320, 1960.

The methods of constructing maps that show velocity gradients of vertical tectonic movements in specific parts of the crust are discussed. The zones of vertical tectonic movement are established from stratigraphic, structural, and geomorphological data by measuring the relative displacement or deformation of the strata and determining the mean velocity gradient of the displacement for the period from 40 m.y. ago to 10 thousand years ago according to the following formula: grad $V_m=(h_1-h_2)/l_{1-2}T$, where h_1-h_2 is the altitude difference between the present position of the points which before the displacement were at the same height, l_{1-2} is the distance between the projection of these points on the horizontal plane, and T is the time during which the displacement was accomplished. A map showing application of this method in the Tien Shan is given. The values of $|\text{grad } V|_m$ here are between 0.1×10^{-7} and 0.01×10^{-7} cm/cm year. — A. J. S.

188-315. Rudich, Ye. M. Sovremennyye dvizheniya Sakhalina [Recent movements of Sakhalin]: Akad. Nauk SSSR Doklady, v. 141, no. 2, p. 437-440, 1961.

It is shown that the south and central parts of Sakhalin Island are being deformed more intensively than the northern part. Differential movements are stronger there, and block faulting is taking place particularly in the central part. In the north, the movement is essentially upwarping.— D.B.V.

188-316. Miyamura, Setumi, and Okada, Atusi. Results of levelling resurvey between Wakayama and Gobo, Wakayama Prefecture [in Japanese with English abstract]: Tokyo Univ. Earthquake Research Inst. Bull., v. 38, pt. 2, p. 355-359, 1960.

Releveling surveys were made in 1954 and 1959 along 70 km of the road from Wakayama to Gobo, Japan, in order to investigate crustal movement connected with local earthquake swarms. Results are tabulated (in English).— D.B.V.

188-317. Gill, Edmund D. Eustasy and the Yarra Delta, Victoria, Australia: Royal Soc. Victoria Proc., n.s., v. 74, pt. 2, p. 125-133, 1961.

Radiocarbon and oxygen isotope paleotemperature measurements have greatly strengthened the hypothesis of glacial control of Quaternary sea level changes. Inferences drawn from a graph of local radiocarbon datings plotted against world temperature for the last 100,000 yr are considered in relation to the geology of the Yarra Delta. Two warm periods of high sea level are separated by a long period of lower temperatures and sea level. No evidence is found of late Quaternary tectonic movements; if any have taken place, they were downward in keeping with the sunkland pattern.— V.S.N.

GLACIERS

188-318. Cress, P., and Wyness, R. The Devon Island expedition: Observation of glacial movements: Arctic, v. 14, no. 4, p. 257-259, 1961.

Observations of the movement of an outlet glacier of the Devon Island ice-cap were made during the summer of 1961. Surface movement was found by determining the position of stakes set into the ice along 3 profiles relative to signals placed on the rock of the cliffs overlooking the glacier valley. The first round of observations on June 2 was made on all stakes; the second round on July 7 was made on profile one only; and the final round, begun on August 2 and completed on August 15, was made on all stakes. The center stake of profile one moved 3.49 m in 35 days and 6.59 m during the next 37 days; the remaining stakes in the profile confirmed the increased rate of movement during the second period. Measurements of vertical movements show that the ice rose slightly at the edges and sank very slightly in the center. The stakes will be resurveyed in 1962.— V.S.N.

188-319. Behrendt, John C. Geophysical and glaciological studies in the Filchner ice shelf area of Antarctica: Jour. Geophys. Research, v. 67, no. 1, p. 221-234, 1962.

Published and unpublished geophysical and glaciological data collected during the International Geophysical Year are integrated in order to present a unified picture of the Filchner Ice Shelf and its surroundings. A large trough underlies the eastern section of the shelf and extends into the unexplored area at its head. Although the trough is not isostatically compensated locally, the area as a whole is essentially in isostatic equilibrium. The elevation of the M-discontinuity is about -31 km, which is consistent with that expected for a continental margin. Berkner Island is a grounded ice feature on Berkner bank, which gravity data indicate is probably composed of morainal material. The eastern section of the shelf is flowing seaward at a high rate, and the amount of ice lost at the ice front is greater than accumulation on the shelf.— D.B.V.

188-320. Crary, A. P. Glaciological studies at Little America Station, Antarctica, 1957 and 1958: IGY, World Data Center A, Glaciol. Rept., no. 5, p. 1-197, 1961.

The macroscopic behavior of the floating Ross Ice Shelf in the vicinity of Little America Station at lat 78°10' S. and long 168°13' W. was examined over an 18-month period to determine the glaciological regime or changes with time. The area extends 15 km from the barrier edge, has an average ice thickness of 250 m with thinning toward the barrier between 300 and 400 cm per km, and a surface 39-47 km above sea level. In addition to many small valleys, two major rift valleys are found with floors 15 m above sea level.

Studies included measurement of snow accumulation, horizontal ice strain or ice creep, ice melting at the bottom of the shelf, and near-surface densities and temperatures. Combining annual variations of thickness caused by accumulation, ice creep, and bottom melting, the ice is found to lose 108 cm annually; this corresponds to an elevation change of about 18 cm. Combined with local surface slope, a velocity of movement of 296 m per yr is determined; extrapolation to the thicker ice southeast of Little America and comparison of measured surface slopes gives an ice movement of 379 m per yr. The ice west of Roosevelt Island may be moving 3-4 times as fast as the ice on the east side. Detailed examination of valleys and barrier edge shows that the rift valleys (Crevasse and Kainan Bay) have abnormally high strain rates. An age for Crevasse Valley of about 40 yr is deduced. However, neither the causes of these valleys nor the reasons for their high strain rates are apparent.— V.S.N.

188-321. Fairbridge, Rhodes W. Radiation solaire et variations cycliques du niveau marin [Solar radiation and cyclic variations of sea level]: Rev. Géographie Phys. et Géologie Dynam., v. 4, no. 1, p. 2-14, 1961.

Analysis of short-range records of sunspots, temperatures, and sea level over three centuries shows that the rise and fall of sea level on a world scale

is measurably related to glaciers and thus to solar-controlled climatic change. Though foreshadowed by Gutenbert (1941) and Thorarinsson (1940) this analysis constitutes the first geophysical proof of the geological theory of glacioeustasy. A 1°C change over 100 yr brings roughly a 10 cm change in sea level, and a maximum of 10°C change over 10,000 yr leads to a 100 m eustatic change. However, over more extreme ranges the curve of log E (elevation) to temperature over years is sinusoidal, because there are finite limits to ice that can be melted and areas that can be glacially covered.— D.B.V.

GRAVITY

188-322. Roy, Amalendu. Rapid computation of gravity anomalies for irregularly shaped three-dimensional bodies: Geophysics, v. 26, no. 5, p. 645-646, 1961.

A method of computing rapidly the gravity anomalies for irregular three-dimensional bodies that is genuinely simple in both derivation and use is outlined, and charts are presented. Though mainly of interest to those who have to undertake manual computation, some simple scheme of programming on digital computers may perhaps also be devised.— D.B.V.

188-323. Paterson, Norman R. An interpretation technique for airborne gravity gradient measurements: Geophysics, v. 26, no. 4, p. 474-479, 1961.

For some purposes it may be desirable to work with the gravity force g rather than its vertical gradient g'. A simple method has been tested by which measurements of g' on a plane surface can be integrated to produce values of g anywhere in space above the plane of measurement. The method appears to show promising results.— Author's abstract

188-324. Chinnery, M. A. Terrain corrections for airborne gravity gradient measurements: Geophysics, v. 26, no. 4, p. 480-489, 1961.

A method is given for the calculation of terrain corrections for airborne measurements of the vertical gradient of gravity. This includes a short account of the theory concerned, a description of the practical procedure, a complete set of numerical tables, and some examples of their application. The method described is shown to be very flexible, both with regard to aircraft height and to complexity of topography. Some discussion is also given of the magnitude of topographic effects on the gravity gradient, and it is shown that terrain corrections are in general more important here than in normal gravity work.— Author's abstract

188-325. Kane, Martin F. Structure of plutons from gravity measurements, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-258-C-259, 1961.

Measured and computed gravity profiles and geologic sections interpreted from them are shown for two outcropping mafic intrusives—one in Maine and one in Pennsylvania. Contacts and directions of dip were determined from the characteristic steep gravity gradients and offsets in peak amplitude. Comparison of several computed profiles suggests that the range of density contrasts that gives a good definition of the intrusive is limited; profiles over dikelike bodies are more helpful than those over irregularly shaped felsic plutons.— V.S.N.

188-326. Colley, G. C. Gravity surveys in heavy sand dunes: Geophysics, v. 26, no. 4, p. 490-498, 1961.

This is a review of problems of gravity surveying in desert sand dune areas; both access and correction of data are treated. Types of sand dunes; the

importance of reconnaissance, aerial photographs, and provision of suitable equipment in planning a survey; and the advantages and disadvantages of motor transport, light aircraft, and helicopters and the operational procedures used with each are discussed.

Suggestions are given for determination of terrain corrections, which are usually necessary. The difference in densities between dune sands and their floor introduces a problem in determination of the Bouguer correction. A method is given whereby close estimates of the sand thickness can be found by contouring on the "floor" or on minimum elevations. The resulting Bouguer values after computation are as regular as those found in areas of small elevational changes.— D.B.V.

188-327. Constantinescu, Liviu, and Botezatu, Radu. Contribuţii la interpretarea fizică a anomaliilor cîmpurilor potenţiale. I. Continuarea analitică in semispatiul inferior [Contribution to the physical interpretation of anomalies of potential fields. I. Analytical continuation in a lower halfspace (with Russian and French summaries)]: Acad. Romîne Probleme de Geofizikă, v. 1, p. 97-138, 1961.

A practical procedure is described for analytical continuation into a lower halfspace of values of the vertical component F of a potential field, where the distribution in the horizontal plane z=0 is known. This problem is of great interest to gravity and magnetic exploration. The point of departure, consisting of the development of a Maclaurin series, is the same as for other methods of analytical continuation. The method followed here uses derivatives deduced from solution of the Laplace equation in a Fourier-Bessel approximation calculated exclusive of the effect of the initial field on two circles in the plane of reduction of the observation data. Practical formulas are given and their application discussed.— J.W.C.

188-328. Constantinescu, Liviu, and Botezatu, Radu. Contribuţii la interpretarea fizică a anomaliilor cîmpurilor potenţiale. II. Condiţii de aplicare a continuării analitice [Contribution to the physical interpretation of anomalies of potential fields. II. Conditions of application of analytical continuations (with Russian and French summaries)]: Acad. Romîne, Probleme de Geofizică, v. 1, p. 139-162, 1961.

Treatment of the physical interpretation of anomalies of potential fields is continued by a study of the conditions of application of the procedures of analytical continuation (see Geophys. Abs. 188-327). The maximum reduction of the probability of the propagation and amplification of initial errors is obtained if formulas are used with the coefficient m=1.5 for a quadractic net and m=1 for an equilateral triangle net. Distortion of anomalies by continuation is reduced by both of these nets. There is a relationship between the factor m of the practical formula and the ratio d/z between the sides of the net and the depth of occurrence of the source of the anomaly. With data on the average depth of the interface bounding the disturbing formation and on the density contrast, analytical continuation of the anomalies to a level near the upper surface of the formation permits an approximate calculation of the relief of the surface of this formation.— J.W.C.

188-329. Gladkiy, K. V. Razdeleniye summarnykh gravitatsionnykh poley kak protsess chastotnoy fil'tratsii [Separation of total gravity fields as a process of frequency filtering]: Prikladnaya Geofizika, no. 25, p. 114-129, 1960.

An analysis of the three methods of gravity field separation (averaging of anomalies, their analytical extension, and the method of higher derivatives of Δg) shows that the fields investigated can always be reproduced according to time (for example, by a photoelectric reproduction of the graph of a function).

The three separation methods are considered to have a single theoretical basis—a frequency filtration of the total field separating its parts with predominant upper or lower frequencies, and the three methods of separation use processes each of which in essence functions like a filter of a particular frequency characteristic. Frequency spectrums of a function $\Delta g(x)$ for a few simple two-dimensional bodies are calculated, and the frequency characteristics of the processes used for separation of the field are analyzed and discussed. Suggestions are made for an automation of the filtering operations, thus establishing qualitatively new methods of separation of gravity fields.— A.J.S.

188-330. Litvinenko, O. K. Primeneniye vychislitel'nykh mashin dlya razdeleniya lokal'nykh i regional'nykh gravitatsionnykh anomaliy [Application of calculating machines for distinguishing local and regional gravity anomalies]: Prikladnaya Geofizika, no. 25, p. 130-134, 1960.

Analytical programming of an initial integral, which gives a solution of the Neumann problem for an infinite plane, is handled by a processing or a high speed electronic computer. A solution is sought for distinguishing anomalies by removing the regional background which conceals them.— A.J.S.

188-331. Afanas'yev, N. L. Opredeleniye vertikal'noy koordinaty tsentra vozmushchayushchego tela po gravitatsionnym anomaliyam [Determination of the vertical coordinate of the center of a disturbing body from gravity anomalies]: Prikladnaya Geofizika, no. 25, p. 135-140, 1960.

Considering the additivity of gravitational potential and its derivaties, and applying the theorem of the integrand's mean value, formulas are derived for determination of the depth of the center of a disturbing body which produces anomalies Δg, and V_{xz}. The effective depth of the center is determined by substituting a spherical body of the same mass for the real body of mass M. The effective depth is near to the depth of the gravity centers of the bodies whose vertical dimensions are approximately equal to or greater than the horizontal dimensions of the body. Two- and three-dimensional bodies are discussed.— A.J.S.

188-332. Raspopov, O. M. Metod opredeleniya elementov zaleganiya anomal'nykh tel po dannym gravirazvedki [Method of determination of the disposition of anomalous bodies acçording to data of gravity prospecting]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 289-296, 1960.

The method of determination of the depth of occurrence H and the mass M of anomalous geologic bodies based on interpretation of the anomalous vertical gravity gradient is discussed. The method has all the advantages inherent in the methods using higher derivatives of gravity potential; the computations are cumbersome, however.— A.J.S.

188-333. Raspopov, O. M. Ob anomaliyakh vertikal'nogo gradienta sily tyazhesti v gornom rayone [On the anomalies of the vertical gravity gradient in mountainous region]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 284-288, 1960.

This is virtually the same paper as that published in Akad. Nauk SSSR Izv. Ser. Geofiz., no. 8, p. 1231-1234, 1959 (see Geophys. Abs. 179-205).— A.J.S.

188-334. Vecchia, Orlando. La densità nella gravimetria in montagna [Density in gravimetry in mountains (with English summary)]: Quaderni di Geofisica Applicata, v. 18-19, p. 3-19, 1957-58.

Gravity surveys in mountainous areas are strongly affected by changes in density of the rock, and the simple solution of adopting a mean value as a constant for the entire surveyed area distorts the Bouguer anomalies considerably. A new method is proposed in which densities are chosen by three dimensional interpretation of geologic maps and profiles. The density introduced into the calculations is not that of the rock at the station; rather, it is an integral determination embracing the gravity effect of every mass within a reasonable radius.— J.W.C.

188-335. Mende, Rastislav. Određivanje prosečne gustine iz podataka gravimetriskih merenja [Determination of average density from gravimetric data (with English summary)]: Vesnik Primenjena Geofizika, ser. C, v. 1, no. 1, p. 9-26, 1960.

By introducing a Fourier series for the expression of the gravity field around a chosen point, Gladki's idea for determining the average density of a superficial layer from observed gravity data by the least squares method is modified. The accuracy of the method is discussed, and its application is illustrated in an example. Although the computation is long and tedious, the method gives accurate and satisfactory results.— J.W.C.

Jacchia, Luigi G. The earth's gravitational potential as derived from satellite $1957\beta_1$ and $1958\beta_2$. See Geophys. Abs. 188-303.

Lecar, Myron, Sorenson, John, and Eckels, Ann. A determination of the coefficient J of the second harmonic in the earth's gravitational potential from the orbit of satellite $1958\beta_2$. See Geophys. Abs. 188-304.

188-336. Mironov, V. S. K teorii gravimetra postroyennogo po printsipu vertikal'nogo mayatnika Golitsyna [On the theory of a gravimeter designed according to the principle of Golitsyn's vertical pendulum]: Leningrad Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 114-124, 1960.

This is a discussion of some consequences of the theory of the vertical pendulum gravimeter constructed by Golitsyn and analyzed theoretically by Shnirman in 1938. The possibility of temperature compensation of a quartz gravimeter without a thermostat applied to its sensitive element is considered.— A.J.S.

188-337. Botezatu, Radu. Reţeaua gravimetrică a R. P. Romîne. I. Triangulaţia staţiilor gravimetrice de ordinul I a R.P. Romîne [Gravity net of Rumania. I. Triangulation of gravimetric points of the first order in Rumania (with Russian and French summaries)]: Acad. Romîne, Probleme de Geofizică, v. 1, p. 7-96, 1961.

The triangulation net of gravimetric points of the first order in Rumania consists of 15 points located at the apexes of triangles with a base point at Bucharest. Selection of the points was guided by the distribution of airports. This net is shown on a map. The exact locations of the points are listed. Definitive results of measurements of the gravity field, values of the normal field, and Faye and Bouguer anomalies calculated for an intermediate layer with a density of 2.20 and 2.67 are presented in tables. Reciprocal control between the triangulation net and the national pendulum net was obtained by several connecting measurements.— J.W.C.

188-338. Black, R[udolph] A., and Roller, J[ohn] C. Relation between gravity and structure of part of the western flank of the Black Hills, South Dakota and Wyoming, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-260-C-262, 1961.

Results of a regional gravity survey to delineate the major structural features of part of the west flank of the Black Hills are presented. The gravity data indicate that there has been greater vertical movement along the north-south direction than along the northwest-southeast direction. A single fault or steep fold with a throw of approximately 3,200 feet provides a close fit to the observed gravity profile. A Bouguer gravity map, a structural contour map, and generalized geologic sections are included.— V.S.N.

188-339. Pakiser, L[ouis] C., and Baldwin, Harry [L.], Jr. Gravity, volcancanism, and crustal deformation in and near Yellowstone National Park, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-B, p. B-246-B-248, 1961.

A gravity survey made during 1960 in Yellowstone National Park and adjacent parts of Idaho, Montana, and Wyoming revealed a gravity high over (a) the pre-Tertiary rocks that form the high mountains north, south, and west of the Yellowstone Plateau, (b) the basalts of the Snake River Plain, and (c) the Tertiary volcanic breccias east of the Plateau; and a gravity low over (a) the Cenozoic rhyolites of the Yellowstone Plateau and (b) the Cenozoic clastic deposits and rhyolites of Madison Valley. The gravity low of Madison Valley probably reflects a narrow graben filled with low-density Cenozoic clastic deposits and rhyolites several thousand feet thick, bounded by high-angle faults. The pronounced low of the Yellowstone Plateau could be explained by a disc-shaped accumulation of rhyolite with gently tapered sides, 10,000 or more feet thick, and 0.3 g per cc less dense than the surrounding rocks. It could also be explained in part by (a) a thickening of the low-density silicic upper part of the earth's crust from 15 to 21 km, (b) a magma chamber, or (c) a silicic batholith. The data are consistent with Boyd's (written communication) conclusion that the plateau marks the site of a gigantic caldera formed by collapse into a huge underlying magma chamber that may still exist, and with Daly's (see Geophys. Abs. 53-1573) suggestion that the rhyolite may be the foundered crust of a roofless batholith of low density.— V.S.N.

188-340. Plouff, Donald. Gravity profile along Roberts Tunnel, Colorado, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-263-C-265, 1961.

Gravity stations established in 1960 in the Roberts Tunnel as a part of a regional gravity survey of the Colorado Rocky Mountains form a unique line of stations across the Rocky Mountains. Gravity measurements in the tunnel and at the surface provide data for study of the density of the intervening rocks and the variation of the vertical gradient of gravity with depth and location. The Bouguer gravity anomaly has a relief of about 70 mgals along the tunnel line (Dillon to Shawnee). The most negative values of the gravity low that is associated with the deficiency of mass beneath the mountains are near the west end of Roberts Tunnel rather than in the vicinity of the Continental Divide as would be expected if underlying rock density were inversely related to elevation. The vertical gradient of gravity, F, is less than 0.09406 mgals per foot, and calculated densities are consistently too high and increase with thickness of cover. The general correspondence of calculated density with topography is attributed largely to the decrease of the vertical gradient of gravity near the major gravity low associated with the Rocky Mountains.— V.S.N.

188-341. Stuart, David J., and Wahl, Ronald R. A detailed gravity profile across the Southern Rocky Mountains, Colorado, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-265-C-267, 1961.

Gravity measurements were made along a 264 mi profile across the Southern Rocky Mountains from east of Denver to Grand Junction, Colo. The broad gravity low, extending from one end of the profile to the other, demonstrates

that the Southern Rocky Mountains are to some extent isostatically compensated on a regional scale. The absence of gravity lows associated with prominent topographic highs suggests that large but geographically limited loads are not compensated locally. Other variations produced by the influence of the Precambrian basement and varying thickness of the sedimentary-rock section are discussed.— V.S.N.

Case, J[ames] E., and Joesting, H[enry] R. Precambrian structures in the Blanding Basin and Monument upwarp, southeast Utah. See Geophys. Abs. 188-451.

188-342. Andreasen, Gordon E., and Kane, Martin F. Isostatic compensation in the Sangre de Cristo Mountains, New Mexico, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-277-D-281, 1961.

A regional Bouguer anomaly and geologic map of the southern Sangre de Cristo Mountains, N. Mex., shows a decrease in gravity values as the mountains are approached from the east with the lowest values occurring over the highest topography. The maximum amplitude is 21 mgals or, with a terrain correction, 16 mgals. If a density contrast of 0.2 is assumed between the Precambrian rocks and the Pennsylvanian clastic rocks that occupy the central part of the Sangre de Cristo synclinorium, then the anomaly indicates a thickness of clastic rocks in excess of 6,000 feet. The correlation between topography and Bouguer gravity is demonstrated by the method in which topography is averaged over large circles, in this case 64 miles in diameter at each station location. Regionalized topographic contours generally parallel Bouguer isogals but there is a notable decrease in the rate of change of regional topography with Bouguer gravity in the highest part of the mountains. A further analysis by a free-air anomaly map shows that the main mountain mass is an excess load and is not supported by the low-density mass outlined by the Bouguer gravity anomaly.— V.S.N.

188-343. Joesting, H[enry] R., Case, J[ames] E., and Cordell, L. E. The Rio Grande trough near Albuquerque, New Mexico, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-282-D-286, 1961.

Gravity and magnetic surveys of the Rio Grande country near Albuquerque, N. Mex. show large gravity and magnetic lows associated with the alluvium-filled trough and highs over the adjacent uplifts. Steepened gravity and magnetic gradients permit the buried fault zones that bound the trough to be traced. The probable thickness of sedimentary materials in the trough is computed to be about 15,000 feet. The vertical displacement of the Precambrian basement along the structural front of the Sandia Mountains near Albuquerque is about 20,000 feet.— H.R.J.

188-344. Plouff, Donald. Gravity survey near Tucson, Arizona, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-258-D-259, 1961.

Results of observations made at 767 gravity stations established near Tucson, Ariz., are discussed briefly and illustrated by a geologic map and Bouguer gravity anomaly map. The maps show a significant correlation between gravity highs and outcrops of Tertiary and older rocks. Relative gravity lows associated with thick alluvium deposits are identified.— V.S.N.

188-345. Kane, Martin F., and Carlson, J. E. Gravity anomalies, isostasy, and geologic structure in Clark County, Nevada, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-274-D-277, 1961.

A gravity survey of Clark County, Nev., started in 1957, has revealed a pattern of anomalies that indicates a close relationship between isostatic adjustment and geologic structures. The general pattern of anomalies, as illustrated in a free-air gravity contour and generalized geology map, shows positive values on Paleozoic bedrock (excess load), negative values on alluvial basins (deficient loads), and near zero values on Precambrian bedrock (balanced loads). As the mountain areas and basin areas are in juxtaposition, it is suggested that they act in pairs; the basin is the depressed end and the range the uplifted end of one tilted mountain block. The presence of low-density masses on the uplifted ends of mountain blocks that are probably tilted suggests that these masses are buoyant and provide the force necessary to tilt the blocks initially.— V.S.N.

188-346. Hill, D. P., Baldwin, Harry L., Jr., and Pakiser, L[ouis] C. Gravity, volcanism, and crustal deformation in the Snake River Plain, Idaho, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-B, p. B-248-B-250, 1961.

The western Snake River Plain in Idaho is characterized by three elongate, en echelon gravity highs oriented in a northwest direction and parallel to the major fault zones of the region. The central high extends for 95 miles and has a maximum amplitude of about 70 mgals, and both the northern and southern highs are approximately 35 miles long and have amplitudes of about 20 mgals. The tops of the anomaly-causing bodies are below the 3,000 feet of Pliocene and Pleistocene low-density sedimentary deposits and interbedded basalt flows that fill the Snake River Plain graben. In the preferred interpretation of two dimensional analyses the disturbing masses are approximated by tabular bodies extending from about 5,000 to 60,000 feet below sea level. The geological hypothesis that best explains the anomalies is probably a combination of (1) a graben bounded by faults of large vertical displacement and filled with lava flows, and (2) large en echelon fissures under the Snake River Plain that have been filled with basalt or basalt-like material.— V.S.N.

188-347. Stuart, David J. Gravity study of crustal structure in western Washington, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-273-C-276, 1961.

A gravity survey covering 25,000 sq mi of western Washington, an area bounded on the east by the western foothills of the Cascade Range and on the other sides by the state boundaries, is discussed. The most conspicuous feature of the gravity field is its correlation with lower and middle Eocene volcanic rocks over which gravity values are relatively high. The continuous gravity high that forms a westward-opening U-shaped pattern around the Olympic Mountains and the intensely negative anomalies, such as those associated with thick Tertiary sedimentary sections at Seattle and Everett, are superposed upon a broad gravity minimum of about -35 mgals. Except for the Olympic Mountains there is a general lack of correlation between elevation and Bouguer anomaly value. A Bouguer anomaly map superposed on a generalized outcrop map of lower and middle Eocene volcanic rocks and a cross-sectional diagram of a two-dimensional mass distribution capable of producing the composite gravity profile extending from the Olympic Mountains into Puget Sound, Wash., are included.— V.S.N.

188-348. Oliver, H[oward] W., Pakiser, L[ouis] C., and Kane, M[artin] F. Gravity anomalies in the central Sierra Nevada, California: Jour. Geophys. Research, v. 66, no. 12, p. 4265-4271, 1961.

More than 1,000 gravity measurements in the central Sierra Nevada and adjacent areas to the east show a decrease in regional Bouguer values from -75 mgal at the western edge of the mountains to a minimum of -235 mgal just west of their crest—a distance of only 100 km. To the east a positive regional

gradient of about 0.6 mgal per km continues for at least 60 km, into the Inyo-White Mountains. Local lows are associated with valleys filled with Cenozoic sediments, and local highs are associated with metavolcanic roof pendants in the batholith.

The variation in regional Bouguer anomalies can be explained by crustal thickening (from 35 to 52 km) combined with eastward decrease in density of the batholith (from 2.76 to 2.64 g per cc). The gravity data support Romney's conclusion based on seismic evidence (see Geophys. Abs. 171-66) that a local mountain root exists under the southern and central parts of the Sierra Nevada but not under the northern part, in general accordance with regional isostasy.— D.B.V.

188-349. Pakiser, L[ouis] C. Gravity, volcanism, and crustal deformation in Long Valley, California, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-B, p. B-250-B-253, 1961.

A gravity survey of Long Valley, Mono County, Calif., has led to the discovery of a pronounced elliptical gravity low bounded by steep gradients that coincide approximately with the margin of the basin and with the exposed boundary between Cenozoic volcanic and sedimentary rocks and pre-Tertiary crystalline rocks. The mass deficiency corresponding to the entire gravity low as determined by Gauss's theorem is about 7.8×10^{17} g, which is equivalent to 470 cubic miles of Cenozoic deposits 0.4 g per cc less dense than the pre-Tertiary rocks. The discrepancy between the probable volume of the structure and that of the stream-transported deposits suggests that a large proportion of the Cenozoic deposits in Long Valley is volcanic. This is supported by observation of volcanic rocks at the surface and by gravity and magnetic evidence of a mass of dense and magnetic material buried near the center of Long Valley. Long Valley may be a volcano-tectonic depression caused by subsidence along faults, following extrusion of magma from a chamber at depth. (See also Geophys. Abs. 181-274).— V.S.N.

188-350. Jackson, W[ayne] H., Shawe, F. R., and Pakiser, L[ouis] C. Gravity study of the structural geology of Sierra Valley, California, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-B, p. B-254-B-256, 1961.

Data from 300 gravity stations established in 1959 and 1960 and from 418 stations made available from the California Department of Water Resources in Sierra Valley, Sierra and Plumas Counties, Calif., have revealed a prominent, elongate gravity minimum associated with the valley floor. A broad, deep basin with a northeasterly trend is indicated. Steep bounding faults are suggested by relatively steep gravity gradients on the northwest and west margins of the valley. In general the structural setting is similar to that of Mono Basin and Long Valley, Calif. (see Geophys. Abs. 181-274, 188-349).— V.S.N.

Mabey, Don R. Regional magnetic and gravity anomalies in the Darwin area, California. See Geophys. Abs. 188-452.

188-351. Barnes, David F. Gravity low at Minto Flats, Alaska, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-254-D-257, 1961.

Recent gravity surveys have defined the form and magnitude of a gravity low in the western embayment of the Middle Tanana basin that covers all the Minto Flats west of Nenana and extends south towards the Alaska Range. The magnitude of the low is -35 to -55 mgals in relation to the surrounding areas, and the steepness of the gradient west of Nenana indicates a shallow source. The thickness of the sedimentary section could range from one to several kilometers because the densities of the Cenozoic rocks beneath Minto Flats vary widely with age and character. Older Tertiary deposits are probably present

in the deeper part of the basin; as these are denser than the Quaternary alluvium, the thickness of the section required to cause the anomaly is probably greater than 1 km.— V.S.N.

188-352. Krivoy, H[arold] L., and Eaton, J[erry] P. Preliminary gravity survey of Kilauea Volcano, Hawaii, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-205-D-208, 1961.

A gravity survey was made in the summit region of Kilauea in December 1959 and January 1960 during the eruption and was repeated in March-April after the major subsidence that coincided with the flank eruption at Kapoho graben, the coastal terminus of the east rift zone. Bouguer gravity anomaly maps based on March-April data are reproduced for both the summit and Puna areas. In general the anomalies reflect the topography of the volcano, although north of the rift zone the contours cut sharply across the topography and follow the rift. The strong positive anomaly centered at Kilauea caldera and extending out along the east rift zone is caused largely by a complex of dense dikes at the core of Kilauea. The shallow reservoir beneath the caldera may be responsible for part of the anomaly.— V.S.N.

188-353. Baker, C. O., and Bott, M[artin] H[arold] P[hillips]. A gravity survey over the Freetown basic complex of Sierra Leone: Overseas Geology and Mineral Resources, v. 8, no. 3, p. 260-278, 1961.

Gravity anomalies measured over the Freetown basic complex of Sierra Leone agree with structural evidence in suggesting a roughly circular or elliptical outline for the complex with the center 8 to 12 miles offshore WSW of York. The character of the large positive Bouguer anomaly, reaching about 75 mgal above background and showing a rapid increase seaward, is consistent with the interpretation that the complex is a lopolithic or inverted cone-shaped body. The contact dips inward at about 20° or 30°, and the depth is at least 10 miles at the center. The background gravity field suggests evidence for a crustal sag beneath the complex that was presumably developed partly during emplacement. If such crustal sag is slightly in excess of the sag of the floor, it is possible that the Freetown Peninsula may be in isostatic equilibrium. Drilling operations in two marginal areas seem to confirm the inward dip of the floor.— V.S.N.

Worst, B. G. The Great Dyke of Southern Rhodesia. Pt. 2—Geophysical observations. See Geophys. Abs. 188-456.

188-354. Simin, Dina. Određivanje gustina na teritoriji Vojvodine [Determination of density in the territory of Vojvodina (with English summary)]: Vesnik Primenjena Geofizika, ser. C, v. 1, no. 1, p. 27-36, 1960.

Laboratory density determinations are reported for 560 samples from 57 deep wells in Banat and for 123 samples from 8 deep wells in Bačka. The variation in density with depth is shown on a graph; the average values range from 1.8-2.0 for the Pliocene to 2.3 for the Mesozoic and 2.6 for the older Paleozoic. The density increases with depth in uniform increments.— J.W.C.

Roksandić, Miodrag M. Some geotectonic features of the southeast part of the Tuzla basin according to data of geophysical investigations. See Geophys. Abs. 188-

188-355. Visarion, Marius. Contribuţia prospecţiunii gravimetrice la determinarea structurilor cu sare şi săruri de potasiu din depozitele neogene ale Carpaţilor Orientali [Contribution of gravity exploration to the determination of salt structures and deposits of potassium salts in Neogene sediments of the eastern Carpathians]: Acad. Romîne Studii şi Cercetări de Geologie, v. 6, no. 3, p. 581-599, 1961.

The gravity method has proved effective and economical in exploration for salt structures and potassium salt deposits in the Neogene sediments of the eastern Carpathians. Three zones are distinguished, and examples accompanied by maps and cross sections are presented to show how gravity surveying was used to advantage in each.— J.W.C.

188-356. Visarion, Marius. Imagini geofizice din regiunea Carpaţilor Orientali de la est şi vest de Masivul Ceahlău [Geophysical maps of the region of the eastern Carpathians to the east and west of the Ceahlău Massiv]: Acad. Romîne Studii şi Cercetări de Geologie, v. 5, no. 4, p. 757-773, 1960.

The results of gravity and magnetic investigations in the eastern Carpathians are reviewed. The gravity anomaly map was compiled by the standard method using a density of 2.4 for the intermediate layer, and the ΔZ map by reducing the effect of the normal field calculated according to a regional formula. These maps accompany the article. A pronounced gravity low in the area appears to be due both to low density flysch sediments at the surface and to thickening of the crust and uplift of a granite mass at depth. A magnetic high coincides with this gravity deficit.— J.W.C.

188-357. Airiney, Shtefan [Airinei, Stefan]. Gravitatsionnyye i geomagnitnyye issledovaniya v zone izgiba Vostochnykh Karpat i Tsara Byrsey [Gravimetric and geomagnetic investigations in the zone of bend of the eastern Carpathians and the Tara Birsei]: Acad. Roumaine, Rev. Geol-Geog., v. 4, no. 1, p. 125-161, 1960.

This is virtually the same paper as that published in Acad. Romîne Studii şi Cercetări de Geologie, v. 4, no. 1, p. 127-162, 1959 (see Geophys. Abs. 181-283).— J.W.C.

Ştefănescu, Sabba S.; Airinei, Ştefan; Botezatu, Radu; Ionescu, Florian; Popovici, Dorin; and Stoenescu, Scarlet. Geophysical exploration for iron in the vicinity of Constanta. See Geophys. Abs. 188-463.

188-358. Faytel'son, A. Sh. Ispol'zovaniye rezul'tatov gravirazvedki dlya vydeleniya osnovnykh paleostrukturnykh elementov zapadnykh rayonov Sovetskoy Pribaltiki [Utilization of the results of gravity exploration for distinguishing the main paleostructural elements of the western regions of the Soviet Baltic]: Razvedochanya i Promyslovaya Geofizika, no. 36, p. 45-57, 1960.

On a basis of a gravity survey in conjunction with data from logging, magnetic, and electrical surveys, a new interpretation is presented for the structure of the pre-Devonian, Devonian, and Meso-Cenozoic strata of the western part of the Baltic region.— A.J.S.

188-359. Karpins'ka, N. M., and Kharechko, G. E. Do pytannya pro deyaki fizychni vlastyvosti porid Pivnichnogo Prysyvashshya [On the problem of some physical properties of rocks of the Northern Sivash area]: Akad. Nauk Ukrayin. RSR Dopovīdī, no. 6, p. 740-744, 1961.

Density characteristics of the Kakhovka-Armyansk profile in the north Sivash area are discussed. The increase in the value of density is intermittent, and several density boundaries were established. A dip of the main density interface to the south and its transgression from older to younger formations were noted. According to the available data the increase in density with depth follows an exponential law. This observation may be true, however, only where the sedimentary rocks have not been subjected to dynamic metamorphism.— A.J.S.

188-360. Mironov, V. S. Gravitatsionnyye anomalii Rudnogo Altaya i ikh geologicheskoye znacheniye [Gravity anomalies of the Rudnyy Altay and their geologic importance]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 278, p. 56-65, 1959.

Small-scale gravimetric data are interpreted on the basis of structural tectonic profiles correlated with Δg of several traverses made across the ore-bearing areas of the Altay and Kolba ranges. It was established tentatively that the relief of Caledonian basement, which ranges from 8 to 16 km in depth, is the principal factor causing the anomalies. The ore-bearing zones of the Altay and Kolba were found to extend into the Kulundin steppes.— A.J.S.

188-361. Momose, Hiroto, Hagiwara, Yukio, and Wani, Katsunosuke. On the gravity prospecting in the metal mine area [in Japanese with English abstract]: Butsuri-Tanko, v. 14, no. 2, p. 87-97, 1961.

A gravity survey of the Yoshino Mine, Yamagata Prefecture, is described as an example of application of this method to exploration for massive shallow metal deposits in areas of complex topography and high relief. Emphasis is placed on the method of making terrain corrections, a correction table is included.— V.S.N.

HEAT AND HEAT FLOW

188-362. Smith, J. H. Geothermal energy—United Nations Conference on new sources of energy. Commentary: Internat. Assoc., no. 1, p. 67-73, 1962.

A general summary is presented of the information contained in the 77 papers and 3 general reports on geothermal energy presented to the United Nations Conference on new sources of energy at Rome in August 1961. Important developments and significant surveys of geothermal resources are discussed briefly by country, and techniques of exploitation of this natural resource are reviewed. (See also Geophys. Abs. 187-346).— V.S.N.

188-363. Shneiderov, A[natol] J. On the internal temperature of the earth: Boll. Geofisica Teor. ed Appl., v. 3, no. 10, p. 137-159, 1961.

A version of the exponential theory of gravitation (see Geophys. Abs. 118-7517), which leads to an influx of cosmic (radional) energy of 9×10^{16} ergs per sec into the earth, is outlined as a background for a semi-empirical formula of the internal temperature of the earth: $\log T=0.424+0.5 \log\delta'+0.5 \log s'+(1/6) \log 0.5\, r^2[1-(R^2/r^2)]^\circ$ K. In this formula δ' is density of a spherical layer at a distance R from the center of the earth, r is its radius, and $s'\approx0.85$ is an exponential series in terms of R, δ', and $\beta_\rho=4\times10^{-11}$ cm^2 per g is a coefficient of absorption. A table showing the internal structure and temperature of the earth, and a graph of the temperature in °C versus depth in kilometers are given.— A.J.S.

188-364. Somerton, W[ilbur] H. Additional thermal data for porous rocks—Thermal expansion and heat of reaction: Soc. Petroleum Engineers Jour., v. 1, no. 4, p. 249-253, 1961.

Thermal expansions and heats of reaction of three typical sandstones were measured in the temperature range of 25°C to 1,000°C. The significance of the measurements in subsurface heat-transfer calculations is discussed. Expansion behavior of sandstones was found to be controlled by the quartz content; differential expansion of quartz and other minerals in the sandstone caused permanent deformation of the samples even after cooling to room temperature. Structural damage resulting from heating is probably an important cause of reduction of thermal conductivity of heated samples.

Thermal reactions were found to require more than 1/4 the amount of heat necessary to raise the temperature of the rock alone. In shales and limestones the reaction heat could be substantially greater than that required for specific heat considerations alone (see also Geophys. Abs. 176-204, 184-415).— V.S.N.

188-365. Clark, Sydney P., Jr. Heat flow in the Austrian Alps: Royal Astron. Soc. Geophys. Jour., v. 6, no. 1, p. 54-63, 1961.

Terrestrial heat flow has been calculated from underground temperature measurements made during construction of the Arlberg and Tauern tunnels in Austria combined with measurements of the thermal conductivity of 42 samples of rock from near the tunnels. The value in the Arlberg is found to be $(1.9\pm0.2)\times10^{-6}$ cal/cm^2 sec, and that in the Tauern, $(1.8\pm0.2)\times10^{-6}$ cal/cm^2 sec. These results are in good agreement with the value of 1.9×10^{-6} cal/cm^2 sec reported for the Loetschberg tunnel in Switzerland (see Geophys. Abs. 172-130), and indicate that relatively high geothermal fluxes extend into the eastern Alps. The high flux can be attributed to radioactive heat generated in the thickened crust.— D.B.V.

188-366. Aliyev, S. A. O velichine geotermicheskoy stupeni v mestorozhdenii Bibieybat [Magnitude of the geothermal step in the Bibieybat field (in Azerbaijan with Russian summary)]: Akad. Nauk Azerbaydzhan. SSR Izv., no. 3, p. 87-90, 1959.

Geothermal observations in the Bibieybat oil field are tabulated, and a geothermal map is presented. The geothermal step in this area ranges from 25 to 27 m per °C, and the average is 26 m per °C.— J.W.C.

188-367. Dzhamalov, S. A. Glubinnoye teplo Zemli [The heat of the earth's interior]: Priroda, no. 6, p. 74-76, 1961.

This is a popular article about utilization of the heat of the earth's interior in general, and in the Dagestan A.S.S.R. in particular. Hot water from deep (1,500 m) boreholes at Makhachkala is of potential economic value. Heat energy was obtained from 63°C water at a cost of 20 kopeks for one million calories.— A.J.S.

Alfano, L[uigi]. Geoelectrical explorations for natural steam near "Monte Amiata". See Geophys. Abs. 188-253.

Cassinis, Roberto. Application of seismic methods to geothermal energy exploration. See Geophys. Abs. 188-555.

188-368. Savul, M., and Pomîrleanu, V. Cercetări paleogeotermometrice asupra zăcămîntului hidrotermal filonian de la Baia-Sprie [Paleogeothermal investigations of hydrothermal vein deposits of Baia-Sprie]: Acad. Romîne Studii şi Cercetări de Geologie, v. 6, no. 2, p. 287-297, 1961.

The crystallization temperature of quartz was determined for the vein deposits of Baia-Sprie by the method of homogenization of different phases of liquid inclusions. The mean arithmetic and the extreme values increase almost uniformly with depth. The average temperature ranges between 200°C at 250 m above sea level to 296.3°C at 400 m below sea level. This temperature variation explains the change in the paragenetic relationships at depth and the formation of scheelite and wolframite in the lower portions. The geothermal gradient of the solutions calculated to a depth of 443 m is 15.6°C per 100 m.— J.W.C.

INTERNAL CONSTITUTION OF THE EARTH

188-369. Cram, Ira H., Jr. A crustal structure refraction survey in South Texas: Geophysics, v. 26, no. 5, p. 560-573, 1961.

Two shots were detonated on the Gulf Coastal Plain on August 11, 1960, 260.2 km apart (one 16 miles northwest of Cleveland and the other 27 miles northwest of Victoria, both in Texas) and on a line approximately parallel to the strike of the Cenozoic sediments. At each shotpoint more than 3,000 lb of explosive were placed in 5 holes, and the top of the charge was at a depth of 95 ft and the bottom at 250 ft. Sixty seismograph crews attempted to record the shots.

The results indicate the following thickness-velocity relationships: 2.0 km of 2.3 kmps material, 5.3 km of 3.94 kmps material, 12.5 km of 5.38 kmps material, and 13.2 km of 6.92 kmps material. The M-discontinuity is represented by a velocity of 8.18 kmps, and total crustal thickness is 33.0 km. The first two layers probably represent the Cenozoic and Mesozoic sediments, the 5.4 kmps layer the Paleozoic and Precambrian rocks, the 6.9 kmps layer is the high-velocity crustal layer, and the 8.18 kmps zone is the upper mantle. This section correlated well with adjacent measurements in the Gulf of Mexico and northeast Arkansas.— D.B.V.

188-370. Annau, Edgar, and Vefalosh, Antall. Materials concerning the structure of the earth crust in northeast China [in Chinese with English abstract]: Acta Geophys. Sinica, v. 9, no. 2, p. 139-143, 1960.

It is shown that the deep seismic reflection waves recorded in northeast China are from a depth of about 15 km and indicate the presence of a seismic discontinuity in that part of the crust. These data are compared with those from various parts of the world.— V.S.N.

188-371. Santo, Tetsuo A[kima]. Observation of surface waves by Columbia-type seismograph installed at Tsukuba Station, Japan. (Pt. 1)— Rayleigh wave dispersions across the oceanic basin: Tokyo Univ. Earthquake Research Inst. Bull., v. 38, pt. 2, p. 219-240, 1960.

Rayleigh wave dispersion for various paths across the Pacific Ocean has been determined from records of a long-period seismograph installed at Tsukuba, Japan, by Columbia University's Lamont group, and the results are interpreted in terms of crustal structure. In the southwest Pacific the crust apparently thickens westward. Under the Arctic the crust is purely oceanic, under Greenland purely continental, and under Antarctica along long 40° W.-140° E. probably continental. The crust under the south Indian Ocean differs from that under the central Pacific and is similar to that from the Kermadec Islands or New Guinea to central Japan. The dispersion curves for paths across or near volcanic islands bordered by trenches are remarkably different from those over other oceanic paths. The crust is thick from Sumatra to Formosa and from Java to Mindinao, and is thin to the south of Australia. Beneath the Ryukyu Islands it is similar to that from the Aleutian Islands to central Japan.— D.B.V.

188-372. Santo, Tetsuo A[kima]. Rayleigh wave dispersions across the oceanic basin around Japan (Pt. 2): Tokyo Univ. Earthquake Research Inst. Bull., v. 38, pt. 3, p. 385-401, 1960.

Rayleigh wave dispersion is calculated for 24 additional shocks. The results confirm the conclusions reached in the first part of this paper (see Geophys. Abs. 188-371) and suggest furthermore that the departure of dispersion curves for the southern Pacific Ocean from the purely oceanic type may be due to the thickening of the crust beneath Micronesia, Polynesia, and Melanesia.— D.B.V.

Deniskin, N. A., Nikiforova, N. N., and Lomakina, Z. D. On electromagnetic sounding of the earth's deep layers. See Geophys. Abs. 188-143.

188-373. Aki, Keiiti, and Press, Frank. Upper mantle structure under oceans and continents from Rayleigh waves: Royal Astron. Soc. Geophys. Jour., v. 5, no. 4, p. 292-305, 1961.

Theoretical seismograms of Rayleigh waves based on several models of mantle structure were compared with actual records for various paths. Model 8099 of Dorman, Ewing, and Oliver (see Geophys. Abs. 181-130) fits records from Pacific Ocean paths but not those from Indian-Atlantic Ocean paths for periods less than 100 sec. The velocity of the Airy phase corresponding to the group velocity maximum is about 0.10 kmps lower for Indian-Atlantic Ocean paths than for the Pacific Ocean; the difference can be accounted for by reducing the shear velocity at the top of the mantle under the Indian Ocean by about 0.1-0.2 kmps. The difference between the Pacific mantle and the continental mantle can be explained either by a reduction in shear velocity of the low velocity layer under the Pacific Ocean or by making the low-velocity zone shallower.— D.B.V.

188-374. Magnitskiy, V. A. Proekt verkhney mantii [The upper mantle project]: Priroda, no. 6, p. 46-47, 1961.

A study of the upper two layers of the earth's mantle to a depth of 700-900 km proposed at the General Assembly of the International Union of Geodesy and Geophysics in 1960 is discussed. The seismic, magnetic, gravimetric, heat flow, tiltmeter, and other geophysical, geological, and geochemical methods are mentioned briefly.— A.J.S.

188-375. Kennedy, George C., and La Mori, Phillip N. The pressures of some solid-solid transitions: Jour. Geophys. Research, v. 67, no. 2, p. 851-856, 1962.

A free piston gage capable of measuring pressures to 60 kilobars has been constructed. The basic element of the gage is a supported carbide vessel entered by a rotating piston. With this apparatus the pressures of solid-solid transitions in teflon, $AgNO_3$, KI, KBr, KCl, KCN, ice, Cs, Bi, Tl, Te, and Ba have been determined with fair precision. The results are tabulated. They are in very close agreement with those of Bridgman; for most substances studied they are about 1 percent below on the average, but for bismuth, which was studied most extensively here, they are slightly higher.— D.B.V.

ISOTOPE GEOLOGY

188-376. Hoering, T. C. The carbon isotope effect in the synthesis of diamond: Carnegie Inst. Washington Year Book 60, p. 204, 1960-61; reprinted in Carnegie Inst. Washington Geophys. Lab. Ann. Rept. of Director for 1960-61, 1961.

The effect of pressure on the fractionation of carbon isotopes between graphite and diamond at 1,700°C is less than twice the experimental error.— B.R.D.

188-377. Keeling, Charles D. The concentration and isotopic abundance of carbon dioxide in rural and marine air: Geochim. et Cosmochim. Acta, v. 24, no. 3/4, p. 277-298, 1961.

An earlier study (see Geophys. Abs. 173-264) is extended by reporting the analysis of 106 additional samples of rural air and 13 samples of air collected over tropical waters in the eastern Pacific Ocean. At locations far from terrestrial plants and cities the concentration and C^{13} abundance of CO_2 in the air are found to be nearly constant, but the O^{18} abundance shows a systematic

variation with air temperature, ocean water temperature, or season. Concentration ranges from 0.0303 to 0.0320 volume percent of original air; the C^{13}/C^{12} ratio ranges from -6.7 to -7.4 per mil; and the O^{18}/O^{16} ratio ranges from -6.7 to -7.4 per mil.

The correlation between C^{13} abundance and concentration of CO_2 previously obtained for forest air is again observed. The C^{13}/C^{12} ratio of the CO^2 released by forest plants, computed on the basis of this correlation, varies between -21 and -26 per mil. The O^{18} abundance of CO_2 in forest air is variable but shows no simple relationship with other measured quantities.— D.B.V.

188-378. Hoering, T. C. The effect of physical changes on isotope fractionation: Carnegie Inst. Washington Year Book 60, p. 201-204, 1960-61; reprinted in Carnegie Inst. Washington Geophys. Lab. Ann. Rept. of Director for 1960-61, 1961.

The isotope fractionation factors accompanying the reactions CO_2 (g) and CO_2 (aq) and exchange of oxygen between CO_2 (g) and H_2O (1) were found to be mostly a function of temperature and relatively unaffected by pressure and activity coefficients. In the reactions involving CO_2 (g) and CO_2 (aq), the heavy isotope of oxygen and the light isotope of carbon concentrate in the aqueous phase.— B.R.D.

188-379. Hoering, T. C. The carbon-isotope effect on the rate of enzymatic decarboxylation of formic and glutamic acid: Carnegie Inst. Washington Year Book 60, p. 200-201, 1960-61; reprinted in Carnegie Inst. Washington Geophys. Lab. Ann. Rept. of Director for 1960-61, 1961.

This study supports the conclusion of other investigators that the isotope effect on the rate of an enzyme-catalyzed reaction is smaller than the corresponding nonenzymatic reaction.— B.R.D.

188-380. Mzhachikh, K. I., and Ashirov, K. B. K geokhimii deyteriya v neftyakh i bitumakh neftyanogo ryada [On the geochemistry of deuterium in oils and bitumens of the oil group]: Sovetskaya Geologiya, no. 6, p. 130-134, 1961.

A study was made of the ratio of protium to deuterium in 23 specimens of oil and 2 of bitumen from oil fields of the Kuybyshev district of the U.S.S.R. Water obtained by combustion of these oils has a protium to deuterium ratio of 3767-4436, which is higher than that for standard water. In the oils examined there is no systematic change in the deuterium content with the age of the enclosing rock. No relationship is found between the deuterium content and such parameters of the oil as specific gravity and content of sulfur, tar, asphalt, and paraffin; nor is there any relationship between the deuterium content and formation pressure or temperature. A zonality, however, was found in the areal distribution of the deuterium content of the oils; three zones are distinguished.— J.W.C.

188-381. Schatenstein, A. I., Jakowlewa, E. A., Swjaginzewa, E. N., Warschawski, Ja. M., Israilewitsch, E. A., and Dychno, N. M. Isotopenanalyse des Wassers [Isotope analysis of water]: Berlin, VEB Deutscher Verlag der Wissenschaften, 270 p., 1960.

This is a German translation of a book published in Russian by the Academy of Sciences Press, Moscow, in 1957. The chapter headings are as follows: relative abundance of the isotopes in natural water, purification of water for isotope analysis, determination of the relative abundance of heavy isotopes of hydrogen and oxygen from the density of water, pycnometer method of density measurement, drop-fall method of determination of density, float method of

density measurement, determination of relative abundance of deuterium by measurement of indexes of refraction, determination of the isotopic composition of oxygen in heavy water, preparation of the glass apparatus for the analysis, purification of the water samples for isotope analysis, thermostating, pycnometer method, drop-fall method, float method, float method with higher accuracy, separate determination of the relative abundance of deuterium and the heavy isotopes of oxygen in water, determination of the relative abundance of heavy isotopes of oxygen in water, and measurement of differences in indexes of refraction with the interferometer.— J.W.C.

188-382. Clebsch, Alfred, Jr. Tritium-age of ground water at the Nevada Test Site, Nye County, Nevada, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-122-C-125, 1961.

Tritium analyses indicate that water in aquifers tapped by supply wells on the Nevada Test Site and in one off-site well has had an apparent residency of more than 50 yr. On the other hand, water in perched aquifers in the high areas has been recharged since 1952 (pre-hydrogen bomb). If perched water contaminated with Sr-90 moves to one of the main aquifers, 40 or more years will be required for travel and in that time Sr-90 activity would be reduced to about 35 percent of its original concentration by radioactive decay and diffusion, dispersion, and ion exchange should further reduce concentration, possibly by several orders of magnitude.— V.S.N.

188-383. Burger, A. J., Nicolaysen, L. O., and de Villiers, J. W. L. Lead isotopic compositions of galenas from the Witwatersrand and Orange Free State, and their relation to the Witwatersrand and Dominion Reef uraninites: Geochim. et Cosmochim. Acta, v. 26, p. 25-59, 1962.

New Pb isotopic analyses are presented for 41 galenas from various mines in the Witwatersrand and the Orange Free State. Certain of the galenas have large proportions of radiogenic lead, and one sample from the St. Helena mine contains a spectacular variation in the proportions of the lead isotopes within a hand specimen.

The addition of radiogenic lead to these galenas is probably complementary to the loss of radiogenic lead from the Witwatersrand uraninites, and the implications of this hypothesis on the uraninite age measurements are pursued. The possible times of abstraction of radiogenic lead from the uraninites have been obtained through graphical analysis of the galena data.

The hypothesis implies the former existence of "parent uraninite" grains, which have undergone chemical alterations; in this view the present Witwatersrand uraninites have maintained textural identity with the parent uraninites, but have been "rejuvenated" chemically through successive alterations and losses of radiogenic lead. The most probable age of crystallization of the parent uraninites is ≈3,000 m.y. This is in agreement with an independent investigation of uraninites from the Dominion Reef, which are probably representative of the "parent uraninites." The effect of mineral separation procedures in concentrating the uraninites for age measurement is also discussed.— Authors' abstract

188-384. Austin, C[arl] F., and Slawson, W[illiam] F. Isotopic analyses of single galena crystals: A clue to history of deposition: Am. Mineralogist, v. 46, no. 9 and 10, p. 1132-1140, 1961.

The variation in the isotopic composition of lead from a small lead deposit was investigated. Large galena crystals were cut into segments. These segments were analyzed individually. A general relationship of a decrease in radiogenic lead towards the interior of a whole crystal was found. The single-crystal isotopic variations are in complete accord with the regional variations found throughout west-central New Mexico. The interpretation given is that the ore fluids in this deposit were not of a random nature and that the relative

times of lead deposition within the deposit may be charted by means of isotopic variations.— R.M.G.

188-385. Emiliani, C[esare], and Mayeda, T[oshiko]. Carbonate and oxygen isotopic analysis of core 241A: Jour. Geology, v. 69, no. 6, p. 729-732, 1961.

Chemical and oxygen isotopic analysis of a short pilot core from the equatorial Atlantic shows a proportionality between $CaCO_3$ percentages and paleotemperatures. This proportionality suggests a causal relationship between temperature and the ratio of carbonate to noncarbonate accumulation, without implying temperature dependence for the carbonate production rate. No relationship could be demonstrated between temperatures and the smaller carbonate variations. However, if these are the residue of larger variations partly smoothed out by reworking of the sediment by bottom organisms, they would assume a significance beyond that of noise.— Authors' abstract

188-386. McCarthy, J. H., Jr., Lovering, T. S., and Lakin, H. W. Density comparison method for the determination of O^{18}/O^{16} ratios in prepared waters, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-387-C-389, 1961.

A modification is described of the usual falling-drop comparison method (Kirshenbaum, 1951) of measuring differences in the density of prepared waters of constant hydrogen isotope content for determination of natural variations in oxygen-18/oxygen-16 ratios. With this method the density of a standard and of an unknown water are compared simultaneously and with sufficient sensitivity and precision to detect the small variations in oxygen-18/oxygen-16 ratios that may be associated with geologic processes.— V.S.N.

188-387. Thode, H. G., Monster, J[an], and Dunford, H. B. Sulphur isotope geochemistry: Geochim. et Cosmochim. Acta, v. 25, no. 2, p. 159-174, 1961.

Sulfur isotope abundances for 39 specimens of 17 meteorites show again the remarkable constancy of the sulfur isotope ratios for meteorites of all types. However, differences in the S-32/S-34 ratios of 0.4 percent would appear to be significant. The S-32/S-34 ratio for meteorites is discussed as a possible base level from which fractionation in the earth's crust began. The value is compared with estimates of average values found for terrestrial samples including some recent results on igneous intrusives.

A large suite of sea water samples collected from widely separated points in three oceans at various depths shows that the sulfate in the three oceans is exceedingly uniform in isotope ratio, with an enrichment of 20.1±0.3 percent in S-34 over that of the meteoritic standard. Present day sea shell sulfate and gypsum forming in evaporite deposits from sea water have a S-32/S-34 ratio close to that in the water from which they form. Sulfate in rain water is depleted by about 15 percent in S-34 compared to sea water sulfate; this provides evidence in favor of the Conway-Eriksson model of rain water, the sulfate being derived from H_2S lost from shallow seas or intertidal flats. The sulfate geochemical cycle is discussed.— I.F.

Gast, P[aul] W. The rubidium-strontium method. See Geophys. Abs. 188-18.

188-388. Smith, R. F., Eby, R. E., and Turok, C. W. Variations in isotopic content of natural uranium: Union Carbide Nuclear Company Rept., no. KY-373, 9 p., 1961.

Uranium ore concentrates from 17 world sources have been compared with a standard to determine variations in isotopic content. There are significant differences in the isotopic contents of unaltered uranium ore concentrates pro-

duced in the various parts of the world. Eight domestic sources of ore concentrate have been analyzed, and a spread of 0.06 percent is indicated. Nine foreign sources show a spread of about 0.03 percent. The overall spread of the 17 sources is 0.06 percent. Although the overall spread indicated is 0.06 percent, larger deviations are considered possible if specific mineral deposits were analyzed.— R.M.G.

188-389. Cherdyntsev, V. V., Orlov, D. P., Isabayev, Ye. A., Asylbayev, U. Kh., Ivanov, V. I., Usatov, E. P., and Borisenko, T. I. Kolebaniya izotopnogo sostava prirodnogo urana [Variation of the isotopic composition of natural uranium]: Akad. Nauk SSSR, Kom. Opredeleniyu Absolyut. Vozrasta Geol. Formatsiy Trudy, no. 9, p. 306-312, 1961.

Enrichment factors of U-235 over the normal ratio to U-238 for 12 samples of uraninite, thorite, molybdenite, chalcopyrite, magnetite, iron oxide, and calcite were determined by alpha spectrometry and by "neutronometry." Results by the two methods usually agree within a few percent and show zero enrichment in all but two samples. A sample of molybdenite from the Tadzhik S.S.R. shows an enrichment factor of 1.5 by alpha spectrometry, and a magnetite from a pegmatite in the Transcaucasus shows factors of 1.5 and 1.35 by alpha spectrometry and neutronometry, respectively. An excess of actinium over radium is observed in the second sample and is presumed for the first.— H.F.

188-390. Koshelev, I. P., and Syromyatnikov, N. G. O nekotorykh zakonomernostyakh migratsii isotopov urana-234 i urana-238 [Some regularities in the migration of isotopes of U-234 and U-238]: Akad. Nauk Kazakh. SSR Izv. Ser. Geol., no. 3, (44), p. 73-82, 1961.

A systematic study was made of the migration of uranium isotopes in order to determine any systematic isotopic fractionation. The U^{234}/U^{238} ratio was determined for waters from igneous, sedimentary, and metamorphic rocks and from various uranium minerals. The leachibility of U^{234} and U^{238} was also determined for these same rocks. The results are tabulated. Preferential migration of U^{234} in the liquid phase is explained by the fact that part of the U^{234} atoms during radioactive disintegration enter microfractures in the solid phases and there can migrate independently of the source atoms of U^{238}, which are bound in the crystal structure.— J.W.C.

Umemoto, Shunji. Isotopic composition of barium and cerium in stone meteorites. See Geophys. Abs. 188-112.

Reynolds, J[ohn] H. Isotopic composition of xenon from enstatite chondrites. See Geophys. Abs. 188-113.

Zähringer, J., and Gentner, W. On the Xe-129 in the Abee meteorite. See Geophys. Abs. 188-114.

Jeffery, P. M., and Reynolds, J[ohn] H. Concerning Xe-129 in meteorite Abee. See Geophys. Abs. 188-115.

MAGNETIC FIELD OF THE EARTH

188-391. Harrison, E. R. Determination of the nature of the earth's distant magnetic field: Nature, v 193, no. 4813, p. 359, 1962.

With the present developments in rockets and space vehicles it is now possible to perform experiments on a global scale which can give direct evidence of the time- and space-varying properties of the distant geomagnetic field. It is suggested that an alkaline-earth element, either Be, Mg, Ca, Sr, or Ba, be released at a high altitude in a gaseous state. When strongly ionized these el-

ements act as strong resonant scatterers of solar radiation. The migrating ions will therefore trace or map out the distant geomagnetic field, and their monochromatic radiation will provide evidence on the topology of the field. Two possible ways of initiating the experiment are discussed. Perhaps as little as 10 kg of material is all that would be needed.— D.B.V.

188-392. Akasofu, Syun-Ichi, Cain, Joseph C., and Chapman, Sydney. The magnetic field of a model radiation belt, numerically computed: Jour. Geophys. Research, v. 66, no. 12, p. 4013-4026, 1961.

The magnetic field of a model ring-current belt encircling the earth symmetrically is calculated numerically to the first approximation for a model previously discussed by Akasofu and Chapman (see Geophys. Abs. 185-432). It is shown that over the earth's surface the field of the ring current is nearly uniform, although in auroral latitudes the diamagnetism of the belt produces an insignificant irregularity in the field disturbance. The Van Allen radiation belts seem likely to contribute little to the ring current field, but during magnetic storms the radius of the belt mainly responsible for this field is probably less than six earth radii.— D.B.V.

188-393. Cahill, L. J. Evidence for ionospheric currents near the geomagnetic equator: Internat. Geophys. Year Annals, v. 12, pt. 2, p. 765-770, 1961.

Measurements of the geomagnetic field made with a nuclear free-precession magnetometer at high altitudes near the geomagnetic equator have indicated the presence of electric currents flowing in the ionosphere. The principle of operation of the magnetometer is reviewed, and the rocket-borne version is described. Preliminary results from recent flights near Jarvis Island in the South Pacific are given. The results are interpreted as follows: the magnetometer passes through a horizontal current sheet extending vertically from 97 to 110 km; from 110 to 117 km there is little or no current flowing; and at 117 km the magnetometer again enters a horizontal current sheet which extends at least to the peak altitude of 121 km.— D.B.V.

188-394. Bottum, J. L., Gebhardt, R. E., and Townshend, J. B. Horizontal intensity comparisons between the sine galvanometer and the proton vector magnetometer: Jour. Geophys. Research, v. 66, no. 12, p. 4319, 1961.

New observations of horizontal intensity with both the sine galvanometer and the proton vector magnetometer, made twice weekly at the Fredericksburg Magnetic Observatory in Virginia, show virtual agreement between the two instruments; the mean difference is less than the uncertainty of $\pm 0.52\gamma$ inherent in the measurements. An earlier-reported discrepancy of 2.7γ (see Geophys. Abs. 181-341) may be accounted for in part by revision of the coil constant, in part by the elimination of certain disturbances during renovation of the sine galvanometer, and in part to some unresolved uncertainty in the slight pier difference existing at the time of the earlier comparison.— D.B.V.

188-395. Leprêtre, Bernard. La correction de barreau dans les mesures magnétiques effectuées à l'aide d'un théodolite [The bar correction in magnetic measurements made by means of a theodolite (with Russian summary)]: Annales Géophysique, v. 16, no. 2, p. 276-277, 1960.

Experimental studies made at Alger-Bouzaréah, Algeria, and at the Chambon-la-Forêt Magnetic Observatory in France show that the discrepancies between measurements of the horizontal component of the geomagnetic field made with certain theodolites and those made with modern instruments are due to attraction of the walls of the casing on the magnet, and that a slight dissymmetry

in this attraction is the cause of an error in declination. Two formulas are given for checking the precision of instruments that consist of a mobile magnetic apparatus enclosed in metal or of a mobile framework within a magnetic field.— D.B.V.

188-396. Pelyushenko, V. M. Polevaya magnitnaya stantsiya [Field magnetic station]: Razvedochnaya i Promyslovaya Geofizika, no. 35, p. 65-69, 1960.

A field variometer station for measuring variations of the earth's magnetic field is proposed. The station, MVS, can be constructed in the field using a M-2 variometer. The modification of the M-2 variometer is discussed in detail. The MVS records variations of 1-2 gammas on 1 mm of the oscillograph paper.— A.J.S.

188-397. Loomer, E. I. Record of observations at Resolute Bay Magnetic Observatory 1957-1958. With a summary of earlier observations: Dominion Observatory Ottawa Pubs., v. 26, no. 2, p. 25-131, 1961.

Magnetic observations recorded at Resolute Bay Magnetic Observatory on Cornwallis Island in the Canadian Arctic Archipelago for the period January 1957 through December 1958 are given in tables that include hourly values of horizontal and vertical intensity and their hourly, daily, and monthly means; the diurnal inequalities of these magnetic elements on all days and on international quiet and disturbed days by month, season, and year; a summary by month, season, and year of the mean hourly values of horizontal and vertical intensity for the period November 1953 through December 1956 for all days and international quiet days; and hourly ranges in the principal horizontal magnetic field component for the period July 1957 through December 1958. The site of the observatory, instruments used, and types of observations made are described briefly in the introduction.— V.S.N.

188-398. Loomer, E. I., and Andersen, F. Record of observations at Baker Lake Magnetic Observatory 1957-1958. With a summary of earlier observations: Dominion Observatory Ottawa Pubs., v. 26, no. 3, p. 131-226, 1961.

Magnetic observations recorded at Baker Lake Magnetic Observatory, Northwest Territories, Canada, for the period July 1957 through December 1958 are given in tables that include hourly values of horizontal and vertical intensity and their hourly, daily and monthly means; the diurnal inequalities of these elements on all days and on international quiet and disturbed days by month for 1957 and by month, season, and year for 1958; a summary by month, season, and year of the mean hourly values of these elements from March 1951 through June 1957 for all days and international quiet days; and the hourly ranges in the principal horizontal magnetic field component for the period July 1957 through December 1958. The observatory site, instruments used, and types of observations made are described briefly in the introduction.— V.S.N.

188-399. Constantinescu, Liviu, and Şteflea, Vladimir. Variaţia seculară a cîmpului geomagnetic pe teritoriul Republicii Populare Romîne în intervalul 1950-1960 [Secular variations of the geomagnetic field of the territory of the Rumanian Peoples Republic in the interval 1950-60 (with Russian and French summaries)]: Acad. Romîne, Probleme de Geofizică, v. 1, p. 249-257, 1961.

The geographic distribution of secular variations of the elements of the geomagnetic field in Rumania is investigated for the interval 1950-60. The materials used in this study were records from the Surlari Geophysical Observatory and data from field measurements. Isopores of D, H, and I are given on one map for epoch 1955.0, and isopores of D are given on another map for e-

pochs 1950.0 and 1960.0. These results permit the geomagnetic measurements for all this period in the entire area of Rumania to be reduced to the same epoch.— J.W.C.

188-400. Constantinescu, Liviu, Soare, Andrei, and Soare, Alexandra. Gradul de perturbaţie geomagnetică în intervalul 1954-1959 pe baza înregistrărilor de la Observatorul geofizic Surlari [Degree of geomagnetic perturbation in the interval 1954-59 on a basis of measurements at the Surlari Geophysical Observatory (with Russian and French summaries)]: Acad. Romîne, Probleme de Geofizică, v. 1, p. 259-273, 1961.

The K three-hour index was used to measure the average daily and average yearly course of magnetic activity in the region of the Surlari Geophysical Observatory. A comparison was also made of the frequency curves of the values of the K index at Surlari on a scale of 350 and 500 gammas with corresponding curves at Swider (scale of 500 gammas) and Odessa (scale of 350 gammas). The average daily distribution of geomagnetic activity is at a maximum in the interval from 9^h to 12^h u.t. Two characteristic maximums occur in the mean annual distribution.— J.W.C.

188-401. Dolginov, S. Sh., Zhuzgov, L. N., and Puskhov, N. V. Preliminary report on geomagnetic measurements with the third Soviet artificial earth satellite: Internat. Geophys. Year Annals, v. 12, pt. 2, p. 761-764, 1961.

The third Soviet earth satellite carried a magnetometer of the second-harmonic type, the main features of which are mentioned briefly. Some examples of curves obtained are given and discussed. Details of instrument design and a geophysical interpretation of the results will be given elsewhere.— D.B.V.

188-402. Nishida, A., and Jacobs, J. A. World-wide changes in the geomagnetic field: Jour. Geophys. Research, v. 67, no. 2, p. 525-540, 1962.

Worldwide changes in the geomagnetic field are not limited to ssc or si; both increases and decreases in horizontal intensity are also frequently observed. The form of the change varies, depending on both local time and latitude. In distribution of magnitude and mode of propagation over the earth this phenomenon is markedly similar to ssc and si. This is consistent with the idea of a permanent interaction between the solar corpuscular stream and the geomagnetic field.— D.B.V.

188-403. Campbell, Wallace H., and Matsushita, Sadami. Auroral-zone geomagnetic micropulsations with periods of 5 to 30 seconds: Jour. Geophys. Research, v. 67, no. 2, p. 555-573, 1962.

The results of observations of geomagnetic micropulsations with periods of 5 to 30 sec that were carried out for a year at College, Alaska, are described. The present evidence indicates that these micropulsations may be detected almost all the time throughout the world, with large amplitudes at the auroral zone. In the auroral zone the 5- to 30-sec-period micropulsations storms are related to auroral-zone electron bremsstrahlung, ionospheric current, and absorption disturbance phenomena.

The data at this time strongly imply that the observed micropulsations result from ionospheric currents set up at the onset of a storm with the arrival of bombarding electrons. A first crude model which may be suggested, therefore, is that with the arrival of a solar terrestrial disturbance front at the distant earth's field lines, the pitch angles of the newly trapped particles are periodically agitated, modulating the precipitation of these particles into the earth's ionosphere. These in turn are thought to set up pulsating ionospheric current systems, which may be measured at the earth's surface.— D.B.V.

188-404. Haraldson, Stig. Rapid geomagnetic fluctuations: Tellus, v. 13, no. 3, p. 432-437, 1961.

Very low frequency oscillations (0.2-200 cycles per second) in the earth's magnetic field were measured in the Stockholm Archipelago during the period July 1957-June 1960 using a high-speed Heiland oscillograph and a low-speed Esterline-Angus recorder. In the Esterline-Angus diagrams a morning minimum at about 8 o'clock local time was noted. Three different features were found in the Heiland oscillograms: (1) Sinusoidal fluctuations presenting a few narrow bands occur frequently; (2) H- and Z-component oscillations are sometimes simultaneous, sometimes not; and (3) amplitudes in the Z-component are smaller than in the H-component. It has not been possible to correlate these fluctuations with other geophysical phenomena. An explanation made on a basis of Aarons' suggestion that ions spiralling in the earth's magnetic field could give rise to fluctuations in gyrofrequency is tentatively proposed.— D.B.V.

188-405. Angenheister, Gustav [H.], and Consbruch, Claus von. Pulsationen des erdmagnetischen Feldes in Göttingen von 1953-1958. II. Teil [Pulsations of the geomagnetic field at Göttingen for 1953-58. Pt. 2 (with English summary)]: Zeitschr. Geophysik, v. 27, no. 3, p. 103-110, 1961.

Continuing the statistical analysis of geomagnetic pulsations recorded at Göttingen in 1953-58 (see Geophys. Abs. 187-421), the daily variation of the index P_z averaged over a year is given for every octave and year of that period. Two further indices are introduced: $P_a(h,d,m,T)=a(h,d,m,T)$ and $P_n(h,d,m,T)=n(h,d,m,T)\cdot(3600/T)^{-1}$; $P_z=P_a\cdot P_n$. P_a and P_n are treated statistically the same as P_z. Averaged over the years 1953 and 1957, the three indices show nearly the same morphology of daily variation.— D.B.V.

188-406. Onwumechilli, C. Agodi. Lunar daily variation of the magnetic declination at Ibadan, Nigeria: Jour. Geophys. Research, v. 65, no. 10, p. 3433-3435, 1960.

The data taken for 52 months at Ibadan are analyzed for lunar variation in geomagnetic declination (D). When grouped according to seasons, the results are found to be statistically significant for the June and December solstices but not for the equinox. There is almost a complete reversal of phase between the variations in the two solstices. It is found that the lunar variation in D at Ibadan does not show the marked effect of the equatorial electrojet so clearly observable in the variations of the horizontal force (H) and the vertical force (Z). Surprisingly, however, the amplitude of variation in the summer is slightly smaller than that of the winter, but it is not yet clear how far this anomaly can be attributed to the electrojet. [See also Geophys. Abs. 182-386.]— Author's abstract

188-407. Oguti, Takasi. K indices at Syowa Station, Antarctica [with Japanese abstract]: Antarctic Rec., no. 13, p. 10-16, 1961.

A flux-gate type self-recording magnetograph is used at Syowa Station (60°00' S., 35°39' E.) for observation of the geomagnetic field. The minimum ranges for each K index at Syowa Station were determined from the 181 day records, and results are given in a table. The values of K-indices for the period February 8, 1959 to January 9, 1960 are tabulated. The seasonal variation of the regression coefficient of K_{Syowa} and K_p is discussed. It is concluded that the small perturbation at the time of the June solstice is larger in the summer (sunlit) auroral zone than in the winter (dark) auroral zone, but, in contrast, during severe storminess the sunlit auroral zone is less active than the dark one. This may mean that the changing mode of magnetic activities is dependent not on seasons but on storminess.— V.S.N.

188-408. Briggs, B. H. The correlation of radio star scintillations with geomagnetic disturbances: Royal Astron. Soc. Geophys. Jour., v. 5, no. 4, p. 306-317, 1961.

Study of the correlation between the degree of scintillation of the radio source Cassiopeia A and the local magnetic K-index shows that the correlation coefficient between these quantities depends on the epoch of the solar cycle at which the observations are made, on the position of the source in the sky, and on the radio frequency used. Their results suggest that the degree of irregularity of the ionosphere always increases during magnetic disturbances in medium latitudes, and that the negative values of the correlation coefficient between scintillation index and magnetic K-index which are sometimes obtained are due to a secondary effect related to the finite size of the source and explain the inconclusive and conflicting results of earlier workers.— D.B.V.

188-409. Wilson, Charles R., and Sugiura, Masahisa. Hydromagnetic interpretation of sudden commencements of magnetic storms: Jour. Geophys. Research, v. 66, no. 12, p. 4097-4111, 1961.

The results of a new analysis of sudden commencements (SC's) and an interpretation of these results are presented. The SC of a magnetic storm is interpreted as an effect of the impact of a solar gas stream on the geomagnetic field, as originally proposed by Chapman and Ferraro (1931) and developed by Ferraro (1952). The impact effect is transmitted to the earth by hydromagnetic waves (see Dessler, Geophys. Abs. 174-265; Dessler and Parker, Geophys. Abs. 180-257; Piddington, Geophys. Abs. 179-294).

It is shown that the perturbation generated by the impact of the solar stream is propagated to the earth primarily by longitudinal hydromagnetic waves in low latitudes and by transverse hydromagnetic waves in high latitudes. These propagation modes are deduced from study of the characteristics of the polarization of the SC magnetic field: in high latitudes the SC magnetic field is essentially elliptically polarized, whereas in low latitudes the polarization is linear.— D.B.V.

188-410. Ondoh, Tadanori. Ionospheric currents responsible for sudden commencements observed at the geomagnetic equator: Jour. Geophys. Research, v. 66, no. 12, p. 4155-4161, 1961.

The intensities and altitudes of ionospheric currents responsible for sudden commencements at the geomagnetic equator are calculated, using the horizontal and vertical disturbance vectors of the SC's observed simultaneously at the Jarvis and Fanning Island stations (geomagnetic lat 00°30', long 269°00', and lat 05°20', long 276°10', respectively), on the assumption that these currents are either line currents or uniform current sheets. It is found that total intensity of the current causing the SC is of the order of 10^4 amps at the geomagnetic equator, and that there is no relation between altitude of the current and local time of SC occurrence. It seems likely that this current is caused by the arrival of hydromagnetic waves generated by the impact of the solar plasma cloud on the geomagnetic field. Possible explanations for the daytime enhancement of the amplitude of the SC at the geomagnetic equator are discussed.— D.B.V.

188-411. Kellogg, P. J., and Winckler, J. R. Cosmic ray evidence for a ring current: Jour. Geophys. Research, v. 66, no. 12, p. 3991-4001, 1961.

This paper develops the idea that a ring current responsible for the main geomagnetic storm field reduces the Störmer cosmic-ray cutoffs. It is shown that cosmic-ray data permit evaluation of both the moment (M') and radius (R) of the ring, whereas surface magnetic measurements determine only M'/R^3.

As cosmic-ray cutoffs return to normal during the main phase of the storm, it must be assumed that the ring shrinks inward so that the surface field is maintained negative. Cosmic-ray evidence concerning the presence of a permanent ring current is discussed. Such a ring is measured directly by satellites during quiet times.— D.B.V.

188-412. Sugiura, Masahisa. Asymmetry of Dst variations of geomagnetic storms with respect to the geomagnetic equator: Alaska Univ. Geophys. Inst. Sci. Rept., no. 3, UAG-R 122, 12 p., 1961.

The seasonal variations in the Dst part of magnetic storms are determined for three pairs of stations, each pair consisting of two stations at nearly equal geomagnetic latitudes in the northern and southern hemispheres. The results show that in solstitial seasons the Dst field is not symmetrical with respect to the geomagnetic equator. The asymmetry is small in low latitudes and increases toward the auroral zones. Dm has a similar asymmetry with respect to the equator. These characteristics of Dst and Dm are interpreted as due to the asymmetry of auroral electrojets with respect to the geomagnetic equator in solstitial seasons.— Author's abstract

188-413. Obayashi, Tatsuzo. Solar corpuscular radiation and polar ionospheric disturbances: Annales Géophysique, v. 17, no. 3, p. 292-304, 1961.

A study of disturbances in the polar ionosphere indicates the existence of energetic solar particles associated with solar flares. High energy protons of the order of 10~100 Mev reach the earth in the polar regions several hours after a solar flare and cause prolonged polar-cap blackouts. The bulk of the corpuscular cloud, consisting mainly of low-energy particles, arrives after a day or so. The particle density of the cloud is high, and it behaves like a conducting fluid; the interaction of such a conducting cloud with the geomagnetic field produces the main part of a geomagnetic storm. Auroral particles, trapped by the magnetic fields in the cloud, impinge on the polar ionosphere through the distorted outer geomagnetic field and cause auroral-zone blackouts, auroras, and polar magnetic storms. An equatorward shift of the auroral zone during the main phase of magnetic storms is due to the distortion of the outer geomagnetic field.— V.S.N.

188-414. Jiang, Bai-Qin. A statistical study of the relations between solar flares and magnetic storms [in Chinese with English abstract]: Acta Geophys. Sinica, v. 9, no. 1, p. 38-46, 1960.

The data of solar flares and magnetic storms are analyzed for the period January 1947-June 1957. During this period 276 (44.2 percent) out of 625 magnetic storms probably originated from solar flares. The statistics show that magnetic storms having sudden commencement and main phase are most likely to have originated from solar flares, and solar flares of class 3 are more apt to cause magnetic storms than are other flares. Solar flares of class 2 inside the 45° belt of the central meridian of the Sun are more apt to cause storms than those outside this belt, and those inside the 30° belt probably cause severe storms. This distribution of storm-effective flares suggests that the conical angle of emission of corpuscles is restricted usually to about 45°, and for more intense streams to 30°. The flare-storm interval varies from 45 to 55 hr; the average value is 52.2 hr.— V.S.N.

MAGNETIC PROPERTIES AND PALEOMAGNETISM

188-415. Kern, John W. Effects of moderate stress on directions of thermoremanent magnetization: Jour. Geophys. Research, v. 66, no. 11, p. 3801-3805, 1961.

Experiments designed to test the effects of directed stress on the thermoremanent magnetization (TRM) of igneous and metamorphic rocks are described. Basalt and andesite specimens exhibited no anomalous directions of TRM when cooled from 600°C under uniaxial stresses of up to 350 bars. Metamorphic rocks with preferred crystallographic orientations were found to exhibit anomalous directions of induced TRM after such treatment. These anomalous TRM directions were apparently related to the lineation of the specimens rather than applied stress. Residual magnetizations of the metamorphic specimens were found to approach the direction of the magnetizing field upon progressive alternating-field demagnetization.— Author's abstract

188-416. Kern, John W. The effect of stress on the susceptibility and magnetization of a partially magnetized multidomain system: Jour. Geophys. Research, v. 66, no. 11, p. 3807-3816, 1961.

An analysis of the effects of directed stress on magnetization and susceptibility is presented, with special attention to the problems of rock magnetization. A model is proposed of partial magnetization of an isotropic multidomain magnetic system, and its behavior in response to applied stress is analyzed. It is found that this response, given by the ratios of magnetization and susceptibility to their respective initial values, is related simply to the saturation magnetization and magnetostriction parameters for the system and to the initial susceptibility. Theoretical results agree well with those of isothermal experiments by Grabovskiy and Parkhomenko (see Geophys. Abs. 155-14382) for magnetite and titanomagnetite. It is concluded that stress response is regular with temperature, and has no strong effects even where the magnetization vanishes at the Curie point.— D.B.V.

188-417. Girdler, R. W. The measurement and computation of anisotropy of magnetic susceptibility of rocks: Royal Astron. Soc. Geophys. Jour., v. 5, no. 1, p. 34-44, 1961.

A method is described for the experimental determination of anisotropy of magnetic susceptibility of rock specimens using a transformer a.c. bridge. The principal susceptibilities are calculated using a least squares solution of the susceptibility tensor on an electronic computer. In the experimental design, sufficient data are obtained to enable an estimate to be made of the precision of the results. An example is given to illustrate the procedure.— Author's summary

188-418. Runcorn, S. K[eith]. Statistical methods in rock magnetism: Philos. Mag., ser. 8, v. 5, no. 53, p. 523-524, 1960.

Wilson (see Geophys. Abs. 182-411) has objected to the use of Fisher's (1953) statistical method, generally used in assessing the precision of paleomagnetic measurements, on the grounds that all distributions of directions of magnetization may not follow Fisher's law and therefore the calculated angle of confidence may contain falsely implied precision. Runcorn answers that Fisher's law can be used in the case of dispersion on a spherical surface because, in physics and geophysics, scatter is usually due to a number of unrelated causes. When there is good reason to believe that scatter is due to a single cause, such as varying amounts of magnetization along the present field sometimes superposed on the original direction of magnetization of a rock, common sense prevents the use of the statistical methods in their straightforward form.— D.B.V.

188-419. Stiller, Heinz, Frölich, Friedrich, and Wagner, Friedrich Christian. Zustandsänderungen in magnetischen Gesteinsproben. Das thermomagnetische Verhalten des Kluftmaterials (Magnetit) von Serpentiniteproben [Changes of state in magnetic rock samples. The thermomagnetic behavior of the vein material (magnetite) of ser-

pentinite samples (with English summary]: Zeitschr. Geophysik, v. 27, no. 2, p. 89-102, 1961. English version in Geofisica Pura e Appl., v. 49, p. 129-136, 1961.

Thermomagnetic diagrams and results of X-ray investigations of magnetite material filling veins in serpentinite are given. The X-ray data indicate that the vein filling contains some α-Fe_2O_3. The thermomagnetic diagrams show only one region of oxidation, in the 280°C-400°C temperature range. The oxidation apparently occurs in two processes: magnetite—γFe_2O_3 and γ-Fe_2O_3—αFe_2O_3.— D.B.V.

188-420. Kobayashi, Kazuo. An experimental demonstration of the production of chemical remanent magnetization with Cu-Co alloy: Jour. Geomagnetism and Geoelectricity [Kyoto], v. 12, no. 3, p. 148-164, 1961; reprinted in Tokyo Univ. Geophys. Inst. Geophys. Notes, v. 14, no. 1, Contrib. no. 17, 1961.

The magnetization-blocking process in chemical remanent magnetization and the variation in intensity of remanent magnetization due to domain wall formation according to the size development of the precipitated ferromagnetic materials are demonstrated by the magnetic behavior of an aging Cu-Co alloy. The magnetic behavior of the alloy changes from superparamagnetic to stable single domain to multidomain according to the increase in size of the ferromagnetic precipitates. A remanent magnetization is acquired during the transition from the superparamagnetic to the stable ferromagnetic state that decreases as a result of the formation of domain walls if the size of the precipitates exceeds the critical single domain grain size. The results are explained by Néel's thermal fluctuation theory of single domain grains and the domain structure theory of ferromagnetics, and are extended successfully to the chemical remanent magnetization phenomena in synthetic and natural ferromagnetic minerals. The magnetic behavior of several specimens reported previously by various investigators can be interpreted consistently on the basis of this study.— V.S.N.

188-421. Petrova, G. N., and Zhilyayeva, V. A. Laboratornyy kriteriy magnitnoy stabil'nosti gornykh porod [A laboratory criterion of magnetic stability of rocks]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 9, p. 1328-1335, 1960.

An attempt is made to establish a laboratory criterion for magnetic stability of rock samples used in paleomagnetic investigations. It was found that the demagnetization field H_c' may serve as such a criterion if the demagnetizing solenoid is removed far enough from the measuring system so as not to affect the measurements. The experiments show that samples having H_c' less than 10 oersteds are magnetically unstable, and those of H_c' greater than 40 oersteds are stable. A further study is intended to determine the degree of stability of samples with H_c' between 10 and 40 oersteds.— A.J.S.

188-422. Metallova, V. V., and Vey, Tsin-yun'. Nekotoryye rezul'taty issledovaniya magnitostriktsii gornykh porod [Some results of investigation of magnetostriction of rocks]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 286, p. 165-173, 1960.

The magnetostriction effect on natural remanent magnetization is discussed. The magnetostriction λ of magnetites, titanomagnetites, and basalts as a function of a magnetizing field of 28-530 oersteds and temperatures up to 600°C was found to be linear for λ (H), 50 oersted$<$H$<$150 oersted. For λ(t) the value of λ was found to reach a maximum at a temperature of 105-112°C, and then to decrease to zero near the Curie point. A complicated variation of λ(t) was established in the range of 250-400°C.— A.J.S.

188-423. Anderson, Lennart A. A remanent magnetometer and magnetic susceptibility bridge, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-370-C-372, 1961.

An instrument that uses separate detecting and common amplifying systems to measure precisely the remanent magnetism and magnetic susceptibility of a rock sample is described. Functional diagrams are given for the remanent magnetometer and the magnetic susceptibility bridge, and the technique of operation is discussed.— V.S.N.

188-424. Bulgakov, Yu. I., Veshev, A. V., and Larionov, L. V. Mostikovyye pribory dlya izmereniya magnitnoy vospriimchivosti porod i rud [Bridge devices for measurement of magnetic susceptibility of rocks and ores]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 278, p. 136-142, 1959.

A new instrument for measuring magnetic susceptibility of rocks is described; it is based on the electrical bridge effect of rock susceptibility κ. The sensitive element is one of the bridge arms whose intensity varies as a function of magnetic susceptibility, κ, of rock in contact with the instruments magnetic flux conductor according to the approximate formula $(\Delta L/L) \approx 4\pi\kappa \times 10^{-6}$. Block-diagrams for κ-meters supplied by d-c and by a-c are given.— A.J.S.

Green, Ronald. Thermoelectric currents in meteorites. See Geophys. Abs. 188-106.

188-425. Costa-Foru, Alexandru; Ghelfan, Pavel; Apostol, Ecaterina; and Baltac, Alexandru. Studiu asupra proprietăţilor magnetice ale unor roci sedimentare din R. P. Romînă [Studies of the magnetic properties of some sedimentary rocks of the Rumanian Peoples Republic (with Russian and French summaries)]: Acad. Romîne, Probleme de Geofizică, v. 1, p. 213-248, 1961.

Studies were made to determine the relationship of magnetic susceptibility to content of ferromagnetic minerals, size of these minerals, and direction and character of the magnetic field. Approximately 4,500 core samples and specimens from outcrops were used in the study. Several horizons with anomalous susceptibilities were found which are regional in character and can be used for stratigraphic correlation. Remanent magnetism was used to determine the direction of dip of cores. In connection with magnetic "cleansing" of rocks, the behavior of the latter under the action of magnetizing and demagnetizing fields shows the great stability of initial remanent magnetization in comparison with secondary magnetization.— J.W.C.

Kopayev, V. V., and Martynova, T. A. A test of the application of the results of laboratory measurements of magnetic properties of iron quartzites to interpretation of magnetic anomalies of the KMA. See Geophys. Abs. 188-464

188-426. Malygin, A. A. O magnitnykh svoystvakh gornykh porod Leninogorskogo rayona [Magnetic properties of rocks of the Leninogorsk region]: Akad. Nauk Kazakh. SSR Izv. Ser. Geol., no. 2(43), p. 78-85, 1961.

Results are presented of magnetic susceptibility measurements on 5,085 rock specimens from the Leninogorsk region of the Rudnyy Altay in the U.S.S.R. The data are tabulated for each rock type according to the categories: nonmagnetic, weakly magnetic, and magnetic. Comparison of ground magnetic surveys with the susceptibility of the specimens shows that the nonmagnetic and weakly magnetic rocks range in age from early Paleozoic to early Permian, and that susceptibility is independent of petrographic composition or genesis. Rocks formed at the end of the Late Paleozoic are magnetic as a

ru. The diastrophism and igneous activity at the end of the Late Carboniferous appears to have been accompanied by a reconstitution of the older magnetic field with loss of the initial magnetism in most of the units.— J.W.C.

188-427. Egyed, L[ászló]. Palaeomagnetism and the ancient radii of the earth: Nature, v. 190, no. 4781, p. 1097-1098, 1961.

The procedure proposed by Cox and Doell for determining the probable value of the Permian paleoradius of the earth (see Geophys. Abs. 185-449) is further refined. Because the radius was practically the same for the whole earth in a given age, separate stable blocks are treated together, diminishing the theoretical error. By plotting the data for radii for individual periods against time and applying a least squares adjustment (assuming a linear variation with time), almost all paleomagnetic data can be used in determining the trend and rate of increase of radius; this further decreases the statistical error. A very simple generalization permits the use of sampling localities not on the same meridian, and thus covers the bulk of paleomagnetic data.— D.B.V.

188-428. Nodia, M. Z., and Vekua, L. V. K voprosu metodiki paleomagnitnykh izmeneniy [On the problem of paleomagnetic variations]: Akad. Nauk Gruzin. SSR Soobshch., v. 23, no. 3, p. 277-279, 1959.

Factors that result in variation of the vector of remanent magnetization are discussed, and it is concluded that in areas of more or less intensive anomaly the astronomic meridian should be used for reference rather than the geomagnetic meridian.— J.W.C.

188-429. Griffiths, D[onald] H[arrison], and King, R[oy] F[avell]. Discussion of paper by N. D. Opdyke, "The paleomagnetism of the New Jersey Triassic: a field study of the inclination error in red sediments" Jour. Geophys. Research, v. 66, no. 12, p. 320, 1961.

Although Opdyke's results (see Geophys. Abs. 185-440) are strong evidence that the sediments of the Newark group of New Jersey did not acquire their remanence by alinement of magnetic particles during deposition, this may not be true of all older sediments. In particular, siltstones with nonmagnetic cement, in which the magnetic particles are not grossly different in size from the nonmagnetic, should show deviations of remanence comparable to those found in varves. In varved sediments (see Geophys. Abs. 184-489) alinement of particles during settling contributes little to inclination error; compaction, which occurs mainly at the time of deposition, is more important. In other sediments compaction is more truly post-depositional.— D.B.V.

Kropotkin, P. N. Paleomagnetism, paleoclimates, and the problem of great horizontal movements of the crust of the earth. See Geophys. Abs. 188-310.

188-430. Bidgood, D. E. T., and Harland, W. B. Palaeomagnetic studies of some Greenland rocks, in Geology of the Arctic, v. 1: Internat. Symposium on Arctic Geology, 1st, Calgary, Alberta, 1960, Proc., p. 285-292, 1961.

The results of paleomagnetic studies made on samples of sedimentary rocks collected in east Greenland in 1957 are summarized. Data for late Precambrian, Devonian, Lower Carboniferous, Permo-Carboniferous, Eo-Triassic, and Upper and Middle Triassic are discussed and summarized in tables and figures. Results show that at the beginning of Cambrian time Greenland was in equatorial regions about 18° east of the general European trend or about 30° east of the North American trend; these are consistent with the results obtained by others for North America and Europe in giving pole positions that lie in the Pacific area and tend toward the equator in older rocks. The eastward position of the Greenland poles relative to America and Europe is consistent

with a post-Triassic movement of Greenland relative to North America that increased the separation of the two areas to give their present positions by opening Davis Strait and Baffin Bay and by some spread among the Canadian Arctic Islands. Taking into account this postulated movement the relative positions of the pole given by rocks of the same age are compared and by extrapolating the comparison to Precambrian rocks a rough date is obtained for Greenland rocks in terms of European and North American data.— V.S.N.

188-431. Everitt, C. W. F., and Belshé, J. C. Palaeomagnetism of the British Carboniferous system: Philos. Mag., ser 8, v. 5, no. 55, p. 675-685, 1960.

Various explanations are offered for the superficially conflicting evidence concerning the direction and sense of the earth's magnetic field in Carboniferous times as measured in British rocks. It is concluded that the discrepancies in direction occur because some sites underwent secondary remagnetization during the Triassic period. If this is correct, the mean direction for the Carboniferous period was 200° east of true north and 27° down, placing Britain 15° south of the equator. Regarding the sense of the field, it is concluded that it probably underwent a rapid series of inversions in Early Carboniferous time and then remained reversed for a considerable time.— D.B.V.

188-432. Everdingen, R. O. v[an]. Studies on the igneous rock complex of the Oslo Region, 17. Palaeomagnetic analysis of Permian extrusives in the Oslo Region, Norway: Norske Vidensk.-Akad. Skr., Mat.-Naturv. Kl., no. 1, 80 p., 1960.

Paleomagnetic studies were made on 538 oriented samples of Permian volcanics from two areas in the Oslo graben—the Krokskogen area northwest of Oslo and the Vestfold area on the west side of the Oslo Fjord. The regional geology, stratigraphy, and petrography of the Oslo region are described, and the instruments used and methods of procedure for studying the paleomagnetism are discussed in detail. It is concluded that a-c-demagnetization can be used as a cleaning method in paleomagnetic research; in general, an alternating field of 950 oersted peak value is sufficient to remove the stronger isothermal magnetizations. All samples should be cleaned in paleomagnetic analysis even when good concentration of the directions of magnetization is found. Measurements were corrected for geologic dip, and from the corrected measurements the mean position for the Permian S-pole was determined to be lat 47° N., long 157° E. A long-term variation of the geomagnetic field (polar-wandering) probably is reflected by the mean directions of magnetization of the various lava-flows, tuff-flows, and other geological units.

An attempt to correlate the behavior of the remanent magnetization with different magnetic minerals or with variations in their grain size showed that rocks with a relatively large amount (>75 percent magnetic minerals) of hematite/ilmenite in small to very small grains (<0.01 mm) have a very good stability of remanent magnetization, whereas rocks with abundant magnetite in coarse grains (>0.05 mm) are highly unstable in alternating magnetic fields. The rock types studied have strong variation in their magnetic minerals, but because they all have the same reversed remanent magnetization it is concluded that a reversed field existed during the Permian. "Self-reversal" processes can be excluded because of the variation in the magnetic minerals.— V.S.N.

188-433. Graham, K. W. [T.], and Hales, A. L. Preliminary paleomagnetic measurements on Silurian sediments from South Africa: Royal Astron. Soc. Geophys. Jour., v. 5, no. 4, p. 318-325, 1961.

Paleomagnetic measurements were made on the Lower "Shales" of the Table Mountain Series near Cape Town, South Africa; these are thought to be Silurain. Samples from the surface were found to be inconsistently magnetized,

but 8 samples from a fine red mudstone bed exposed in a deep road cut gave consistent results that indicate a mean direction of D=341.8°, I=3.5°, with the south pole down. The north pole position inferred from these measurements is at long 169° E., lat 50.3° S.; this is not in agreement with Ordovician, Silurian, or Devonian poles calculated for any other continent.— D.B.V.

188-434. Norris, D. K., and Black, R. F. Application of palaeomagnetism to thrust mechanics: Nature, v. 192, no. 4806, p. 933-935, 1961.

Paleomagnetic directions, in conjunction with surface geologic data, suggest that the Lewis thrust plate in the southeast cordillera of Canada moved as a coherent tectonic unit, and that the present configuration of the eastern limit of the thrust plate is genetically related to the geometry of the thrust surface during the initial stages of movement rather than to differential erosion along the eastern margin of the plate.— D.B.V.

MAGNETIC SURVEYS

188-435. Gorodenskiy, S. N. Nekotoryye obshchiye osobennosti magnitnykh anomaliy ΔT znachitel'noy intensivnosti [Some general features of magnetic anomalies ΔT of considerable intensity]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 1, p. 96-103, 1961.

A mathematical analysis of the correction term for the value of ΔT is given in general form and for particular cases in order to make the features of its structure apparent. A graphic representation shows the values of Δ/T_a as a function of the angle γ between the direction of the normal (T_o) and anomalistic (T_a) magnetic field values. The curves of such a graph each have an extremum $T_a/2T_o$, which indicates that the equation $\left(\frac{\Delta}{T_a}\right)_{max} = T_a/2T_o$ remains accurate in the interval $0 \leqslant T_a \leqslant T_o$ for the anomalies ΔT of any intensity. It was found that for anomalies ΔT of low intensity, the value of the correction term is independent of the sign of the anomaly, since in this case $\Delta/T_a = T_a/2T_o \sin^2\gamma$.— A.J.S.

188-436. Gorodenskiy, S. N. O magnitnykh anomaliyakh ΔT proizvol'noy intensivnosti [On magnetic anomalies ΔT of arbitrary intensity]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 9, p. 1349-1353, 1960.

A formula is given for determination of magnetic anomalies ΔT when the angle γ between the directions of the normal earth's magnetic field T_o and the anomalistic field T_a are known. It was found that $\Delta T = T \cos\gamma + T_a \sin\gamma \tan 1/2 \arctan [T_a \sin\gamma/(T_o + T_a \cos\gamma)]$, and that for $T_a \ll T_o$ $\Delta/T_a = 1/2(T_a/T_o)$. For $/\gamma/ = 1/2\pi$, $\Delta T = \tan 1/2 \arctan (T_a/T_o)$, so that the difference between the last two formulas reaches about 8.5 percent of the value of the anomalistic field when its magnitude is commensurable with that of the normal field of the earth.— A.J.S.

188-437. Strakhov, V. N. O vychislitel'nykh skhemakh dlya analiticheskogo prodolzheniya potentsial'nykh poley. 1. [On calculation systems for analytic extension of potential fields. 1.]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 2, p. 215-223, 1961.

This is a demonstrative mathematical analysis of the problem of determination of values of potential fields extended analytically into a layer between the surface of the earth and disturbing bodies. Singularities of the harmonic functions that describe the field are shown, and calculating schemes for an analytic extension of two- and three-dimensional potential fields are worked out.— A.J.S.

188-438. Kolyubakin, V. V., and Lapina, M. I. Obzor sposobov resheniya pryamoy i obratnoy zadach magnitnoy razvedki [A survey of methods of solution of direct and inverse problems of magnetic exploration]: Akad. Nauk SSSR Inst. Fiziki Zemli Trudy, no. 13, (180), 362 p., 1960.

This is a compilation of methods of solution of direct and inverse problems of magnetic exploration for the case of uniformly magnetized bodies published in the U.S.S.R. (275 references in Russian) and elsewhere (201 references) up to 1956. The analytical and graphical methods of solution of the direct problem are given in part 1; the solutions of the inverse problem for bodies of known and unknown form are treated in part 2; and the third part evaluates gravity and magnetic potentials and their derivatives in an upper half-space and on an observation surface. The methods of derivation of the formulas presented are not given.— A.J.S.

188-439. Pudovkin, I. M. Prostranstvennyy analiz struktury magnitnogo polya v prilozhenii yego v praktike interpretatsii anomaliy [Spatial analysis of the structure of a magnetic field, and its application to the practice of interpretation of anomalies]: Prikladnaya Geofizika, no. 25, p. 141-156, 1960.

This is an extension analysis of the structure of geophysical fields, illustrated by solutions of several geophysical problems, and a discussion of calculation methods for determination of geophysical parameters of disturbing bodies such as depth, axis and intensity of magnetization, and elements of profiles.—A.J.S.

188-440. Kal'varskaya, V. P. Issledovaniye krivykh karotazha magnitnoy vospriimchivosti (KMV) na modelyakh [Investigation of curves of magnetic susceptibility logging on models]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiziki, no. 278, p. 143-148, 1959.

The effects of the diameter of the borehole and thickness of the strata on interpretation of magnetic susceptibility logs are discussed, and results of experimental investigations of apparent magnetic susceptibility carried out with models of magnetic layers by the electric bridge method are given.— A.J.S.

188-441. Jenny, W. P. Regional magnetic data show prospective trends (pt. 2): World Oil, v. 153, no. 5, p. 148-149, 1961.

Isogon maps, which show lines of equal magnetic declination, can be used effectively for preliminary appraisal of the geology of a large region. Such a map for Venezuela indicates that the Maracaibo and Maturin basins are located on basement anticlinal trends.— J.W.C.

188-442. Jenny, W. P. Many old, updated magnetic prospects prove to be valid: World Oil, v. 153, no. 6, p. 124-130, 1961.

Case histories are presented that substantiate the accuracy of earlier micromagnetic surveys. Maps of areas in Texas, Louisiana, Oklahoma, and Michigan show by contours the earlier magnetic interpretations with superposed data from later oil-field development.—J.W.C.

188-443. Jenny, W. P. Aeromagnetics develop new prospects and techniques: World Oil, v. 153, no. 7, p. 105-106, 1961.

Careful micromagnetic interpretation can provide an accuracy in aeromagnetic surveys that duplicates that of slower ground methods. Accuracy of micromagnetic measurements can be improved if a process can be found to eliminate instrumental drift and daily variation directly from each profile and also to correct each profile individually for regional effects according to a set rule without construction of isogam maps.— J.W.C.

188-444. Jenny, W. P. How to correct magnetic data for instrumental drift, diurnals: World Oil, v. 154, no. 1, p. 68-71, 1962.

The chording process is essentially a second derivative process along profiles; sets of points at constant horizontal distances are averaged. This method corrects magnetic, gravimetric, and other profiles individually for instrumental drift, daily variation, and regional effects according to a parameter that is dependent on the average depth of basement and other regional factors. The great advantage of chorded profiles is that they may be used to interpret local anomalies by shape rather than by change in intensity, which is usually too weak and of too small horizontal extent to yield a recognizable isogam pattern.— J.W.C.

188-445. Hoylman, H. Wayne. How to determine and remove diurnal effects precisely: World Oil, v. 153, no. 7, p. 107-112, 1961.

With development of the absolute recording magnetometer, it is now advisable to improve the quality of magnetic surveys by removing all diurnal effects through use of a base station continuous recording proton magnetometer. If airborne magnetometer surveys are to have the desired sensitivity and repeatibility, which is possible with the proton free precession type instrument, diurnals should be removed by a direct subtraction method. Mathematical tools for interpretive purposes are now available for accuracies down to 0.1 gammas, compared to reliabilities hitherto available ranging from 1.0 to 5.0 gammas. In middle latitudes and in the auroral belt, airborne magnetic data can be corrected accurately for diurnal variation by direct subtraction provided the aircraft remains within 20-30 miles of the base station and the diurnal micropulsations do not exceed ±5 gammas and are of less than 3 min duration.— J.W.C.

Constantinescu, Liviu, and Botezatu, Radu. Contribution to the physical interpretation of anomalies of potential fields. I. Analytical continuation in a lower halfspace. See Geophys. Abs. 188-327.

Constantinescu, Liviu, and Botezatu, Radu. Contribution to the physical interpretation of anomalies of potential fields. II. Conditions of application of analytical continuations. See Geophys. Abs. 188-328.

188-446. King, Elizabeth R., Zietz, Isidore, and Dempsey, William J. The significance of a group of aeromagnetic profiles off the eastern coast of North America, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-299-D-303, 1961.

Fourteen aeromagnetic profiles that make a fan-shaped pattern from Bermuda to the West Indies, the United States, and Canada form the basis of this study. Three distinct magnetic patterns were observed: a continental zone bounded by a large linear anomaly along the outer edge of the continental shelf, a zone of smooth profile over the continental rise, and a broad zone around Bermuda of closely-spaced anomalies produced by magnetic rocks near the ocean floor. The large magnetic anomaly may reflect the buried basement ridge that has been detected seismically along the edge of the shelf; primarily, however, it indicates rocks of higher magnetic susceptibility, possibly a series of igneous intrusions along the continental margin.— E.R.K.

188-447. Allingham, John W. Aeromagnetic interpretation of zoned intrusions in northern Maine, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-265-D-266, 1961.

Recent aeromagnetic surveys in northern Maine reveal distinctive circular anomalies associated with granite intrusions in the Wood Pond and Chandler Lake areas. The anomalies are believed to indicate magnetically zoned plu-

tons. Three-dimensional analyses of aeromagnetic data give the relative width of the magnetic zones and indicate the approximate attitude of their contacts. The fit of observed and theoretical curves indicates that the contacts of pluton with country rock are nearly vertical, and the absence of small, sharp isolated anomalies over the contact zones shows that the magnetite is evenly distributed.— V.S.N.

188-448. McGinnis, Lyle D., and Heigold, Paul C. Regional maps of vertical magnetic intensity in Illinois: Illinois Geol. Survey Circ. 324, 12 p., 1961.

Two maps of the regional vertical magnetic intensity in Illinois are presented. One contains observed values and the other shows the field remaining after a normal gradient due to the earth's field is removed. Magnetic data were obtained from observations at 118 localities by U.S. Coast and Geodetic Survey parties in 1955.

Alinement of magnetic trends with the trends of major geologic structures is apparent where control points are adequate. An aeromagnetic profile along the fortieth parallel and a coincident profile from the map of uncorrected values show marked correlations between magnetic maximum and minimum. The regional maps are intended to be used as a basis for continued magnetic work in Illinois.— Authors' abstract

188-449. James, H. L., Pettijohn, F. J., and Wier, K. L. Magnetic surveys, in Geology of Central Dickinson County, Michigan, Chapter B, General Geology: U.S. Geol. Survey Prof. Paper 310, p. 87-96, 1961.

Ground and aeromagnetic surveys were made during the course of investigation of the geology of central Dickinson County, Mich. Although most of the ground surveys were made with a dip needle, more sensitive instruments (Hotchkiss Superdip and Schmidt-type vertical-component magnetometers) were used in some local areas. The principal anomalies in the areas of the ground surveys are caused by the Vulcan iron-formation, and much of the interpretation of the position and structure of this unit is based on the magnetic surveys. The types of rock giving rise to magnetic anomalies in the county are listed in a table giving the strength of anomaly, location, and descriptive remarks.

An aeromagnetic survey was made of most of Dickinson County in 1948 (see Geophys. Abs. 154-14641). As many of the geologic interpretations of central Dickinson County are based on these data, the results are summarized here.

Ground magnetic maps and aeromagnetic total-intensity profiles are included.— V.S.N.

188-450. Allingham, John W., and Bates, Robert G. Use of geophysical data to interpret geology in Precambrian rocks of central Wisconsin, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-292-D-296, 1961.

The Precambrian complex of metamorphosed volcanic, pyroclastic, and sedimentary rocks in the Driftless Area around Wausau, Wis., can be divided into several groups according to density, magnetic susceptibility, and radioactivity. Comparison of aeromagnetic and geologic profiles shows relationships that can be used to interpret geology over the larger Driftless Area. Specific examples are discussed, and it is concluded that geophysical data can add significantly to knowledge of geology in areas of complex structure and poor exposures.— V.S.N.

Joesting, H[enry] R., Case, J[ames] E., and Cordell, L. E. The Rio Grande trough near Albuquerque, New Mexico. See Geophys. Abs. 188-343.

188-451. Case, J[ames] E., and Joesting, H[enry] R. Precambrian structures in the Blanding Basin and Monument upwarp, southeast Utah, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-287-D-291, 1961.

Prominent aeromagnetic and gravity anomalies in the Blanding basin and Monument upwarp of southeast Utah trend northeast transverse to other geophysical anomalies and regional folds of Laramide age. Their source is evidently within rocks of the buried Precambrian basement, probably deep-seated blocks of low density and irregular magnetization bordered by faults. The large magnetic and residual gravity high at Blanding represents comparatively dense, magnetic rock and probably indicates that the basement is shallower here than has been estimated from stratigraphic data. These and other northeast-trending structures in central Colorado are evidently part of an ancient regional structural pattern which may include transverse zones such as the northeast-trending Colorado mineral belt of the southern Rocky Mountains.— V.S.N.

188-452. Mabey, Don R. Regional magnetic and gravity anomalies in the Darwin area, California, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-276-C-279, 1961.

An aeromagnetic and generalized geologic map and a complete Bouguer gravity anomaly map are presented for the Darwin area, an upland in eastern California about 5,000 feet above sea level between the south end of the Inyo Mountains and the north end of the Argus Range. Gravity and magnetic profiles from the Sierra Nevada at Owens Lake to the east side of Death Valley near Badwater are illustrated and discussed.— V.S.N.

188-453. King, Elizabeth R. An aeromagnetic profile from Anchorage to Nome, Alaska: Geophysics, v. 26, no. 6, p. 716-726, 1961.

A total-intensity aeromagnetic profile was obtained on a 500-mile flight from Anchorage to Nome, Alaska, on May 4, 1954. The average flight altitude was 6,000 feet above sea level except over the Alaska Range, where it was 9,000 feet. This profile crossed 8 of Alaska's major tectonic elements at right angles to their trend and gives valuable regional information in an area where other geophysical and geological information is scarce or lacking. The profile is divisible into 4 major segments and 9 subsegments, each of which has a distinctive magnetic pattern. These magnetic units can be related to the tectonic units and in many cases provide a representative sample of the type of magnetic profile which is associated with each of the tectonic units, particularly east of the Yukon.— D.B.V.

188-454. Koulomzine, T., and Jaeggin, R. P. Discovery of the iron ore deposit of Mount Wright Iron Mines Co. Limited: Canadian Mining Metall. Bull. , v. 54, no. 594, p. 761-767, 1961.

The discovery of an iron ore deposit in Quebec is described; this is a simple case history of the successful use of geophysics. A grid of widely spaced ground rather than aeromagnetic profiles was made to explore the area in order to establish sound topographical control and to make a reconnaissance geologic map at the same time. Anomalies were found in an area devoid of rock outcrops, and additional ground magnetometer measurements along lines 400 feet apart outlined the deposit. Five drill holes to investigate the deposit revealed crystalline hematite with a small proportion of magnetite interbedded in a very pure friable quartzite.— V.S.N.

Rose, Edward R. Iron and titanium in the anorthosite of St. Urbain, Quebec. See Geophys. Abs. 188-51.

188-455. Gregory, A[lan] F., Morley, L. W., and Bower, Margaret E. Airborne geophysical reconnaissance in the Canadian Arctic Archipelago: Geophysics, v. 26, no. 6, p. 727-737, 1961.

Profiles of total magnetic intensity and gamma radioactivity were obtained along a series of widely-spaced flight lines across the main tectonic regions of the Canadian Arctic Archipelago. The interpretation of these data and the calculated depths-to-basement substantiate the recognized regional structures, confirm general geological continuity between the islands, and provide some additional structural detail. Results of particular interest are the maximum depths-to-basement in the sedimentary basins (10,000 feet or more), the interpretation of the structure of the Precambrian arches, the extent of nonbasement igneous activity, the apparent absence of disturbed ferromagnetic rocks on the Polar Continental Shelf except near the edge, and the anomalous radioactivity in certain sedimentary rocks on Bathurst Island. Remarkable magnetic anomalies showing a central minimum with marginal maximums are associated with known gypsum domes in the Sverdrup Basin. (See also Geophys. Abs. 185-479.)— D.B.V.

188-456. Worst, B. G. The Great Dyke of Southern Rhodesia. Pt. 2—Geophysical observations: Southern Rhodesia Geol. Survey Bull., no. 47, p. 178-181, 1960.

Results from aeromagnetic and ground magnetic surveys of the Great Dyke of Southern Rhodesia indicate that the structure of the dike bears a relationship to the magnetic curves only in the case of the ground survey. A combined magnetic-geologic profile is included. Results of 9 gravimetric traverses across various points of the dike are illustrated by gravimetric profiles accompanied by geologic sketch maps of the traverse. The gravity anomalies begin well into the granite on either side of the dike; this indicates that a heavy core exists and extends to greater depth than previously assumed.— V.S.N.

188-457. Jaeger, Wolfgang. Geologisch-geophysikalische Untersuchung des Phonoliths von Hammerunterwiesenthal (Erzgebirge) [Geologic-geophysical investigation of the Hammerunterwiesenthal phonolite (Erzgebirge) (with English and Russian summaries)]: Zeitschr. Angew. Geologie, v. 7, no. 11, p. 587-592, 1961.

A study of the intrusion process of the Hammerunterwiesenthal phonolite body, one of the largest Tertiary volcanoes of the Erzgebirge in Germany, was aided by magnetic and electrical surveys. A ΔZ magnetic survey fixed the outline of the chimney and indicated another, heretofore unknown body under the tuff. The thickness of the tuff covering the phonolite was investigated by means of a resistivity survey, using the Wenner configuration.— D.B.V.

188-458. Müller, Karel. Regionale magnetische Untersuchung und tektonischer Bau der Kleinen Donautiefebene [Regional magnetic investigation and the structure of the Kleine Donau Plain: Československé Akad. Věd Geofys. Sborník, no. 91, p. 277-317, 1958.

A regional magnetic survey was made of the Kleine Donau Plain in order that earlier regional magnetic measurements could be combined. The field procedures, treatment of the data, compensation of the base net, and accuracy of earlier measurements are discussed. The distribution of magnetic anomalies is shown on a map, and the geologic significance of each is described.— J.W.C.

188-459. Damnjanović, K[onstantin], and Milanović, B[ožidar] Mogucnost određivanja položaja rudnih tela na osnovu geomagnetnih anomalija na rudama gvožđa u Makedoniji [Possibility of determination of the

position of an ore body on the basis of a magnetic anomaly at an ore deposit in Macedonia]: Jugoslovanski Geol. Kong., 2d, Sarajevo 1957, p. 375-383, 1957.

Several chamosite deposits occur in Macedonia, and their magnetization depends on the concentration of magnetite in them. Using the method of derivatives of higher order, the attempt is made to calculate depth of occurrence of several ore bodies; these are illustrated by maps and profiles.— J.W.C.

188-460. Perić, M., and Milovanović, D. Poređenje rezultata geomagnetnih ispitivanja i rudarskih istražnih radova na magnetit-hematitnom rudištu Damjan Istočna Makedonija [Comparison of the results of geomagnetic and mining exploration on the magnetite-hematite ore body at Damjan in east Macedonia (with English summary)]: Jugoslovanski Geol. Kong., 2d, Sarajevo 1957, p. 408-414, 1957.

The magnetite-hematite iron deposit of Damjan is located at the contact of an andesite with Cretaceous flysch sediments. The magnetic susceptibility of the ore ranges from 10,000 to $35,000 \times 10^{-6}$ cgs units, whereas the sediments are practically nonmagnetic. Vertical intensity anomalies ΔZ are shown on a map. Depth to the ore body was determined by the method of vectors of magnetic anomalies on a profile perpendicular to the average direction of the isodynamic ΔZ contours and approximately parellel to the magnetic meridian. The depth of 30-40 m determined by this method was later checked by mining exploration. The configuration of the ore body was deduced on a basis of the best fit between the field curve of ΔZ and calculated curves for various extensions of the ore body.— J.W.C.

188-461. Krulc, Zvonimir. Geomagnetsko ispitivanje željeznog rudišta Baščine kod Ljubije [Geomagnetic investigation of the iron deposit of Baščine near Ljubije (with German summary)]: Jugoslovanski Geol. Kong., 2d, Sarajeva 1957, p. 424-429, 1957.

A brief history of magnetic exploration of the Baščine iron deposit in Yugoslavia is given, and the magnetic characteristics are examined on the basis of a map and three profiles of vertical intensity. The greatest success was obtained using the step-method with small distances of the measuring point.— J.W.C.

188-462. Ionescu, Florian. Aplicaţii ale metodei micromagnetice la studiul rocilor cristaline din Carpaţii Meridionali [Application of the micromagnetic method to the study of crystalline rocks of the South Carpathians]: Acad. Romîne Studii şi Cercetări de Geologie, v. 6, no. 3, p. 601-617, 1961.

Micromagnetic investigations were made on the north flank of the South Carpathians to determine whether the various structural elements of the crystalline schists are reflected in the magnetic picture. The method proved capable of determining the strike of the schistosity, the main direction of fracturing, and under favorable conditions also the direction of dip. The results are presented in sketch maps and rose diagrams.— J.W.C.

188-463. Stefanescu, Sabba S.; Airinei, Ştefan; Botezatu, Radu; Ionescu, Florian; Popovici, Dorin; and Stoenescu, Scarlet. Prospecţiuni geofizice pentru fier lîngă Constanţa [Geophysical exploration for iron in the vicinity of Constanta (with Russian and French summaries)]: Acad. Romîne, Probleme de Geofizică, v. 1, p. 163-179, 1961.

This is virtually the same as the paper published in Acad. Roumaine, Rev. Geol.-Geog., v. 5, no. 1, p. 119-132, 1961. See Geophys. Abs. 187-521).— J.W.C.

Airiney, Shtefan [Airinei, Ştefan]. Gravimetric and geomagnetic investigations in the zone of bend of the eastern Carpathians and the Tara Birsei. See Geophys. Abs. 188-357.

188-464. Kopayev, V. V., and Martynova, T. A. Opyt ispol'zovaniya rezul'tatov laboratornykh izmereniy magnitnykh svoystv zhelezistykh kvartsitov pri istolkovanii magnitnykh anomaliy KMA [A test of the application of the results of laboratory measurements of magnetic properties of iron quartzites to interpretation of magnetic anomalies of the KMA]: Akad. Nauk SSSR Izv. Ser. Geofiz., no. 4, p. 553-566, 1961.

Taking the Oskoletz section of the Kursk magnetic anomaly (KMA) as an example, a comparison is made between the results of interpretation of ground magnetic surveys and the direct measurements of magnetic susceptibility and remanent magnetization. An attempt is made to explain the origin of the local minimums.— Authors' abstract, A.J.S.

188-465. Kravchenko, G. L. Pryroda Manhus'koyi mahnītnoyi anomalīyi Pīvdenno-Skhīdnoho Pryazov'ya [Nature of the Mangush magnetic anomaly southeast of the Sea of Azov (in Ukrainian with Russian summary)]: Akad. Nauk Ukrayin. RSR Heol. Zhur., v. 21, no. 4, p. 41-51, 1961.

The Mangush magnetic anomaly, discovered in 1956 during geophysical investigations of the region bordering the Sea of Azov, was studied geologically in 1958-59. The Mangush crystalline complex consists of steeply dipping (almost vertical) pyroxene-gneisses, gabbro-amphibolites, and scapolite- and diopside-bearing basic rocks, with some migmatites and granites. The magnetic maximums occur above a pyroxene-magnetite quartzite up to 5 m thick that is closely connected genetically with the pyroxene-gneisses and gabbro-amphibolites. The various rock types are described petrographically.— D.B.V.

Visarion, Marius. Geophysical maps of the region of the eastern Carpathians to the east and west of the Ceahlau Massiv. See Geophys. Abs. 188-356.

Vantsyan, G. M. On the method of geophysical investigations of ore deposits of the Armenian S.S.R. See Geophys. Abs. 188-258.

188-466. Hou, Zong-Tsu. On the magnetic property of volcanic rocks occurring in the Great Shingan Mountain region, northeast China [in Chinese with English abstract]: Acta Geophys. Sinica, v. 9, no. 2, p. 144-148, 1960.

An aeromagnetic survey in the Great Shingan region of northeast China has revealed a large number of intensive negative magnetic anomalies. Ground observations show that they are caused by volcanic rocks both on and beneath the surface that have a particularly strong and often reverse residual magnetism. The inductive magnetism is much weaker. Chemical and mineralogical investigations indicate that the rocks are composed chiefly of oxides of silicon and aluminum with low ferromagnetic mineral content.— V.S.N.

188-467. Adams, R. D. Total magnetic field surveys between New Zealand and the Ross Sea: Jour. Geophys. Research, v. 67, no. 2, p. 805-813, 1962.

Total magnetic field surveys were made with ship-towed nuclear spin magnetometers between New Zealand and the Ross Sea during the summers of 1958-59 and 1959-60. Total field contours are given for the region between New Zealand and lat 70° S. and for the Ross Sea area. In general, smooth

magnetic profiles are found in the shallow water to the north of the deep ocean basin, and in the basin itself a typical pattern of deep-water magnetic anomalies is found. Both bathymetric and magnetic profiles are rough over a ridge that is crossed before entering the Ross Sea. A smooth magnetic profile in the Ross Sea shows the absence of any disturbing igneous rock close to the surface.— D.B.V.

RADIOACTIVITY

188-468. McNair, A. The half-life of vanadium-50: Philos. Mag., v. 6, no. 64, p. 559-561, 1961.

The half life of the naturally occurring odd-odd isotope V-50 for electron capture decay to the first excited state of Ti-50 is shown to exceed 8×10^{15} yr and for negatron decay to the first excited state of Cr-50 to exceed 1.2×10^{16} yr.— Author's abstract

188-469. Dobrowolski, T., and Young, J. The determination of the half life of RaC': Phys. Soc. [London] Proc., v. 77, pt. 6, p. 1219-1220, 1961.

The half life of radium C' (Po^{214}), the shortest-lived member of the radium family, was measured in two different ways with apparatus consisting essentially of two proportional counters and a time analyzer. The results obtained by the two methods were compatible, and their weighted mean value and and standard deviation give a value of $t_{1/2}=164.3\pm1.8$ μ sec.—D.B.V.

188-470. Zaghloul, Z. M. The alpha-particle radioactivity of zircon. Zircon specific alpha-particle radioactivity and the grain-size effect: Egyptian Jour. Geology, v. 3, no. 2, p. 159-166, 1959.

With the aid of nuclear emulsions, the specific alpha activity of zircon as a function of grain-size was studied. The specific alpha activity ($\alpha/cm^3/sec$) for crystals 25 micron thick is about 200 whereas crystals 100 micron thick have only about 50 $\alpha/cm^3/sec$ specific alpha activity.— T.W.S.

188-471. Pavlović, Boško V. Sistemi radioaktivnih neravnoteža između urana, jonijuma i radijuma u sedimentima [Radioactive disequilibrium systems among uranium, ionium, and radium in sediments (with English summary)]: Vesnik Primenjena Geofizika, ser. C, v. 1, no. 1, p. 107-114, 1960.

The relationship between uranium, ionium, and radium under disequilibrium conditions in sediments is considered. An equation is given for calculation of the maximum and minimum amount of radium at any depth of sediment if the amount of uranium, ionium, and radium at the top of the sediments is known.— J.W.C.

188-472. Russell, William L., and Steinhoff, R. O. Radioactivity of volcanic sediments in Brazos County, Texas: Geophysics, v. 26, no. 5, p. 618-625, 1961.

Measurements on volcanic sediments of upper Eocene and Miocene age in Brazos County, Tex., show gamma-ray emissivities of 4.5-10.9 percent potassium equivalents of gamma-ray emissivity. This is about the same as for ordinary shales. The mixture of volcanic particles with clastic sediments in these samples suggests that the radioactivity of the original volcanic matter may possibly have been reduced by weathering.— R.M.G.

188-473. Buchwald, Vagn, and Sørensen, Henning. An autoradiographic examination of rocks and minerals from the Ilímaussaq batholith, South West Greenland: [Denmark] Medd. om Grønland, v. 162, no. 11, 35 p., 1961.

Rocks and minerals from the lower Ilímaussaq complex exhibit increasing radioactivity from early naujaite to later lujavrite and hydrothermal veins. The individual radioactive minerals exhibit various amounts of radioactivity as determined by glass-backed nuclear track plates placed in contact with uncovered thin sections. Radioactive minerals studied include: eudialyte, lovozerite, rinkite, epistolite, thorianite, apatite, britholite, monazite, and steenstrupine.— T.W.S.

188-474. Spears, D. A. The distribution of alpha radioactivity in a specimen of Shap granite: Geol. Mag., v. 98, no. 6, p. 483-487, 1961.

A nuclear emulsion technique indicates that more than 95 percent of the activity of the Shap granite of Scotland is concentrated in the accessory minerals. The accessory minerals observed in order of decreasing specific activity are monazite, zircon, sphene, apatite, and magnetite.— T.W.S.

188-475. Vučíc, Vlastimir M., and Pavlovíc, Boško V. Radioaktivnost travertina u Niškoj Banji [Radioactivity of travertine at Niška Banja (with English summary)]: Vesnik Primenjena Geofizika, ser. C, v. 1, no. 1, p. 99-106, 1960.

Radium is deposited in the travertine at Niška Banja without its parents ionium and uranium. The radium content decreases with depth in the travertine. The radioactivity of the travertine is independent of the accessory minerals and of the content of Mn, Fe, Al, and hydrated Si oxides. Studies using photonuclear plates indicate that the radioactive elements are distributed in all the mineral fractions. The thorium content of the travertine was also measured.— J.W.C.

188-476. Kita-Badak, Maria, and Badak, Jerzy. Występowanie łupków radioaktywnych w utworach serii menilitowej w Karpatach [Occurrence of radioactive shales in sediments of the Menilite series in the Carpathians (with English summary)]: Kwartalnik Geologiczny, v. 4, no. 1, p. 173-180, 1960.

Several occurrences of radioactive shale in Poland are described and discussed; most of these occur in the lower part of the Melilite series. The radioactivity of the shales is in general directly proportional to the bitumen content. Two rock types exhibit an increased radioactivity: argillaceous shale at the base of the series with an activity of 40 μr/hr, and marly shale higher in the section with an activity of 480 μr/hr.— J.W.C.

188-477. Yamaguchi, Masaru. Alpha-activity of granite and andesite zircons from southwest Japan measured with nuclear emission: Kyushu Univ., Mem. Fac. Sci., Ser. D., Geol., v. 11, no. 1, p. 49-59, 1961.

Using nuclear emulsions the alpha activity of zircon grains is examined and compared with crystal features and color. Light-colored euhedral zircon is low in alpha activity, whereas dark-colored irregularly shaped zircon exhibits high alpha activity. A wide variation in alpha activity and color of zircon is noted in some rocks.— T.W.S.

188-478. Jones, Alun R. Airborne gamma monitor for ground contamination: Nucleonics, v. 20, no. 3, p. 66-69, 1962.

An airborne monitor has been developed that can relate instrument response to ground contamination at tolerance levels. A small aircraft is used. The components are housed in a control unit (9×5×6 in; 8.8 lb with mercury batteries) in front of the observers seat and a head unit (10×4×6 in; 6.9 lb) on the floor of the luggage compartment in the rear. In this way the sodium iodide crystal is well removed from most of the aircraft mass, and there is only a

thin aluminum skin between it and the ground. The instrument was calibrated by flying over point sources of I-131, Cs-137, and Co-60. Flight altitude was between 100 and 1,500 feet.

The detector response to a source a distance x away in a scattering medium is of the form $e^{\mu x}B(\mu x)/x^2$, where $B(\mu x)$ is a buildup factor that increases with x; μ is a function of the initial gamma energy. The buildup factor increases appreciably from 1 when μx equals 1 or more and arises from Compton scattering in the air; this changes the direction of the photons, lowers their energies, and enhances detector response. The detector response varies slowly with height for gammas of energy $\geq$360 Kev, the signal-to-noise ratio is greatest at low altitudes, and 1 $\mu c/m^2$ of I-131, Cs-137, or Co-60 is detected easily in the presence of a normal background.— J.W.C.

188-479. Husain, M. Khurshid; Azeem, Mohammad; and Qurashi, Mazhar M. The design of a simple uranium-thorium discriminator for weakly active ores containing less than 1 percent U_3O_8 equivalent: Pt. II—Design, use and testing of discriminator: Pakistan Jour. Sci. and Indus. Research, v. 4, no. 3, p. 93-96, 1961.

An annular sample holder and Geiger counter arrangement is described for measuring the U/(Th+U) ratio of radioactive ores containing less than 1 percent U_3O_8 equivalents. The technique of measuring and standardizing of this counter is given along with some typical tests using radioactive ores.— F.E.S.

188-480. Kment, Vítězslav, and Kuhn, Arno. Technik des Messens Radioaktiver Strahlung [Technique of measuring radioactive radiation]: Leipzig, Akademische Verlagsgesellschaft Geest and Portig K.-G., 602 p., 1960.

The first part of this book is devoted to radiation detectors; the subjects discussed are the physical principles of radiation detection, the theory of detection with gas-filling, ionization detectors, scintillation counters, secondary emission detectors, crystal counters, chemical detectors, and thermodetectors. The second part deals with electrical and electronic apparatus including the detector signal and its measurement, electrostatic measuring apparatus, basic characteristics of amplification, the tube voltmeter and tube electrometer, impulse amplification, counting apparatus, and sources of strain in detectors. The third part discusses measuring apparatus and its application. The subjects treated here are integrating and experimental apparatus, counting apparatus for activity measurement, counting apparatus for special purposes, operation of measuring apparatus, observations on measurement of radioactive preparations, and review and comparison of various detectors.— J.W.C.

188-481. Bespalov, D. F. Novaya radiometricheskaya apparatura v promyslovoy geologii [New radiometric apparatus in commercial geology], in Yadernaya Geofizika: Moscow, Gostoptekhizdat, p. 17-64, 1959.

Various types of radiometric apparatus developed in the U.S.S.R. from 1953 to 1957 are described. Schematic diagrams are given for the circuits of four scintillation counters (LC-1, LC-2, LC-3, and LC-4), and their efficiency with variation of such factors as temperature and source of radiation is reported. The NNK-57 apparatus for recording thermal neutrons (the neutron-neutron method) is also described and a schematic diagram given.— J.W.C.

188-482. Light, D. E., Freitag, C. A., Hudson, G. B., and Nurse, E. J. The flotation of radioactive minerals—Pt. 2: Canadian Mining Metall. Bull., v. 55, no. 597, p. 30-34, 1962.

Flotation studies were made on a variety of radioactive mineral samples. Fatty acids, petroleum sulphonates, and alkyl acid phosphates are satisfactory collectors.— T.W.S.

RADIOACTIVITY SURVEYING AND LOGGING

188-483. Sano, Shun-Ichi. A study on airborne radioactivity surveying [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 11, p. 701-719, 1960.

Some of the technical problems encountered by the Geological Survey of Japan during airborne radioactivity surveys of 90,000 sq km are discussed. Calculations of the distribution of gamma-ray intensity in the air based on a semi-empirical theory containing the effect of scattering are described. The effect of topography, atmospheric radioactive substances, and the thin surface layer on the altitude correction for gamma-ray intensity is discussed in detail. The analysis of anomalous gamma-ray intensity and the selection of flight line intervals are outlined briefly. The procedures and results from surveys over very rough terrain and in local areas using twin-engine aircraft are described.— V.S.N.

188-484. Flanagan, Francis J. Fatigue in scintillation counting, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-B, p. B-324-B-326, 1961.

Experiments designed to determine the primary cause of photomultiplier fatigue that results in variations in counting rates are described and the results in variations in counting rates are described and the results discussed. It is inferred from the experiments that photomultiplier fatigue may be caused by bremsstrahlung resulting from the interaction of beta particles with the glass ampoules. Since bremsstrahlung and X-rays are similar, this fatigue is a serious defect in the use of photomultipliers as X-ray detectors.— V.S.N.

188-485. Skrzat, Zofia. Badanie promieniotwórczósci pegmatytów okolio Szklarskiej Poręby metodą klisz jądrowych [Investigation of radioactivity of pegmatites from the Szklarska Poręba region by the method of nuclear plates (with Russian and English summaries)]: Kwartalnik Geologiczny, v. 4, no. 4, p. 874-888, 1960.

Quantitative measurements of the radioactive elements in the pegmatites of the Szklarska Poręba region, Poland, were made by exposing tablets of the pulverized rock to nuclear plates. The ratio of uranium to thorium was determined by measuring the long trajectories. The main source of radioactivity in these pegmatites is zircon, fergusonite, and monazite. The radioactive substances are concentrated in fractures and on the surface of the mineral grains.— J.W.C.

188-486. Wedo, Helmuth. Thorium and rare earths in the Pocos de Caldas zirconium district, Brazil, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-D, p. D-214-D-216, 1961.

Unusual high-grade thorium and rare-earth deposits at Morro do Ferro, Brazil, were discovered by an airborne radioactivity survey of the Pocos de Caldas Plateau, Minas Gerais and Sao Paulo States, Brazil, in 1953. An exploration program to determine the extent of material that might be amenable to openpit mining consisted of preliminary scintillation-counter surveys followed by trenching and gamma-ray logging of deep auger holes. The geology of the area is described briefly, and the results of ground surveys are illustrated by maps and graphs.— V.S.N.

Gregory, A[lan] F., Morley, L. W., and Bower, Margaret E. Airborne geophysical reconnaissance in the Canadian Arctic Archipelago. See Geophys. Abs. 188-455.

88-487. Koizumi, Hisanao; Igarashi, Toshio; Ohmachi, Hokuichiro; Okumi, Shizuka; and Okano, Takeo. Radiometric reconnaissance of the metallic ore deposits at the environs of Kesennuma City, Miyagi Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 11, p. 743-756, 1960.

A radiometric survey in the vicinity of Kesennuma City located uranium minerals in the Maeda and Ryusei deposits of the Matsuiwa mine but not in any of the other mines in the area. The uraninites from the Matsuiwa mine are concentrated in the footwall or hanging wall of the veins. The mineral association and genetic sequence of mineralization are discussed.— V.S.N.

188-488. Nagahama, Haruo, and Hoshino, Kazuo. Radioactive anomalies in eastern Tsuyama, Okayama Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 11, p. 759-761, 1960.

No significant abnormal radioactivity was found from a surface survey over the Tertiary and Quaternary sediments of the Tsuyama basin. A portable Geiger counter was used.— V.S.N.

188-489. Horikawa, Yoshio, and Hosono, Takeo. Radiometric survey with car-mounted instrument in the southeastern part of Iwate Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 12, p. 789-792, 1960.

A systematic survey with a car-mounted scintillometer of 3,000 sq km in southeast Iwate Prefecture shows that the granites and the Paleozoic and Mesozoic formations have radioactive intensities of 400~700, 400~600, and 500~700 counts per second, respectively. No notable radioactive anomalies were observed.— V.S.N.

188-490. Sugiyama, Tomonori, and Horikawa, Yoshio. Radiometric survey with car-mounted instrument at the surroundings of Mt. Asahidake [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 12, p. 793-797, 1960.

As a result of a radiometric survey for uranium resources in the area surrounding Mount Asahidake, intense anomalies were found in six places. One anomaly (Hongo Village) is in sedimentary rock underlain by granite; all the others are in granitic rocks. The Budo Mountain Range shows high intensity over its entire area.— V.S.N.

188-491. Horikawa, Yoshio; Ujiie, Akira; and Hosono, Takeo. Radiometric survey with car-mounted instrument in the Jōban Province, Fukushima Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 12, p. 798-800, 1960.

A scintillometer survey of 2,400 sq km in Jōban Province, Fukushima Prefecture, shows radioactive intensities of 500-700, 300-500, and 400-500 counts per second for granitic, metamorphic, and sedimentary rocks, respectively.— V.S.N.

188-492. Nakai, Junji, and Hosono, Takeo. Radiometric survey with car mounted instrument in Hiroshima Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 12, p. 801-804, 1960.

A radiometric survey in Hiroshima Prefecture, underlain primarily by the Hiroshima granite, resulted in locating a few areas of high radioactive intensity; one area in Yamagata-gun has an intensity of 2,000 counts per second. It is thought that the anomaly is due to a clayey zone in the quartz and granite porphyries in the area, and further prospecting is recommended.— V.S.N.

188-493. Iwasaki, Shoji; Kanaya, Hiroshi; and Komai, Jiro. Airborne radiometric survey in the western part of Kitakami area, Iwate Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 6, p. 435-437, 1961.

An aeromagnetic survey of about 3,600 sq km of the Kitakami area of Iwate Prefecture, Japan, is reported. In general the radioactivity of all formations is low. Some anomalous zones occur over Paleozoic sections, and radioactivity over granite areas is generally lower than over the Paleozoic sedimentary rocks.— V.S.N.

188-494. Iwasaki, Shoji; Kojima, Seishi; Kanaya, Hiroshi; and Komai, Jiro. Airborne radiometric survey in the eastern part of Fukushima Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 6, p. 438-440, 1961.

An aeromagnetic survey of 3,400 sq km over eastern Fukushima Prefecture, Japan, shows generally low radioactivity. Higher values and some anomalous zones occur over granite, granodiorite (later stage), and Paleozoic rocks. Values are lower over granodiorite (earlier stage) and Neogene formations.— V.S.N.

188-495. Iwasaki, Shoji, Kanaya, Hiroshi, and Komai, Jiro. Airborne radiometric survey in Jōban area, Fukushima Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 6, p. 441-445, 1961.

Results of an aeromagnetic survey of 2,100 sq km over the Jōban area, Fukushima Prefecture, Japan, are discussed. Intensities are higher over granites and granodiorites (later stage) than over granodiorites (earlier stage), Tertiary formations, and crystalline schists. A ground survey is recommended for the eastern part of Iwaki-gun where an anomalous area occurs along a fault.— V.S.N.

188-496. Sugiyama, Tomonori, and Komai, Jiro. Airborne radiometric survey in the western part of Mt. Asahidake [in Japanese with Engish abstract]: Japan Geol. Survey Bull., v. 12, no. 6, p. 446-449, 1961.

As a result of an aeromagnetic survey of western Mount Asahidake, two areas of high radioactivity were found, the Budo Range along the Japan Sea coast and the region of Mount Matsudaira, Mount Goto, and Mount Hishigatake in the southeast. A detailed ground survey of the anomalous zones is recommended.— V.S.N.

188-497. Iwasaki, Shoji; Kanaya, Hiroshi; and Komai, Jiro. Airborne radiometric survey in the southern part of Okayama Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 6, p. 450-454, 1961.

About 2,300 sq km were traversed by an aeromagnetic survey of southern Okayama Prefecture, Japan. Higher values of radioactivity were found over areas of granite and granite porphyry than over areas of Paleozoic and Quaternary formations. Some anomalies were found over granite areas. A test survey at the Ningyo Pass uranium-producing district showed a clear radioactivity anomaly.— V.S.N.

188-498. Iwasaki, Shoji, Kojima, Seishi, and Kanaya, Hiroshi. Airborne radiometric survey in the northern part of Yamaguchi Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 6, p. 455-458, 1961.

An aeromagnetic survey over 4,600 sq km in northern Yamaguchi Prefecture, Japan, revealed higher radioactivity values over granite and quartz porphyry areas than over Paleozoic, Mesozoic, and Cenozoic sedimentary rock areas. Anomalies were found adjacent to the cities of Yamaguchi and Otake, and in the central part of the Abu district.— V.S.N.

188-499. Hatuda, Zin'itiro; Nishimura, Susumu; and Hirose, Yoshihisa. Radioactivity around ore-deposits [in Japanese with English abstract]: Japanese Assoc. Mineralogists, Petrologists, Econ. Geologists Jour., v. 46, no. 5, p. 151-157, 1961.

The distribution of radioactivity around ore deposits of nine mines has been investigated by means of a radioscope with a Lauritsen element and a low-background gas-flow counter. Results are summarized in tables and graphs with English subtitles.— V.S.N.

188-500. Balashov, V. N., and Polyakov, A. K. Opytnyye raboty po radiometricheskomu oprobovaniyu na sur'myanom rudnike [Experimental work with radiometric testing in an antimony mine]: Sovetskaya Geologiya, no. 1, p. 164-169, 1962.

The possibility of direct determination of the heavy element content of ores by the method of diffused gamma radiation has been demonstrated. This method is based on the photoasborption of soft gamma rays by elements with high atomic numbers. Under favorable geologic conditions in mines and boreholes the content of metals can be estimated, contacts can be established, and faults can be traced.

An example is given in which the gamma radiation method is used to determine the antimony content of a bedded antimonite deposit. Tests were made in both trenches and boreholes. A schematic diagram of the instrument is given, and two borehole logs are illustrated. The radiometric method proves to be just as accurate as the chemical method for antimony deposits.— J.W.C.

188-501. Dyad'kin, I. G., and Batalina, E. P. Izmeneniye vo vremeni prostravstvenno-energeticheskogo raspredeleniya neytronov ot impul'snogo istochnika [Temporal change of space-energy distribution of neutrons from an impulse source]: Atomnaya Energiya, v. 10, no. 1, p. 5-12, 1961.

The temporal distribution of neutrons of a given energy corresponds precisely to the Poisson's probability that 2ξ neutrons will appear during the time t, under the conditions that the probability of neutron appearance is the same for any moment of time and is equal to $(v/l)dt$, if the moments of time considered are comparable or greater than $t=(1/v_0)$, where v_0 and v are the initial and observed values of a neutron's velocity, and l is its free path. It was found that the temporal distribution is completely independent of the initial energy of the neutron; rather, it depends entirely on the neutron parameters of the medium. The characteristics of the change in the space-energy distribution in time and the mean square of the retardation length are discussed, and solutions of a problem with a variable length of neutron free path are given. The results are applicable to problems of nuclear geophysics and neutron logging in particular.— A.J.S.

188-502. Bulashevich, Yu. P., and Sen'ko-Bulatnyy, I. N. Experimental'naya proverka usloviy optimal'nosti nepreryvnogo aktivatsionnogo karotazha [Experimental verification of the optimum conditions for continuous activation logging]: Akad. Nauk SSSR Izv., Ser. Geofiz., no. 4, p. 541-543, 1961.

The results of experimental verification of the basic principles of the theory of continuous activation (neutron) logging are presented. Satisfactory a-

greement between the experimental and theoretical data was found for Mesozoic bauxite deposits. The quantitative relationships in the theory are improved. Suggestions for carrying out continuous activation logging in practice are given.— Authors' abstract, A.J.S.

188-503. Filippov, Ye. M. Issledovaniye pri pomoshchi metoda grup raspredeleniya plotnosti neytronov v sil'no pogloshchayushchikh gornykh porodakh, peresechennykh burovoy skvazhinoy [Investigation by the method of groups of neutron density distribution in highly absorbing rocks intersected by a borehole]: Prikladnaya Geofizika, no. 27, p. 201-211, 1960.

The theory of neutron logging for determining the content of elements of high effective absorption cross section (boron, lithium, mercury, cadmium, and others) in the rocks and ores intersected by a borehole is analyzed mathematically on the basis of the groups method (see Geophys. Abs. 178-344). The theoretical data obtained is compared with experiments performed on a model. The best agreement between theory and experiment in recording thermal neutrons is observed when the radius is taken to be equal to the thickness of a water layer between the wall of the hole and the measuring apparatus; in recording epithermal neutrons the agreement is better when the actual radius of the borehole is taken for calculation.— A.J.S.

188-504. Ostroumov, G. V. Neytronnyy metod analiza na bor rud skarnovogo tipa [The neutron method of analysis of skarn-type ores for boron]: Razvedka i Okhrana Nedr, no. 5, p. 36-40, 1961.

The method of neutron analysis of boron-bearing skarn ores is based on the high absorption of thermal neutrons (energy 0.025 ev) by boron (absorption cross-section 752). The accuracy of this method is comparable to that of the chemical method for B_2O_3 content of 10-12 percent, and to that of spectral analysis for 0.3-1.0 percent B_2O_3. The main advantage of the neutron method is its operating efficiency.— A.J.S.

188-505. Garkalenko, I. O. Vydeleniye ugol'nykh plastov i opredeleniye ikh moshchnosti po gamma-gamma karotazhu [Differentiation of coal seams and determination of their thickness by gamma-gamma logging]: Prikladnaya Geofizika, no. 25, p. 234-242, 1960.

Laboratory and field studies of gamma-gamma logging in coal deposits are reported. This method completely replaced electrical methods in the Donets Basin in 1956 and is effective for differentiating coal seams 15-20 cm thick.— A.J.S.

188-506. Bilotserkovets', Yu. I. Vyznachennya potuzhnosti vugil'nogo plasta po kryviy GGK [Determination of the thickness of a coal bed according to gamma-gamma logging-curves]: Akad. Nauk Ukrayin. RSR Dopovīdī, no. 8, p. 1030-1033, 1961.

A method of determination of thickness of a coal bed by several independent and mutually controlled techniques is discussed. Six characteristic points on a gamma-gamma log are used, the points being determined on the basis of the calculated boundary surface which limits the "region of influence" of the apparatus in the borehole.— A.J.S.

188-507. Makarov, A. N. O primenenii neytronnogo gamma-karotazha na ugol'nykh mestorozhdeniyakh [Application of neutron gamma logging in coal deposits]: Leningrad. Univ. Uchenyye Zapiski, Voprosy Geofiz., no. 278, p. 109-118, 1959.

A theoretical investigation was made of the neutron gamma logging method on the basis of field tests in the brown coal deposits in the Moscow basin in

1956 and in the Turgay depression in 1957. This method can be successfully applied to coals of high moisture content and bound water, and can also be used to obtain an approximate percentage ash content (accuracy 5-8 percent).— A.J.S.

188-508. Garkalenko, I. O. Vplyv kavern pry robotakh metodom gamma-gamma karotazhu [The effect of caverns in investigations by the gamma-gamma logging method]: Akad. Nauk Ukrayin. RSR Dopovīdī, no. 8, p. 1034-1038, 1961.

Caverns show up on gamma-gamma logs as positive anomalies which are also common for coal beds. To remedy this effect, logging with instruments of different lengths using hard and soft gamma radiation is recommended.— A.J.S.

188-509. Bryant, H[arvey] L. Flowing well logs can save you money: World Oil, v. 152, no. 2, p. 33-36, 1961.

Nuclear logging can be used to solve a variety of production problems while the well is in operation. Examples are cited of locating gas-oil contacts with a neutron log and of locating points of oil and gas entry by gamma-gamma logs. (See also Geophys. Abs. 182-235.)— J.W.C.

Ivankina, A. T., and Morozova, A. A. Composition of a detailed velocity section from neutron gamma logging. See Geophys. Abs. 188-539.

188-510. Sano, Shun-Ichi; Nakai, Junji; and Takei, Yoshiyuki. Geophysical loggings at Tazawa Lake district, Akita Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 12, p. 811-813, 1960.

An outcrop of black material with a uranium content $\lll$ 1 percent was found in the Neogene sediments of the Tazawa Lake district, Akita Prefecture. Radioactivity logs made in shallow pits located a weak anomaly at a depth of 10 m and also a fractured zone.— V.S.N.

188-511. Sano, Shun-Ichi; Takagi, Shin-Ichiro; and Nakai, Junji. Geophysical loggings at Higashi-Tagawa district, Yamagata Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 12, p. 814-817, 1960.

Radioactivity and electric logs of boreholes in Neogene Tertiary sediments of this area located a basal conglomerate slightly rich in uranium in hole No. 1 and showed the presence of radioactive pebbles in the upper mudstone in hole No. 2.— V.S.N.

188-512. Sano, Shun-Ichi. Radioactivity logging of sedimentary rocks in the Jōban district [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 12, p. 818-824, 1960.

A radioactivity logger for use in deep drill holes in sedimentary rock is described and illustrated, and several problems concerning measurement and analysis are discussed briefly. The results of surveys in the Jōban district are reported and illustrated; no radioactive anomalies were discovered.— V.S.N.

Moston, R. P., and Johnson, A. I. Geophysical exploration of wells as an aid in location of salt-water leakage, Alameda Plain, California. See Geophys. Abs. 188-268.

SEISMIC EXPLORATION

188-513. Levi, V. A. K voprosu o perevode izonormaley v izovertikali [On the problem of transformation of isonormals into isoverticals]: Razvedochnaya i Promyslovaya Geofizika, no. 35, p. 69-73, 1960.

An improvement is proposed in the method of transformation of isonormals into isovertical based on determination of displacement Δl of an isovertical in relation to the respective isonormal as used in interpretation of seismic data. A nomogram is given for the isovertical intervals of 100, 50, and 25 m and for map scales of 1:100,000, 1:50,000, and 1:25,000.— A.J.S.

188-514. Vol'vovskiy, B. S., Vol'vovskiy, I. S., and Tal'virskiy, D. B. Usloviya provedeniya seysmicheskoy razvedki v Ferganskoy doline [Conditions of conducting seismic prospecting in the Fergana Valley]: Razvedochnaya i Promyslovaya Geofizika, no. 35, p. 73-77, 1960.

Seismic exploration of the Fergana Valley by the methods of reflected and refracted waves requires high efficiency arrays in order to reduce the intensities of interfering waves due to the complex peripheral geology of the depression, sharp facies changes in the sediments, and the lack of uniformity in the thickness of the units. Grouping of shots and seismographs, placement of charges into high moisture strata below the low velocity zone, and selection of an optimum observation interval result in satisfactory data by the method of reflected waves in determining local geological structures.— A.J.S.

188-515. Markuze, L. S. Ispol'zovaniye teoreticheskikh godografov pri interpretatsii seysmorazvedochnykh materialov po Pripyatskomu progibu [Use of theoretical traveltime curves in the interpretation of seismic exploration data in the Pripyat' depression]: Razvedochnaya i Promyslovaya Geofizika, no. 36, p. 3-7, 1960.

To improve interpretation of seismic exploration data on the Upper and Middle Devonian formations underlying thick salt-bearing strata in the region of the Pripyat' depression, master charts for theoretical traveltime curves in two-layer mediums having horizontal interfaces are constructed according to the formula: $t=(2h_1/v_1 \cos \alpha_1)+(2h_2/v_2 \cos \alpha_2)$, where h_1 and h_2 are the thicknesses and v_1 and v_2 are the velocities of the first and the second layers, respectively; α_1 is the angle of incidence on the first interface and α_2 is the angle of refraction.— A.J.S.

188-516. Kaplan, B. L., and Mayorov, V. V. K voprosu vozbuzhdeniya poperechnykh voln napravlennymi vzryvami [On the problem of generation of transverse waves by directed shots]: Razvedochnaya i Promyslovaya Geofizika, no. 36, p. 14-23, 1960.

Transverse seismic waves commonly have advantages over longitudinal waves. Methods of directed shots that would produce predominantly shear waves are discussed here. The experimental work carried out in 1957-58 indicated that the amplitude ratio A_{SH}/A_P and the A_{SH} itself have the greatest values when a flat charge is placed on or close to the vertical side of a ledge when the ratio of the radius of the charge to its thickness is 3.3.— A.J.S.

188-517. Bespyatov, B. I. Nekotoryye voprosy teorii gruppirovaniya v seysmorazvedke [Some problems of grouping theory in seismic prospecting]: Prikladnaya Geofizika, no. 25, p. 19-36, 1960.

Methods are discussed for analysis of directional sensitivity in the impulse regime of seismic oscillations, the statistical effect of various interference systems (including multiple seismograph reception), and the methods of study

of wave patterns for determination of the optimum parameters for group arrangement of seismometers. The results of study of areal and linear arrangements of seismometers according to the method proposed are given.— A.J.S.

188-518. Weber, Max. Zur Approximation von Laufzeitfunktionen aus diskreten Messwerten mit abgebrochenen Potenzreihen [On the approximation of traveltime functions from discrete measured values with discontinuous power series (with English summary)]: Geofisica Pura e Appl., v. 49, p. 1-12, 1961.

An approximation of traveltime functions from discrete measured values by means of a discontinuous power series is treated. Tables convenient for numerical computation are presented, and a practical example is given.— D.B.V.

188-519. Ghosh, M. L. On the singing phenomenon in the offshore seismic experiments: Geofisica Pura e Appl., v. 49, p. 61-74, 1961.

The seismic record in some offshore areas assumes the appearance of a sine wave or a simple combination of sine waves. The dominant frequency on such offshore "singing" records is the third harmonic of a fundamental whose wave length is four times the water depth. In this paper it is proved mathematically that this phenomenon is due to the slope of the sedimentary layer near the observation point. Using Covert's method (1958) of finding the Green's function for built in bodies, the pressure field in the water layer is obtained for a two-dimensional point source in the same medium; it is shown that due to the slope of the sedimentary layer, singing is caused by waves whose length is equal to four times the water depth.— D.B.V.

188-520. Gassmann, Fritz. Ein räumliches n-Schichtenproblem der Refraktionsseismik [A spatial n-layer problem of seismic refraction surveying (with English summary)]: Geofisica Pura e Appl., v. 47, p. 1-11, 1960.

In the three-dimensional n-layer problem, the subsoil is bounded by a plane surface and divided by plane interfaces of arbitrary position into homogeneous isotropic solid layers. A method is presented for computing wave front velocities and positions of the interfaces on the basis of appropriate refraction measurements.— D.B.V.

188-521. Banaś, Henryk. Postęp techniczny w dziedzinie sejsmicznykh badań prospekcyjnych [Technical progress in seismic prospecting]: Przegląd Geol., v. 9, no. 3, p. 144-148, 1961.

The development of seismic prospecting methods since 1917 are summarized, and brief descriptions of various apparatus applied in seismic prospecting are given. The behavior of seismic waves in mediums of variable thicknesses, elasticities, and densities is discussed, and methods of interpretation of seismographic data given.— A.J.S.

188-522. Moore, R. Woodward. Observations on subsurface exploration using direct procedures and geophysical techniques, in Symposium, 12th, on geology as applied to highway engineering: Tennessee Univ. Eng. Expt. Sta. Bull., no. 24, p. 63-87, 1961.

Geophysical methods of exploring the subsurface offer faster, more economical means of obtaining information than is generally possible when using any of the direct procedures such as digging pits, auger boring, rod sounding, and others. The application of seismic and resistivity methods to exploring the subsurface for engineering construction purposes is discussed in detail. Use of various direct procedures is dictated by the type of information desired and the detail required.— V.S.N.

188-523. Gassmann, Fritz. Solution of an n-layer problem by a seismic reflection method: Royal Astron. Soc. Geophys. Jour., v. 4, (special volume), p. 151-157, 1961.

The n-layer seismic reflection problem is treated, assuming that the subsoil is bounded by a plane surface and subdivided into homogeneous isotropic solid layers by plane interfaces of arbitrary position. In the first section recursion formulas are derived for rays reflected by one interface and refracted by the others. In the second section it is shown that a parametric representation of the traveltime function can be found for an arbitrary position of the point source. Section 3 deals with computation of the traveltime for a given seismometer position by a method based on successive approximations using a Taylor expansion of the traveltime. In sections 4 and 5 a method is presented for computing the wave front velocities and the positions of the interfaces on the basis of appropriate seismic reflection measurements.— D.B.V.

188-524. Goupillaud, Pierre L. An approach to inverse filtering of near-surface layer effects from seismic records: Geophysics, v. 26, no. 6, p. 754-760, 1961.

This paper suggests a scheme for compensating the effects that the near-surface stratification, variable from spread to spread, produces on both the character and the timing of the seismic traces. For this purpose, accurate near-surface velocity information is mandatory. This scheme should greatly reduce the correlation difficulties so frequently encountered in many areas. It may also be used to enhance the resolving power of the seismic reflection technique. The approach presented here is based on the rather restrictive assumptions of normal incidence, parallel equispaced plant reflectors, and noiseless conditions.— Author's abstract

188-525. Kharaz, I. I., and Raykher, L. D. Sposob liniy $t_o/2$ v metode otrazhennykh voln [The $t_o/2$ lines process in the method of reflected waves]: Razvedochnaya i Promyslovaya Geofizika, no. 34, p. 29-33, 1960.

A new method is proposed for construction of reflecting boundaries in seismic exploration, which takes into consideration the intervening refracting mediums. The method is based on utilization of the arrival time t_o at each shot point. The line $t_o/2$ is constructed for each correlated reflection (not less than three shot points) according to the arrival times of the reflected waves at the shot point taken directly from the seismograms. As the incidence time of such a wave is equal to the time of reflection, the line $t_o/2$ is considered as a traveltime curve for which the reflecting boundary is the zero isochrone. Using the $t_o/2$ line, the traveltime curves of this wave for the refracting boundaries are determined by the method of the field of times, proposed by Riznichenko (see Geophys. Abs. 132-9819), and the reflecting boundary sought is constructed by the circumference method proposed by Puzyrev.— A.J.S.

188-526. Vol'vovskiy, B. S., Vol'vovskiy, I. S., and Ryaboy, V. Z. Laboratornoye primeneniye metoda RNP dlya interpretatsii materialov glubinnogo seysmicheskogo zondirovaniya [Laboratory application of the RNP method for interpretation of data of deep seismic sounding]: Razvedochnaya i Promyslovaya Geofizika, no. 36, p. 8-13, 1960.

Because of difficulties in separating reflected waves obtained by the method of deep seismic sounding (GSZ), especially in the range of minimums on the traveltime curves, a method is proposed for applying controlled direction of reception (RNP) of seismic waves to deep seismic sounding. The method was tested in the laboratory on data from the Fergana Valley The initial points of the waves refracted from the M-discontinuity and other seismic boundaries in

the crust were obtained, and the reflected waves separated. The method is recommended for field studies of the deep structure of the earth's crust.— A.J.S.

188-527. Nagumo, Shozaburo, and Kawashima, Takeshi. On the interpretation of seismic reflection method (2). Making of seismic cross-section [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 2, p. 85-94, 1961.

A new method of making seismic cross sections is presented. Reflection events are plotted by wave fronts and dip-segments on the first seismic cross section, which is then interpreted with the seismic record section to produce the second seismic cross section. The third section is a seismic-geologic cross section on which continuous horizon, phantom horizon, fault, and other structural interpretations are represented.— V.S.N.

188-528. Kaneko, Tetsuichi. Reflection signal from a layered refractor [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 2, p. 95-100, 1961.

The following are illustrated: the concept of the sampling filter used to obtain a reflection signal and a transmission signal from a simple layered refractor; the characteristics (amplitude and phase) of reflection and transmission; the wave forms of reflection and transmission signals from and through the layered refractor when the reflection coefficient is 0.2 or 0.4 and the incident original signal is Ricker's wavelet; and the deformation of the reflection and transmission signals when there is a change in thickness of the refractor.— V.S.N.

188-529. Kaneko, Tetsuichi, and Hirasawa, Kiyoshi. An experiment on the reduction of wave noises by using multiple geophone setting and pattern shooting [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 2, p. 101-134, 1961.

The results are reported of an experiment in the Sarukawa oil field for reducing wave noises by using multiple geophone settings and pattern shooting based on the theory of characteristic function. The classification of wave noises, their apparent velocities and predominate frequencies, and the combinations of geophones, shooting, and filters used are shown in tables. The experimental results of wave noise reduction are compared with values determined from characteristic functions; coincidence is fairly good. An example is illustrated.— V.S.N.

188-530. Weston, D. E. Underwater explosions as acoustic sources: Phys. Soc. [London] Proc., v. 76, pt. 2, p. 233-249, 1960.

The manner in which underwater explosions differ from low-amplitude point sources of sound is considered theoretically, especially effects due to cavitation near the sea surface. Some measured differences between the acoustic source levels of various size charges (0.002 to 50 lb) and some absolute charge source levels (7 to 60 fathoms) are given. The results at a given depth are shown to obey a simple scaling law. Theoretical source levels are calculated by Fourier analysis of shot pressure-time curves reported by Arons (see Geophys. Abs. 134-10542). At high frequencies the theoretical spectral energies of the shock wave and the bubble pulses are simply added together, but at low frequencies it is necessary to take account of phase. In general, agreement between experimental and theoretical levels is good; certain small discrepancies are explained in terms of bubble migration and related effects.— D.B.V.

188-531. Bobrovnik, I. I. O skorostyakh rasprostraneniya seysmicheskikh voln v donnykh otlozheniyakh rek i poverkhnostnom sloye bolot [On the propagation velocity of seismic waves in bottom sediments of

rivers and in the surface layer of marshes]: Razvedochnaya i Promyslovaya Geofizika, no. 36, p. 24-30, 1960.

Experiments were carried out in the field for determining the sources of discrepancies in the traveltime curves of reflected seismic waves (0.015 sec and more) and the change in character of seismic records in prospecting along rivers and marshes in western Siberia. Seismic velocities in the river sediments were determined to be 140-150 m per sec in sand and 360-500 m per sec in ooze. The velocities in the underlying layers were found to range from 200 to 1,350 m per sec. A sharp change in the vertical time and a distortion of cophasal axes were found along rivers and marsh lands. The conclusion was reached that water-saturated soft sediments in river beds and surface layer of marshes cause the observed discrepancies in time and form of seismic records.— A.J.S.

188-532. Layat, C., Clement, A. C., Pommier, G[ilbert], and Buffet, A. Some technical aspects of refraction seismic prospecting in the Sahara: Geophysics, v. 26, no. 4, p. 437-446, 1961.

The first seismic surveys in the Sahara were made in 1951 using the reflection method. Several difficulties were encountered that led to introduction of the refraction method. Its first tests revealed the existence of a rather deep marker bed having a velocity of about 6,000 m per sec (20,000 fps), which later proved to be the eroded basement surface. Refraction can now be used successfully for detailed surveys, at least in certain areas, and at a cost per kilometer that can compete with the reflection method. Many difficulties still exist concerning the interpretation of data.— D.B.V.

188-533. Hawkins, L. V. The Reciprocal Method of routine shallow seismic refraction investigations: Geophysics, v. 26, no. 6, p. 806-819, 1961.

The Reciprocal Method of shallow seismic refraction investigation provides a simple reliable method for surveys where the absolute depths to important refractors and an analysis of the velocities in the refractors are required in detail. The depth computation is based on an early concept, here termed the time-depth concept (see Geophys. Abs. 30-434), which differs slightly from the delay-time. The calculation of the individual time-depths and of the corrected travel times within the refractor require only simple numerical computation; hence the method is very suitable for routine survey procedures in which use is made of composite velocity terms for multilayered overburdens. The basis and procedures of the method are given, with examples illustrating its application and the technique of velocity analysis.— D.B.V.

188-534. Weber, Max. Die Interpretation von seismischen Refraktionsmessungen im Grenzfall $c_0=0$ [The interpretation of seismic refraction measurements in the limiting case $c_0=0$ (with English summary)]: Geofisica Pura e Appl., v. 49, p. 119-128, 1961.

Continuing the study of the traveltime function and its interpretation in seismic refraction surveying of a uniaxially nonhomogeneous body (see Geophys. Abs. 168-294, 179-123, and 188-518), the special case $c_0=0$ is treated mathematically.— D.B.V.

188-535. Shneyerson, M. B. Interpretatsiya godografov prelomlennykh voln pri razvedke pologikh platformennykh struktur [Interpretation of traveltime curves of refracted waves in prospecting on flat platform structures]: Prikladnaya Geofizika, no. 25, p. 3-19, 1960.

Differential methods of interpretation of the results of seismic exploration on the gentle structures of the Russian platform by the refraction method are

developed to permit graphic construction of deep boundaries by the fields method, without fixing boundary velocities. The method proposed is discussed, its mathematical formulation given, and analysis of probable errors developed. It was found that the method proposed is not highly accurate, but it can be used for preliminary investigations.— A.J.S.

188-536. Kaneko, Tetsuichi. A simple method of determination for three velocity layers by the seismic refraction [in Japanese with English abstract]: Butsuri-Tanko, v. 14, no. 2, p. 82-86, 1961.

In order to determine three velocity layer structures by the seismic refraction method, a simple method of treating them as a two-layer structure has been developed. The method is described and illustrated; error is estimated to be less than 5 percent in most cases.— V.S.N.

188-537. Zounková, Milada, and Beránek, Bretislav. Velocity conditions in the inneralpine Vienna basin: Československé Akad. Věd Geofys. Sborník, no. 85, p. 193-208, 1958.

Velocities of longitudinal waves in the rocks of the Vienna basin and in the substratum are reported. Velocity logs were made on six boreholes; these are shown on a map and illustrated in diagrams. Mean velocities and interval velocities were calculated for each borehole, and a curve of actual velocities was constructed.— J.W.C.

188-538. Konovalov, M. M. Skvazhinnaya seysmorazvedka [Borehole seismic prospecting]: Razvedka i Okhrana Nedr, no. 8, p. 36-40, 1961.

The method of prospecting by recording elastic waves using borehole geophones is discussed. On the basis of theory and field tests, it was found that this method is useful in determining structures of plane layers, profiles of steep and vertical slopes, and under favorable conditions the configuration of the bottom of a geological body.— A.J.S.

188-539. Ivankina, A. T., and Morozova, A. A. Sostavleniye detal'nogo skorostnogo razreza po diagrammam neytronnogo gamma-karotazha [Composition of a detailed velocity section from neutron gamma logging]: Razvedochnaya i Promyslovaya Geofizika, no. 34, p. 22-28, 1960.

As data on neutron gamma logging and on velocity of elastic waves are closely correlated, both being dependent on the porosity and density of the rock, seismic velocity sections can be determined from neutron-gamma logging data. Field tests in the Saratov and Karamyshevo areas show that the method proposed increases the accuracy of determination of the horizontal velocity gradient, differentiates the seismic velocities in detail in the section, and reduces the seismic logging necessary for regional logging.— A.J.S.

188-540. Geertsma, J. Velocity-log interpretation: The effect of rock bulk compressibility: Soc. Petroleum Engineers Jour., v. 1, no. 4, p. 235-246, 1961.

The relationship between porosity and speed of propagation of acoustic waves in fluid-saturated porous rocks as measured by the sonic log and by ultrasonic techniques is analyzed. Biot's continuum theory is used to explain the difference in acoustic wave propagation between dry and liquid-saturated porous materials. Acoustic wave propagation in a dry rock depends on porosity, although this dependence is not predicted by the theory. An empirical relationship of the form, $1/V=A+B\phi$, applies for many porous dry rocks provided that porosity is the only variable. The presence of liquid in the pores changes the value of B, and this change is in agreement with the Biot theory. The time-

average relation now used for deriving porosity values from an acoustic log, although not based on a sound physical picture, predicts approximately correct A and B values at depths between 1,000-3,000 m.

Carbonate rocks with their complicated pore structures sometimes show a wave velocity/porosity relationship that is unfavorable for log interpretation; examples are cited. Other complicating effects are related to the influence of shale streaks and natural fractures on the average wave velocity observed by the logging tool, and to the effect of adsorption phenomena on wave propagation in unstressed rocks, particularly in sandstones.— V.S.N.

188-541. Tuman, V. S. Refraction and reflection of sonic energy in velocity logging: Geophysics, v. 26, no. 5, p. 588-600, 1961.

It is suggested that the source of energy for the first arrivals recorded in velocity logging is not a straight-line path of the refracted beam, but a curved path. Equations are developed for this curved path, based on Pickett's empirical relation (see Geophys. Abs. 180-374). Analysis of some specific cases, using the IBM 650 computer, shows that these curved paths could be used in some cases to yield information about permeability in place. In general it is concluded that the field of velocity logging has tremendous potentialities, and there is much room for further research. After further experimental verification, the ideas presented in this paper could also be applied to surface prospecting.— D.B.V.

188-542. Acta Geophysica Sinica. A supersonic impulse well-logging instrument [in Chinese with English abstract]: Acta Geophys. Sinica, v. 8, no. 1, p. 84-93, 1959.

The construction and operation principles of a supersonic impulse well-logging instrument are described. The principles of choice of the dimensions of the component parts are discussed, and schematic diagrams are given. One emitter and two detectors of supersonic impulses, together with their respective pre-amplifiers are built into the probe. On the other end of the cable are the main oscillator, the four frequency divisors, the impulse generator, the intermediate amplifier, the cathode-ray oscillograph, the time-mark generator, and the time delay circuits. The supersonic waves are picked up by the two detectors and with the time marks are photographed as they appear on the screen of the cathode-ray tube. The accuracy of results and future improvements are discussed.— V.S.N.

188-543. Knothe, Christian. Homogene Dreikomponentenanordnungen für tiefenseismische Untersuchungen [Homogeneous three-component arrangements for deep seismic investigations (with English summary)]: Zeitschr. Geophysik, v. 27, no. 2, p. 67-74, 1961.

Deep seismic sounding using three or more components has the advantage of better identification of wave type, better determination of the angle of emergence and vibration angle of a wave, and better determination of the position of layer boundaries. Homogeneous calibration appears to be the best way of obtaining these advantages. A homogeneous three-component station has been constructed and is described here, with photographs and diagrams.— D.B.V.

188-544. Polshkov, M. K. Voprosy teorii i rascheta elektrodinamicheskogo seysmografa s uchetom vkhodnoy tsepi seysmicheskogo usilitelya [Problems of the theory and design of an electrodynamic seismograph taking into account the input circuit of the seismic amplifier]: Prikladnaya Geofizika, no. 25, p. 37-54, 1960.

The shape of the frequency and phase characteristics of seismographs, as affected by the electric circuit of the input of the amplifier and the form of the stabilization processes that arise in the seismograph during its connection to the seismic channel are discussed.— A.J.S.

188-545. Lozinskiy, Z. N. Primeneniye vysokochastotnoy fil'tratsii seysmicheskoy apparatury v Kuybyshevskom Povolzhe [Application of high frequency filtration of seismic apparatus in the Kuybyshev region on the Volga]: Razvedochnaya i Promyslovaya Geofizika, no. 34, p. 55-58, 1960.

Seismic wave resolution for frequencies of the order of 50 cycles per sec is improved by introducing a frequency characteristic VCh-70 to the seismic station SS-26-51D and a filtration arrangement FVCh-70 to the seismic station SS-30/60. These were employed for seismic surveying in the Kuybyshev region. The correlation of reflected waves was found to improve; however, the intensity of seismic recording was reduced, which requires grouping of charges and of seismic receivers.— A.J.S.

188-546. McManis, L. B. Proposed standards for seismic amplifiers—and what they mean to field records: Geophysics, v. 26, no. 5, p. 543-549, 1961.

Seismic amplifier performance may be categorized broadly into AGC action, filtering, and distortion (including noise). The characteristics of each can be defined by 8 specifications that allow a user to predict, and consequently to allow for, amplifier action—both desirable and deleterious—in obtaining field records.

It is proposed that these specifications, together with the usual "external" specifications, be considered as a starting point for establishing a standardized method of specifying seismic amplifier characteristics similar to the SEG "Standard Methods of Specifying Performance" for magnetic recording.— D.B.V.

188-547. Gol'tsman, F. M., and Keyl'man, Yu. N. Universal'nyy fil'tr seysmicheskikh signalov [Universal filters of seismic signals]: Prikladnaya Geofizika, no. 25, p. 55-65, 1960.

A seismic frequency filter for the range 10-150 cycles per second is described and discussed. The device is based on the principle of magnetic "memory," using lag lines for "memory cells." Change of the filter's frequency characteristics is accomplished by assigning the ordinates of the appropriate natural oscillations function on the adjusting potentiometers of the circuit. The device is capable of imitation of any arbitrary linear quadripole of concentrated or distributed constants having an effective time parameter not more than 72 m per sec. It is suggested that the device can be used for frequency separation of magnetic and gravity anomalies.— A.J.S.

188-548. Officer, Charles B. [Jr.]. Use of continuous seismic profiler (Sparker) in geologic investigations for vehicular tunnel and bridge crossings, in Symposium, 12th, on geology as applied to highway engineering: Tennessee Univ. Eng. Expt. Sta. Bull., no. 24, p. 33-37, 1961.

The application of the continuous seismic profiler to engineering geological surveys in water-covered areas is illustrated by a discussion of some sample Sparker records from offshore areas of Louisiana, Lake Erie, California, the Akashi Straits of Japan, and the Gulf of Paria off Trinidad.— V.S.N.

188-549. Oilweek. Rogers develops new seismic system and truck: Oilweek, v. 13, no. 5, p. 50, 1962.

Rogers Explorations reports the development of a versatile universal recording-playback system, the Unicord, which can handle refraction and (or) reflection shooting in addition to weight-dropping. A companion weight-dropping truck eliminates secondary truck vibrations. The outstanding advantage

of the new units is that any standard seismic technique can be handled with the same type of equipment. The "Thumper" truck, geophone cables, recording-playback system, and magnetic-tape transport system are described briefly.— V.S.N.

188-550. Militzer, H. Nahseismische Untersuchungen mit einem Bodenvibrator [Near-seismic investigations with a ground vibrator (with English summary)]: Zeitschr. Geophysik, v. 27, no. 2, p. 49-58, 1961.

An electrodynamic vibrator capable of exciting either periodic vibrations or impulses in the frequency range of 20-5,000 cycles per second has been developed for seismic investigations in connection with engineering problems. The resulting ground movement is registered by a three-component geophone. Comparison with hammerblow seismic investigations shows that with the ground vibrator, first arrivals and surface wave arrivals are clearer—especially in the case of solid rock—with the result that traveltimes can be measured more accurately.— D.B.V.

188-551. Kántás, K[arl]. Computing and plotting seismic data with electronic computer: Geofisica Pura e Appl., v. 49, p. 75-82, 1961.

A simple method for calculating seismic data on an electronic computer is described. The method is suitable either for linear or for curved ray paths. A profile computed and plotted by digital computer according to this method is given.— D.B.V.

188-552. Tuttle, Curtis R., Allen, William B., and Hahn, Glenn, W. A seismic record of Mesozoic rocks on Block Island, Rhode Island, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-254-C-256, 1961.

Seismic traveltimes from six refraction seismic traverses made on Block Island, R. I., in June 1960, are compared with data from 10 boreholes. Four subsurface geologic units are recognized: (1) V_0=3,200 fps, drift of Pleistocene age 16-153 feet thick; (2) V_1=6,270 fps, an unconsolidated zone of Cretaceous sediments 408-856 feet thick extending beneath the entire profile; (3) V_2=12,200 fps, a semiconsolidated zone of probable Cretaceous but possible Triassic sediments; and (4) V_3=19,700 fps, a crystalline zone of Paleozoic or older rocks.— V.S.N.

188-553. Chang, T. Y. Geophysical case history of Theuvenins Creek field, Tyler County, Texas: Geophysics, v. 26, no. 6, p. 682-690, 1961.

The first seismic survey in the Theuvenins Creek area was made in 1938. In 1942 a reconnaissance seismic survey was made using the spot correlation method; anomalous conditions were indicated. In 1955 the area was detailed using a continuous seismic profile method. The seismic data were later reviewed, and the reviewed interpretation substantiated the existence of Wilcox structural closure. A total of 38 producing wells have been drilled on the structure with no dry hole to date.— D.B.V.

Cram, Ira H., Jr. A crustal structure refraction survey in South Texas. See Geophys. Abs. 188-369.

188-554. Earl, John H., and Dahm, John N. Case history—Desert Springs gas field, Sweetwater County, Wyoming: Geophysics, v. 26, no. 6, p. 673-681, 1961.

The producing reservoirs in the Desert Springs area, on the west flank of the Red Desert Basin in central Sweetwater County, Wyoming, are the Upper Cretaceous Lewis and Almond formations. A seismic survey made in April-

July 1956 showed evidence of faulting, on the basis of which the discovery well was drilled. A detailed study of stratigraphy, lithology, and sedimentation, together with a detailed review of the seismic data utilizing the velocity survey in the first well showed that the phenomenon originally mapped as a fault is actually a series of facies changes. Three main stratigraphic trap types are believed to be present in this area, making an integrated and coordinated exploration program between geologists and geophysicists necessary before the finding of additional reserves can be expected.— D.B.V.

188-555. Cassinis, Roberto. Application of seismic methods to geothermal energy exploration: Quaderni di Geofisica Applicata, v. 21, p. 28-37, 1960 (1961).

The main task in exploration for sources of geothermal energy is to locate both shallow and deep faults, which are the avenues of ascent of steam. The reflection method can seldom be used in such exploration because the complex geology of geothermal areas does not allow reception of reliable signals. Refraction surveying, however, is very useful and can be applied by the common in-line procedure. Areal techniques such as arc shooting generally cannot be employed due to variability of surface and deep conditions. Even continuous correlation in-line shooting is not always suitable; many controls of subsurface and surface velocities are necessary and are accomplished by means of short spreads and small charge shots. The method is illustrated by one example from Italy and another from Sardinia.— J.W.C.

188-556. Roksandić, Miodrag M. O nekim geotektonskim osobinama jugoistočnog dela Tuzlanskog basena po podacima geofizičkih ispitivanja [Some geotectonic features of the southeast part of the Tuzla basin according to data of geophysical investigations (with French summary)]: Vesnik Primenjena Geofizika, ser. C, v. 1, no. 1, p. 37-44, 1960.

Results are reported of gravity and seismic reflection surveys in the southeast part of the Tuzla basin, Yugoslavia. The area is divided into two structurally different areas by the Tuzla-Lipovice fault. To the south of this fault and to the east of the line Orasje-Zivinice all the sediments to a depth of 4,000 m have a synclinal structure; there are three structural stages—Neogene, Eocene, and Mesozoic. To the south of the fault and west of this line the Mesozoic and Eocene sediments drop out of the section and anticlines are also present. To the north of the Tuzla-Lipovice fault seismic reflection surveys have determined two anticlines and a syncline.— J.W.C.

188-557. Dragašević, Tihomir. Neke karakteristike refrakcionih seizmičkih ispitivanja u području Ulčinja [Some characteristics of seismic refraction investigations in the Ulcinj area]: Vesnik Primenjena Geofizika, ser. C, v. 1, no. 1, p. 45-56, 1960.

Preliminary results are presented of seismic refraction surveys in the Ulcinj area of Yugoslavia. As velocity differentiation in the strata under the flysch-limestone area of Ulcinj is poor, the method of first arrivals cannot be used. The refraction method is attempted, using later arrivals. Several seismograms are reproduced, and cross sections are presented to illustrate interpretation.— J.W.C.

188-558. Paicu, Dumitru, and Patrichi, Constantin. Rezultate seismice obţinute pe formaţiuni metamorfice şi eruptive [Seismic results obtained on metamorphic and igneous formations (with Russian and French summaries)]: Acad. Romîne, Probleme de Geofizică, v. 1, p. 205-212, 1961.

A seismic refraction survey was made in the Apuseni Mountains at an elevation of 1,700 m for determination of the relation between a granodiorite

penetrated by the drill at a depth of 800 m and a granodiorite that crops out at a distance of 6 km. A surface of contact between granodiorite and overlying schist was traced successfully between the two points, thus confirming their continuity.— J.W.C.

188-559. Tuyezov, I. K. Metodika seysmorazvedki pri poiskakh i detalizatsii mezokaynozoyskikh struktur Tatarskogo Priirtysh'ya [Seismic exploration method for search and detailing of Meso-Cenozoic structures of the Tatar Irtysh River region]: Razvedochnaya i Promyslovaya Geofizika, no. 34, p. 34-38, 1960.

The procedure used in reflection surveys of Meso-Cenozoic structures in the Irtysh River region of the Tatar A.S.S.R. is discussed. Charges of 0.5-3.0 kg were shot at depths of 12-25 m, and 15-20 reflections were obtained.— A.J.S.

188-560. Yepinat'yeva, A. M., and Kosminskaya, I. P. Seismic surveying in China [in Chinese with Russian abstract]: Acta Geophysica Sinica, v. 8, no. 1, p. 60-70, 1959.

Problems connected with oil and gas exploration in various regions of China are discussed. Deserts, a continental climate, and few roads make working conditions very difficult in the Tsaidam depression. The basement occurs at great depth in the central part of the depression, the wave picture is complex, and there are no marker horizons. The area where reflected waves can be traced is small. Refracted waves are not registered for the basement; they are probably shielded by a high velocity bed in the sedimentary cover.

Working conditions are also difficult in the Tszyutsyuan' depression because of the presence of many dry gravels and because of abrupt changes in velocity in vertical and horizontal directions. Reflected and refracted waves can be recorded using grouped shots and geophones.

The extensive rice fields of the Sychuan depression necessitate use of special procedures. The reflection method is favorable here, and marker horizons are registered.

Both the reflection and refraction methods are favorable in the North China Plain. No marker horizons occur here. One of the tasks to be solved here is that of exploration of structures with beds that pinch out.— J.W.C.

188-561. Tseng, Jung-Sheng; Kan, Yung-Chü; Ho, Chuan-Da; and Lee, Pang-Nian. A study of the crystalline basement in Chai-Da-Mu basin by the low frequency refraction seismic method [in Chinese with English abstract]: Acta Geophys. Sinica, v. 9, no. 2, p. 155-168, 1960.

The field procedures, methods of interpretation of results, and the characteristics of the seismic recording instruments are described for a seismic refraction survey for mapping the depth and relief of the crystalline basement of the Chai-Da-Mu basin. The time-distance curves and their interpretation will be published in another paper.— V.S.N.

188-562. Furuya, Shigemasa, and Ninagawa, Shinji. Seismic prospecting at the Ombara district of Ningyo-toge [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 11, no. 12, p. 805-810, 1960.

Seismic refraction surveying was carried out in the Ombara district, Okayama Prefecture, to determine the applicability of the method to exploration for the uranium ore deposits distributed widely in this area. In general, the velocity distribution calculated from traveltime curves corresponds to the geologic structure known from boreholes.— V.S.N.

188-563. Chujo, Junsuke; Kondo, Nobuoki; and Kurasawa, Hajime. Marine sonic survey and land geological survey on the Shimabara Kaiwan

[in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 4, p. 247-283, 1961.

As a part of a reclamation program in the Ariake Sea and Shimabara Bay, western Kyushu, Japan, a marine sonic survey (Sparker) was made. Four sets of profiles were obtained—one from Shimabara Peninsula south to Amakusa Island, two from Shimabara Peninsula in southeast and northeast directions to the mainland, and one to the north connecting the mainland across the Ariake Sea. Geological surveys were made along the shores to aid in interpretation of the reflected waves. Results are illustrated in profiles and geologic maps. Sparker records are also reproduced.— V.S.N.

188-564. Kitsunezaki, Choro. Study on high frequency seismic prospecting (2) [in Japanese with English abstract]: Butsuri-Tanko, v. 13, no. 4, p. 185-193, 1960.

Results of the application of high-frequency seismic surveying (see Geophys. Abs. 186-561) to prospecting in the drifts of the Myoho mine, Wakayama Prefecture, Japan, are described. From a study of the velocity distribution of the P- and S-waves a high-velocity silicified zone occurring around the pyrite vein was identified. The reflections of P- and S-waves from this zone and from faults were observed.— V.S.N.

188-565. Ishida, Tamotsu. Preliminary reports on a traverse to the Yamato Mountains in 1960: Pt. IV, Preliminary report of seismic soundings along the route to the Yamato Mountains [with Japanese abstract]: Antarctic Rec., no. 13, p. 8-9, 1961.

The Yamato Mountains, a newly discovered range about 300 km southwest of Syowa Base in Antarctica, were traversed by the Japanese Antarctic Research Expedition in 1959-61. Studies included a seismic reflection survey carried out along a 270 km traverse from the mountains toward the base with soundings at 10 km intervals. Ice thicknesses range from about 400 to 2,000 m and cover rough terrain that includes 3 deep valleys.— V.S.N.

188-566. Thiel, Edward, and Ostenso, Ned A. Seismic studies on Antarctic ice shelves: Geophysics, v. 26, no. 6, p. 706-715, 1961.

Seismic velocity as a function of depth in the Ross ice shelf has been determined at Little America V by three methods: refraction shooting interpreted by the Herglotz-Bateman-Wiechert integral, seismic logging of a deep borehole, and Robin's formula relating P-wave velocity to density and temperature measurements made in the borehole. Results of the three methods are compared, discrepancies are discussed, and the preferred P and S velocity-depth profiles are obtained. A complete determination of the elastic properties of the ice shelf is possible from the profiles and from the borehole density measurements.

Small velocity differences obtained at depth by the refraction shooting and borehole logging can be explained by the effects of crystal orientation. A new determination of the variation of seismic velocity in ice as a function of temperature is made on the basis of recent experimental work.— D.B.V.

STRENGTH AND PLASTICITY

188-567. Thomas, Tracy Y. Plastic flow and fracture in solids: New York Academic Press, 267 p., 1961.

An account of plastic flow and fracture in solids is given that is suitable for students of applied mathematics and engineering at the graduate level. In chapter 1 the tensor invariants of the continuous medium are discussed, and the fundamental equations of continuity and motion and the general dynamical

conditions for discontinuity in density, velocity, and stress over a surface are derived. In chapter 2 the theory of geometrical and kinematical conditions of compatibility is developed. In chapter 3 the problem of the decay of waves in an elastic medium is treated. The various constitutive equations for a perfectly plastic solid are derived from a set of assumptions characterizing plastic deformation in chapter 4. Chapter 5 treats characteristic surfaces in perfectly plastic solids, interpretations of these surfaces as wave surfaces, and problems involving propagation from plastic into elastic regions. The problem of determination of possible surfaces of fracture in a perfectly plastic solid is discussed in the final chapter. An appendix deals with the equilibrium theory of Luders bands.— V.S.N.

188-568. Lachenbruch, Arthur H. Depth and spacing of tension cracks: Jour. Geophys. Research, v. 66, no. 12, p. 4273-4292, 1961.

Contraction cracks in basalt, permafrost, and mud, and crevasses in glaciers are geologic phenomena that might be studied by reference to a theoretical model of tension cracks in a semi-infinite solid. The effect of the crack in relieving stress at the ground surface bears on the problem of crack spacing, and the rate of energy dissipation at the advancing crack tip bears on that of crack depth. An elastic model of stress near the crack can be useful as long as cracks, once initiated, propagate rapidly. Results are presented for the elastic stress perturbation caused by a crack in an infinite or semi-infinite medium in which the initial stress is a step function or a linear function of depth. Tables and graphs are presented that can be applied directly to problems in which variation of stress with depth is arbitrary. These results, used with a modified Griffith theory of macroscopic fracture, suggest a means of predicting depth and spacing of tension cracks in terms of the stress field and measurable properties. The method is illustrated by discussion of columnar jointing and other problems of tension fracture in geology.— D.B.V.

188-569. Kanizay, S. P. Mohr's theory of strength and Prandtl's compressed cell in relation to vertical tectonics: U.S. Geol. Survey Prof. Paper 414-B, p. B-1-B-16, 1962.

Mohr's theory of strength, given in functional form, is particularized graphically to show that failure under tension occurs along planes oriented at right angles to the largest principal stress and under compression along complementary orthogonal slip planes, whose orientation range from 30° to 45° with the largest principal stress. A correlation is proposed to exist between mean stress, as measured along the axis of a modified Mohr yield envelope, and depth in the earth's crust that leads to a functional relationship in which mean stress increases with depth. As mean stress increases, deformation is characterized by less brittle and more plastic behavior. In a rising geologic mass a structural unit that exhibits brittle deformation is assumed to have undergone deformation nearer to the surface than one that exhibits plastic deformation; moreover, assuming equal rates of upward motion, brittle type deformation is younger than plastic type.

Prandtl's solution for a compressed cell is used as an example of perfectly plastic deformation in which the angle of internal friction is zero, and Hartmann's solution is used for the case where there is internal friction. Hence, plastic solutions exist under Mohr's theory which hold throughout the compressive domain of the yield envelope. Prandtl's solution is used to define active and passive cells of deformation which together with wedge variations may simulate structural units.— V.S.N.

188-570. Osterwald, Frank W. Deformation and stress distribution around coal mine workings in Sunnyside No. 1 mine, Utah, in Geological Survey Research 1961: U.S. Geol. Survey Prof. Paper 424-C, p. C-349-C-353, 1961.

Deformation features around mine workings in the Sunnyside No. 1 coal mine indicate that compressional deformation resulting from lateral stress components is greater than deformation from vertical stress (load). The lateral stress is high and has an asymmetric distribution. Study of small deformational features in mines reveals the types of deformation present and makes possible effective design of mine layouts and artificial supports. The various deformation features in this mine are discussed and illustrated.— V.S.N.

188-571. Reynolds, Tom D., and Gloyna, Earnest F. Creep measurements in salt mines, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull., no. 76, p. 11-17, 1961.

The background theory of the creep process in salt and a description of field measuring processes and results as observed in salt mines at Grand Saline, Tex., and Hutchinson, Kan., are reported (see also Geophys. Abs. 182-515). Measurements in the Grand Saline mine indicate that the creep rate decreases as the tunnel's age increases; about 95 percent of the total deformation appears to occur in the first 5 years. The total deformation of the openings is not expected to exceed 5 percent of the tunnel's height. The creep rate for salt in the Hutchinson mine is less than that in the Grand Saline mine, although overburden and room sizes are approximately the same. This is thought to be a result of the greater compressive strength of the Hutchinson salt. The increase in temperature produced by operation of a furnace pit in the older section of the Hutchinson mine demonstrates that plasticity of salt and thus creep rate increases with increasing temperature. Vertical creep rate was greater than horizontal in both the tunnel and opening of the Hutchinson mine; creep rate was approximately equal, however, in both the horizontal and vertical directions in a room. An empirical equation expressing the closure rate as a function of time is developed.— V.S.N.

188-572. Poncelet, E. G. Theoretical aspects of rock behavior under stress, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull., no. 76, p. 65-72, 1961.

The mechanics of a continuum shed little or no light on the problem of rock behavior under stress. To treat the problem of elastic deformation, semipermanent deformation, permanent deformation, and fracture detected in rocks under stress, the fundamental nature of stress and its application to rocks are examined critically. Theories are developed for fracture and flow based on atomic considerations with the common assumption that either fracture or flow starts by rupture of atomic bonds; the tensile strength is expressed as a limiting principal stress above which fracture occurs, while the yield strength is expressed as a limiting skew stress above which flow takes place.— V.S.N.

188-573. Serata, Shosei. Transition from elastic to plastic states of rocks under triaxial compression, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull., no. 76, p. 73-80, 1961.

A theory describing the mechanism of triaxial behavior of rocks in underground formations, developed for the purpose of analyzing underground stress conditions, predicts an abrupt transition from elastic to plastic states of rocks under triaxial compression. The laboratory verification of the theory is discussed and the following conclusions are reached: the static stress field in underground formations can be calculated if the octahedral shearing strength and the Poisson's ratio of the formations are known; the plastic state of underground formations is distinguished from the elastic state by a definite boundary of transition between the two; the state of stress approaches the hydrostatic condition with increasing depth beyond the transition boundary; and

the transition from plastic to elastic is caused by an abrupt change in the mechanism of yielding in underground formations.— V.S.N.

188-574. Serdengecti, S., and Boozer, G. D. The effects of strain rate and temperature on the behavior of rocks subjected to triaxial compression, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull., no. 76, p. 83-97, 1961.

The results of dynamic triaxial compression tests performed in the laboratory to determine the strength characteristics of Berea sandstone, Solenhofen limestone, and Pala gabbro subjected to controlled stress, strain rate, and temperature conditions are reported. The laboratory techniques used are discussed. The data obtained show that, for a given state of stress and temperature, the axial compressive stress required to fracture the rock specimen increases as the strain rate is increased, and the type of failure observed changes from ductile to brittle. Furthermore, within the specified ranges of temperature and strain rates it appears that for a given state of stress the effects of changing the strain rate may be obtained by merely changing the temperature of the test. A mechanical equation of state is proposed for Solenhofen limestone that predicts compressive strength for given stress, strain rate, and temperature conditions.— V.S.N.

188-575. Brace, William F. Dependence of fracture strength of rocks on grain size, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull., no. 76, p. 99-103, 1961.

The objective of this study is to see if compressive strength of rocks under atmospheric conditions is correctly predicted by the Griffith theory when it is assumed that the length of Griffith cracks are of the order of the diameter of the largest grains. According to the Griffith theory macroscopic fractures start at preexisting flaws (Griffith cracks) which enlarge and spread under the influence of applied stress. With this model the brittle strength of a material can be calculated for any system of loading if certain material constants and the shape and size of Griffith cracks are known; this is of interest in regard to behavior of rocks under engineering loads as well as in the study of the mechanics of faulting in the earth's crust. For the rocks studied so far it is concluded that length of Griffith crack is of the order of the maximum grain diameter, and, hence, Griffith cracks must lie within grains or at grain boundaries. A very tentative conclusion based on a few indirect observations suggests the likelihood of the latter for rocks at low confining pressure.— V.S.N.

188-576. Fairhurst, C. Laboratory measurement of some physical properties of rock, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull., no. 76, p. 105-118, 1961.

The methods described are those used in the rock mechanics laboratory at the School of Mines and Metallurgy, University of Minnesota, to determine the following static and dynamic physical properties of rocks: static compressive strength, static tensile strength, static and dynamic modulus of elasticity, and static and dynamic Poisson's ratio. A description of the testing methods is supplemented by comments on alternative techniques.— V.S.N.

188-577. Isaacson, E. de St. Q. Stress waves resulting from rock failure, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull., no. 76, p. 153-159, 1961.

By assuming (1) a tunnel or shaft of circular cross section in rock having a hydrostatic stress field of magnitude P units and (2) sinusoidal displace-

ment of the rock particles during the period of vibration, it is possible to estimate the magnitude of transient stresses which occur. It is shown that these stresses frequently may produce failure in an excavation in which the peripheral static stresses are subcritical. Certain aspects of design are discussed, and suggestions are made to minimize the failure under vibrationary stresses. Estimates of the energy released in a rock burst may be derived from two sources: (1) the energy of the wave train, and (2) the strain energy released at the site. The two estimates frequently indicate that a given burst is not centered at the supposed site but has occurred elsewhere. This leads to the possibility of bursts occurring in solid rock in areas not immediately adjacent to mining excavations.— V.S.N.

188-578. Wilson, A. H. A laboratory investigation of a high modulus borehole plug gage for the measurement of rock stress, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull., no. 76, p. 185-195, 1961.

An instrument is described that is suitable for measuring the change of stress in rock and that does not require a laboratory sample study or an accurate knowledge of the elasticity of the rock for accuracy of results. The experimental work carried out to prove the suitability of the instrument when used in rocks of various moduli of elasticity is described. It is concluded that a solid plug of relatively high modulus will serve as a suitable borehole plug gage for measuring change in rock stress when the modulus of elasticity of the rock is not known; however, an estimate of the rock modulus will increase the accuracy of the measurement. The experiments show that provided the plug is placed in intimate contact with the rock and allowance is made for the cross sensitivity of the gages, the experimental and theoretical values of strain in the plug are sufficiently close to permit use of the theoretical formulas when interpreting the results. Methods of obtaining an intimate contact are described.— V.S.N.

188-579. Livingston, Clifton W. The natural arch, the fracture pattern, and the sequence of failure in massive rocks surrounding an underground opening, in Fourth symposium on rock mechanics, 1961, Proc.: Pennsylvania State Univ. Mineral Industries Expt. Sta. Bull., no. 76, p. 197-204, 1961.

The principles that apply to the behavior of rock subject either to forces of nature or to forces occurring as a result of man-made excavations are stated. Fractures within a rock mass are classified as occurring during either loading or unloading, and the attitude of the fractures is related to the orientation of the principal strain axes. The shapes of natural arches produced by static loading and unloading of sandstone in nature and as a result of the dynamic loading of a circular opening in sandstone are illustrated with diagrams and photographs. The sequence in which the fractures form is described, and the orientation of the fractures is compared with the theoretical orientation of loading and unloading fractures relative to the axes of principal strain.— V.S.N.

SUBMARINE GEOLOGY

188-580. Oulianoff, Nicolas. Ripple marks croisées (rhomboïdes) et le problème général de fossilisation des rides [Crossed (rhomboid) ripple marks and the general problem of fossilication of ridges]: Acad. Sci. [Paris] Comptes Rendus, v. 254, no. 1, p. 148-150, 1962.

It is suggested that only seismic vibrations are truly capable of creating ripple marks, either simple or rhomboid, on the ocean floor and of assuring their preservation under the conditions prevailing in the deep sea.

As advocated in previous papers (see Geophys. Abs. 184-174, 185-135, -288,

-585), several other problems of the evolution of marine sediments (transport, settling, sorting, isolation of water pockets) can best be explained by the fact that the earth's crust is perpetually and universally in a state of strong vibration. Other factors such as turbidity currents and other marine currents undoubtedly play a part, but their role is local, sporadic, and accidental.— D.B.V.

188-581. Hersey, J. B. The Puerto Rico Trench, a geophysical laboratory: Oceanus, v. 8, no. 3, p. 14-21, 1962.

Geophysical work in the vicinity of the Puerto Rico Trench since 1949 is reviewed briefly. During cruises in 1960 and 1961 boulders were photographed on the north wall of the trench, and some were recovered by a dredge. Three successful hauls were made on a steep slope where it seems probable that both the 5.2 kmps and 6.5 kmps seismic layers crop out. Crystalline rock, called serpentinite, was taken at a depth of greater than 7 km and probably represents the 6.5 kmps layer. The weak links in this hypothesis are in extrapolation of seismic results to the north wall and in depth measurements of the rock samples and photographs.— V.S.N.

188-582. Heezen, Bruce C., and Ewing, Maurice. The mid-oceanic ridge and its extension through the Arctic Basin, in Geology of the Arctic, v. 1: Internat. Symposium on Arctic Geology, 1st, Calgary, Alberta, 1960, Proc., p. 622-642, 1961.

The characteristics of the great mid-oceanic ridge system are summarized, and evidence for its extension through the Arctic Basin is presented. A belt of earthquake epicenters crosses the Arctic Basin from the vicinity of the Verkhoyansk Range of Siberia to the Spitsbergen-Greenland strait, continues through the Norwegian Sea, follows the central graben across Iceland, and joins the seismic belt of the Mid-Atlantic Ridge. In the Mid-Atlantic Ridge earthquake epicenters are limited to the central rift valley, which is invariably found close to the axis of the ridge. Reinterpretations of the soundings of Fram and Sedov in the light of the mid-oceanic ridge are not unfavorable to the concept that a rifted ridge follows the long recognized earthquake belt in the Arctic Basin. The rift valleys of Africa and the central graben of Iceland suggest that extension is characteristic of this whole system of seismic belts and rifts. According to this line of reasoning, that portion of the Arctic Basin between the Lomonosov Ridge and the Eurasian continental shelf is growing wider.— V.S.N.

188-583. Eardley, A[rmand] J. History of geologic thought on the origin of the Arctic Basin, in Geology of the Arctic, v. 1: Internat. Symposium on Arctic Geology, 1st, Calgary, Alberta, 1960, Proc., p. 645-665, 1961.

Past and current theories of the origin of the Arctic Basin are reviewed. Modern seismic studies have revealed that the basin is underlain by oceanic crust and that the subsidence theory, held by many including Eardley at one time, is not tenable. The theory that the Lomonosov Ridge is a fold belt conflicts with the theory that the adjacent basin is a rift belt; the fold-belt theory may also be incompatible with an oceanic crust. Both the fold-belt and the rift-belt concepts are difficult to place compatibly in the orocline version of continental drift.— V.S.N.

188-584. Carsola, A[lfred] J., Fisher, R[obert] L., Shipek, C. J., and Shumway, George. Bathymetry of the Beaufort Sea, in Geology of the Arctic, v. 1: Internat. Symposium on Arctic Geology, 1st, Calgary, Alberta, 1960, Proc., p. 678-689, 1961.

A bathymetric chart and bathymetric profiles of the Beaufort Sea based on ice-breaker echo soundings made during 1950, 1951, and 1958 are presented. Between the Colville and Mackenzie River deltas, the continental shelf has a

width of about 40 nautical miles with a shelf edge as shallow as 35 fm; the upper slope is relatively steep. The floor of the Canada Basin near the continental slope is flat and featureless. East of Barter Island the slope character changes because of the Mackenzie River and its sea valley. Further to the east near Banks Island are the Amundsen trough and outer end of Amundsen Gulf. The trough is of glacial origin and is the westernmost unfilled trough of of the Canadian Archipelago. Photographs of the slope and deep basin show no evidence of ice-rafted pebbles.— V.S.N.

188-585. Standard, Jim C. Submarine geology of the Tasman Sea: Geol. Soc. America Bull., v. 72, no. 12, p. 1777-1788, 1961.

The physiographic features of the continental margin of east Australia, the Tasman Basin, Lord Howe Rise, and the Coral Sea Platform are described and discussed geologically. Three guyots, each having more than 14,000 feet of relief and a platform depth of less than 150 fathoms, are mapped and described.

The present continental slope of southeast Australia west of the Tasman Basin marks the maximum eastward development of the Australian continent. Lord Howe Rise is considered orogenic in origin and probably of early Paleozoic age. The Tasman Basin is a stable area underlain by permanent ocean-type crust which may have acted as a nucleus for the eastward growth of the island arcs which lie between the Tasman Basin and the South Pacific Basin.— Author's abstract

188-586. Menard, Henry W. The East Pacific Rise: Sci. American, v. 205, no. 6, p. 52-61, 1961.

This is virtually the same paper as that published previously in Science, v. 132, no. 3441, p. 1737-1746, 1960, (see Geophys. Abs. 184-587).— V.S.N.

VOLCANOLOGY

188-587. Yokoyama, Izumi. The flow and upwelling of lava (Pt. 1 and 2) [in Japanese with English abstract]: Volcanol. Soc. Japan Bull., ser. 2, v. 6, no. 2, p. 51-59, 1961.

In part 1, an attempt is made to determine the coefficient of viscosity of a lava flowing in an inclined channel of triangular section. A formula for the coefficient of viscosity is obtained by the method of dimensional analysis using experimental coefficients determined for various apex-angles of sections by experiments with flow of glycerine. The formula obtained is applied to the lava flow extruded in the 1951 Mihara eruption.

In part 2, the upwelling of lava from a central crater or linear fissure is treated as a Hagen-Poiseuille's flow. The length of the vent from the crater to the reservoir can be estimated if the rate of flow, the height of lava accumulation corresponding to the residual pressure head at the magma reservoir, the coefficient of viscosity, and the radius of the vent are known. This principle is applied to the central eruptions of Tarumai in 1909, Mihara in 1950, and Sakurazima in 1958. Results are plausible.— V.S.N.

188-588. Coombs, Howard A. Catalogue of the active volcanoes and solfatara fields of the United States of America, in Catalogue of the active volcanoes of the world, pt. IX, p. 1-58: Naples, Internat. Volcanol. Assoc., 1960.

The location, form and structure, activity, and petrography are given for 6 volcanoes in the United States with recorded eruptions (Mounts Baker, Rainier, and St. Helens in Washington, and Shasta, Cinder Cone, and Lassen Peak in California); 2 volcanoes in solfatara or fumarole stage with no known eruptions (Glass Mountain and Coso Hot Springs, California); 1 fumarole field (Steamboat Springs, Nev.); and 2 volcanoes with well-preserved volcanic forms

but with no certain activity in historic time (Craters of the Moon, Idaho, and Little Glass Mountain, Calif.). A bibliography is given for each volcanic feature.— V.S.N.

188-589. Vlodavets, V. I., and Piip [Piyp], B. I. Catalogue of the active volcanoes of the world including solfatara fields. Part VIII, Kamchatka and continental areas of Asia: Naples, Internat. Volcanol. Assoc., 110 p., 1959.

The name and location, volcanic activity, petrography, and a bibliography are given for 28 volcanoes in Kamchatka, of which 20 have had eruptions in historical time and 8 are in a solfatara stage (see also Geophys. Abs. 173-365); for 2 volcanoes in north and northeast Siberia; for 2 volcanoes in Manchuria; and for 1 volcano in Tibet.— V.S.N.

188-590. Tomkeieff, S. I. Kamchatka-Kuriles volcanoes: Science Progress, v. 49, no. 196, p. 641-650, 1961.

Studies of the Kamchatka-Kurile volcanoes based on outstanding publications in the U.S.S.R. are reviewed briefly under the following headings: individual volcanoes; chemical aspects; volcanic exhalations, thermal waters and sublimates; seismology, tectonics, and magnetism; and miscellaneous items. A list of periodicals that carry most of the publications on the Kamchatka-Kurile volcanoes and a reference list of approximately 70 items conclude the paper.— V.S.N.

188-591. Berninghausen, William H., and Van Padang, M. Neumann. Catalogue of the active volcanoes of the world including solfatara fields. Part X, Antarctica: Naples, Internat. Volcanol. Assoc., 32 p., 1960.

Essential data are given on 13 active volcanoes in Antarctica, including location, form and structure, volcanic activity, and petrography. Seven volcanoes have recorded eruptions, 3 are in a solfatara or fumarole stage, and 3 islands show solfatara or fumarole fields not belonging to a well-formed volcanic cone. Eleven of these volcanoes are located on the Scotia Arc extending from the southern extremity of South America through the South Sandwich and South Shetland Islands to Graham Land, and 2 are associated with the fault pattern of Victoria Land and the Balleny Islands. A sketch map shows the locations of the reported volcanoes.— V.S.N.

188-592. Thorarinsson, Sigurdur. Um möguleika á pvi að segja fyrir naesta Kötlugos [On the possibilities of predicting the next eruption of Katla (with English summary)]: Jökull, v. 9, p. 6-18, 1959.

Katla, one of Iceland's most active volcanoes, is hidden beneath an ice cover. Since 1580 the average length of the interval between eruptions has been 42 yr, and the largest deviation from this interval was 26 yr. Short and long intervals have alternated so that eruptions have taken place at the end of either the second or sixth decades of each century. According to this periodicity an eruption can be expected within the next few years.— J.W.C.

188-593. Ogorodov, N. V. Deystvuyushchiy vulkan v Sredinnom khrebte [An active volcano in the Sredinny Khrebet]: Priroda, no. 5, p. 113-114, 1961.

In 1956 a fumarole was discovered at an elevation of 2,950 m on the northeast flank of Ichinskaya Sopka, a volcano in the central part of the Kamchatka Peninsula. In 1957 another fumarole was found on the same flank at a slightly lower elevation. The temperature of the steam at the fumarole was 90°C, and a small quantity of atmospheric air was found in the steam. This volcano had

been considered to have been inactive since the early Quaternary. The possibility of other active volcanoes in the area is not excluded.— A.J.S.

188-594. Taneda, Sadakatu. Temperature variation of active crater—Short communication on the Naka-dake crater of the Aso Volcano: Japanese Assoc. Mineralogists, Petrologists and Econ. Geologists Jour., v. 47, no. 2, p. 57-64, 1962.

Measurements of temperature variations in the first crater of the Naka-dake crater of Aso Volcano were made by thermistors at two points during an active period from September 25 to October 20, 1958; during a period of small explosions from May 13 to July 23, 1959; and during a period beginning in January 1960. It was found that temperature changes are not related to rainfall. Explosion or increased activity takes place usually at the temperature peak period and usually occur within 6 to 12 hours following the peak of the average temperature for a six hour period or on the day after the peak of daily average temperature. The beginning of a distinct increase in temperature variation appears to indicate a possible explosion within 2-3 days. No systematic relation was found between explosions and tremors or earthquakes; however, a variation of amplitude of tremors or earthquakes takes place during the periods of temperature peak with the peak of amplitude lagging about one week behind the temperature peak.— V.S.N.

188-595. Shimozuru, D[aisuke]. Étude séismologique du volcan Nyiragongo [Seismologic study of Nyiragongo Volcano (with English abstract)]: Acad. Royale Sci. Outre-Mer [Belgium] Bull., v. 6, no. 3, p. 464-482, 1960; reprinted as Centre Natl. Volcanologie [Belgium] Pub. no. 4, 1960.

The inner crater of Nyiragongo Volcano in Kivu, Belgian Congo, was studied seismically in order to observe the vibrations related to the continuous activity of the lava lake. Of the 15 earthquakes recorded, all but one were local (originating within the rift valley) but only 5 were volcanic.

The period of volcanic tremor varied between 0.1 and 0.5 sec; the amplitude was 0.6-0.8 mu on the upper platform of the crater and up to 20 times greater near the edge of the lower platform. The source of the tremors appeared to be at the south end of the lava lake.— D.B.V.

188-596. Delsemme, A. H. Première contribution à l'étude du debit d'énergie du volcan Nyiragongo [First contribution to the study of the energy release of Nyiragongo Volcano (with English abstract)]: Acad. Royale Sci. Outre-Mer [Belgium] Bull., v. 6, no. 4, p. 699-707, 1960; reprinted as Centre Natl. Volcanologie (Belgium) Pub. No. 7, 1960.

The energy release at Nyiragongo Volcano in Kivu, Belgian Congo has been estimated. Heat radiation from lava was computed as 1.3×10^8 cal per sec and energy lost through the gas phase at 1.0×10^8 cal per sec. Over a period of 50 yr the energy released has probably amounted to 2×10^{18} cal, approximately equal to the energy calculated by Verhoogen (1948) for the 1938-40 eruption of Nyamuragira Volcano.— D.B.V.

188-597. Blot, C., and Tazieff, H[aroun]. Quelques résultats de séismologie volcanique au volcan de Tanna. Nouvelles Hébrides [Some results of volcanic seismology at the volcano on Tanna, New Hebrides]: Acad. Royale Sci. Outre-Mer [Belgium] Bull., v. 7, no. 2, p. 270-279, 1961; reprinted as Centre Natl. Volcanologie [Belgium] Pub. no. 13, 1961.

A preliminary seismic investigation was made of the volcano Yahue (Yasour) on the island of Tanna in the New Hebrides Archipelago. In the week of April

20-26, 1959, an average of 5 local volcanic shocks per hour were registered. These were of two different types: Shallow explosions in the crater gave rise to shocks of 0.5-0.8-sec period with surface wave amplitudes 5-10 times greater than P and S amplitudes, whereas true volcanic earthquakes at depths of 2-4 km produced waves of 0.2-0.4-sec period.

Microseisms of 2-sec period originated in the sea; others of 0.15-sec period were of eolian origin. Several tectonic earthquakes were also registered, but are not discussed here.— D.B.V.

188-598. Howard, Arthur D. The hydrothermal phenomena of the Yellowstone National Park, in Catalogue of the active volcanoes of the world, pt. IX, p. 59-68: Naples, Internat. Volcanol. Assoc., 1960.

The location, form and structure, volcanic activity, and petrography of the Yellowstone National Park area are discussed briefly. Present volcanic activity is entirely hydrothermal; no post-glacial flows or pyroclastics have been reported. The six hydrothermal areas—Mammoth Hot Springs, Heart Lake Basin, and Norris, Lower, Upper, and Shoshone Geyser Basins—are described.— V.S.N.

188-599. Nakamura, Hisayoshi, and Sumi, Kiyoshi. Geothermal investigations of Matsukawa hotspring area, Iwate Prefecture [in Japanese with English abstract]: Japan Geol. Survey Bull., v. 12, no. 2, p. 73-84, 1961.

The Matsukawa hotsprings area is located at the northwest foot of Mount Iwate. Quaternary Matsukawa andesites and lavas and debris from Marumori Volcano overlie Tertiary dacite and marine sediments. The springs with highest temperatures occur in the area of junction of the Matsukawa and Sumikawa Rivers, drilling here located natural steam at 169-327 m depth. The highest temperature reached in drilling was 189°C. The natural steam occurs in a Tertiary dacite tuff and is confined by the overlying compact Matsukawa andesites. It is concluded that the natural steam is a characteristic feature of the geothermal conditions of this Quaternary volcanic region.— V.S.N.

188-600. Fukutomi, Takaharu. On the possibility of volcanic hot springs of meteoric and magmatic origin and their probable life span: Hokkaido Univ. Fac. Sci. Jour., ser. 7, v. 1, no. 4, p. 224-266, 1960.

A theoretical discussion is presented on the life span of volcanic hot springs with water of magmatic origin and with water of meteoric origin, and on the possible discharge rate of heat, volume output, and temperature of these springs in comparison with observed values. The cooling of a sheet-like magma forming a shallow, horizontal intrusion in the earth's crust is treated, and the secular change of temperature of the magma and that of the temperature gradient at the surface of the earth are calculated. Applying these results to the cooling of a magma of cylindrical form (volcanic magma chamber) a rough estimate is made of the life span of the two types of volcanic hot springs. The calculated values for the heat energy transported from molten or solidified magma by ascending steam or heat conduction, for water discharge, and for water temperature are compared with those observed at hot springs in New Zealand, the United States, the West Indies, and Japan.— V.S.N.

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