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FOREWORD

This bibliography consists of 567 annotated references on asteroids, comets, meteorites, meteors, micrometeorites, noctilucent clouds, nonterrestrial dust, origin of the solar system, tektites, the zodiacal light, and related subjects. The majority of the ~~references~~ are those published in 1962 as well as those released in 1962 by ASTIA and NASA. A few ~~references~~ not listed in the original edition of this bibliography are included. The abstracts ~~contained in this bibliography~~ are primarily those written by the individual authors. If an author does not include an abstract with his paper, one is prepared by the compiler from the text of the report using the author's words; if this is impractical, a brief summary statement or table of contents is provided.

Qualified Department of Defense contractors may obtain copies of the ASTIA documents listed herein from the Armed Services Technical Information Agency, Arlington Hall Station, Arlington 12, Virginia; qualified NASA contractors may obtain documents bearing NASA numbers from the National Aeronautics and Space Administration, Office of Scientific and Technical Information (AFSS-AD), Washington 25, D.C. References bearing O.T.S. photocopy prices are also available to private scientific and industrial firms and organizations (which do not have access to ASTIA or NASA) from the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C.

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A

1. Adams, E. W.
APPLICATION OF ABLATION ANALYSIS TO STONY METEORITES AND THE TEKTITE PROBLEM, by E. W. Adams and R. M. Huffaker, Nature (London), v. 193, no. 4822, 31 Mar 62, pp. 1249-1251, 3 figs., 8 refs.

Since sufficient information is available about the initial and the final shapes of the button-type australites, their final descent can be analysed by ablation and trajectory equations, the validity for missile heat protection shields of which is well established. Details are given of the investigated tektite model, the calculation method and the results of the calculation.

2. Adams, E. W.
PARENT BODY HYPOTHESIS FOR ORIGIN OF TEKTITES, by E. W. Adams and R. M. Huffaker, Nature (London), v. 195, no. 4842, 18 Aug 62, pp. 681-684, fig., 9 refs.

Experiment and analysis indicate that button-type australites were derived by aerodynamic heating from initially cold glassy spheres which, in case of average-size specimens, entered the atmosphere in a nearly horizontal direction between 6.5 and 11.2 km/sec; the lower limit, 6.5 km/sec, is demanded by the observed mass loss, 70-90 percent of average-size buttons. Trajectory analysis shows that terrestrial origin of the spheres is impossible. Since the smallest discovered buttons, according to ablation analysis must have entered at less than 7 km/sec, extraterrestrial origin of such a cluster is impossible. The existence of limited tektite-strewn fields can be explained if tektites were released as liquid droplets from the ablating surface of a hypothetical parent body in skipping flight through the earth's atmosphere. Ablation analysis shows that this parent body must consist of a glassy substance, which cannot be generated by fusion of siliceous stone due to aerodynamic heating. Terrestrial origin of such a parent body, even when the material is not in the liquid but in the solid state, would require a violent event of such magnitude as to be very unlikely to have ever occurred.

3. Aerojet-General Corp., Azusa, Calif.
ROCKETS IN SPACE ENVIRONMENT. PHASE I. PARAMETER STUDY, by P. D. Gray, N. A. Williams, R. G. Sandoval, G. K. Cornelius, J. D. O'Donnell, and R. A. Brass, Contr. AF 04(611)-7441, Proj. 3058-03, Rept. no. 2112, Phase rept. (30 June-30 Sep 61), 27 Oct 61, ASTIA AD 275 189, (OTS $13.50), 195 pp., 57 figs., 21 tbls., 141 refs.

Continued

Design criteria for space propulsion systems are being studied by defining the space environment, determining the behavior of rocket engine materials and components in this environment, developing design criteria based on the results of these material behavior tests, and designing a piggyback space experiment to verify the conclusions and design criteria established previously. Environmental factors to be considered include: radiation (nuclear, infrared, and ultraviolet), micrometeoroids, temperature, vacuum, and zero gravity. Environmental factors constituting the space environment between 300 and 22,000 n.mi. altitude were defined. The propulsion-system materials and components most likely to be exposed to this environment were established, and available data regarding the behavior of these materials in the space environment were surveyed. Deficiencies in these data were determined, and appropriate tests were planned for obtaining data now lacking.

4. Aerojet-General Corp., Azusa, Calif.
ROCKETS IN SPACE ENVIRONMENT. PHASE II. INDIVIDUAL COMPONENT INVESTIGATION, by P. D. Gray, J. D. O'Donnell, G. K. Cornelius, R. A. Brass, and J. L. Kortenhoeven, Contr. AF 04(611)-7441, Proj's. 3058-03, 6753-01, Rept. no. 2263, Phase rept. (1 Oct 61-30 Mar 62), 11 Apr 62, ASTIA AD 278 055, (OTS $12.50), 173 pp., 69 figs., 16 tbls., 9 refs.

Components and materials having use or potential for use in space propulsion systems were tested according to plans formulated during Phase I. Test data indicated that, in many cases, materials and components now used in liquid-propellant propulsion systems would be suitable for space applications. Test data are presented and discussed, and recommendations are made for the use of particular components and materials on space missions. Included are data from tests made to simulate the effects of micrometeoroids; tests to determine the effectiveness of single and double thin plates as micrometeoroid barriers were also conducted.

5. Aerojet-General Corp., Ordnance Div., Downey, Calif.
IMPACT AND PENETRATION OF 0.100-INCH ALUMINUM PLATES BY ALUMINUM PROJECTILES AT 29,000-33,000 FEET PER SECOND, by K. N. Kreyenhagen et al., Contr. AF 04(635)-975, Proj. 5841, Jul 62, APGC-TDR-62-40, ASTIA AD 278 537, NASA 62-15938, (OTS $8.10), 83 pp., 61 figs., 3 tbls., 2 refs.

The shaped charge hypervelocity projectile accelerator is being used to study impact and penetration effects upon relatively thin targets at velocities between 29,000 and 38,000 fps. This report presents and analyzes 128 data points gathered for impacts in the 29,000 to 33,000 fps range with aluminum projectiles against 0.100-inch thick 2024-T4 aluminum target plates. Angles of obliquity between the velocity and the target surface for these experiments were 90°, 50°, and 20°. Curves, photographs, and flash radiographs illustrating the data are presented.

6. Aerojet-General Corp., Ordnance Div., Downey, Calif.
SHAPED CHARGE HYPERVELOCITY FRAGMENT PROJECTOR STUDY. DEVELOPMENT OF FRAGMENT PROJECTION AND INSTRUMENTATION TECHNIQUE, by J. L. Squier, Contr. AF 08(635)-975, Rept. no. 0377-01(15)FP, Final rept., Sep 61, APGC-TR-61-42, ASTIA AD 265 069, (OTS $10.50), 130 pp., 78 figs., 4 tbls., 20 refs.

A technique-development program was conducted with the ultimate goal of providing terminal ballistics data for hypervelocity fragments striking selected targets. Shaped-charge hypervelocity fragment projectors and instrumentation techniques were developed and tested which will permit the gathering of terminal ballistics data for fragments one grain and larger in size when they impact targets at velocities between 30,000 and 40,000 ft/sec. The fragment projectors developed were shaped charges with conical liners of small apex angle (42 degrees, 30 degrees, 25 degrees, 20 degrees). Special designs and techniques were developed for separating the points of impact of the fragments, and for limiting, eliminating, or preventing undesired fragments. Instrumentation techniques included the application of flash radiographic instrumentation providing sequential and orthogonal views of the fragments immediately prior to impact, a high-speed framing camera observing the target-impact process, and other auxiliary and supplementary equipment. The projectors and their performance, the instrumentation and its operation are described and briefly reviews the problems encountered and solutions provided during the development program. Some of the problems which remain unsolved, along with plans for their solution, are also discussed.

7. Aerojet-General Corp., Spacecraft Div., Azusa, Calif.
"Meteoroids," pp. III-49 to III-51; in RESEARCH STUDY TO DETERMINE PROPULSION REQUIREMENTS FOR SPACE MISSIONS, v. IIa, RESEARCH STUDIES (TEXT), Contr. NAS 5-915, Rept. no. 2150(Final), Dec 61, ASTIA AD 268 631, (OTS $17.00), 254 pp.

A general discussion of the meteoroid hazard in space and of methods of protection against meteoroids. No direct experimental data exist that yield the distribution of micrometeorites in interplanetary space. Values are being computed on the basis of derived orbits of visual meteors, and preliminary results indicate that the change in density between Venus and Mars will be less than 1 order of magnitude, with a peak density in the vicinity of the earth.

8. Ahrens, L. H.
POSSIBLE Zr-Hf FRACTION BETWEEN EARTH AND METEORITES, Geochim. et Cosmochim. Acta, v. 26, Oct 62, pp. 1077-1079, tbl., 15 refs.

If the data presented are tentatively accepted and if it is assumed that the Zr/Hf ratio in zircons from three basic

Continued

rocks provide a reasonably close approximation of the ratio in rock as a whole, two interesting inferences arise. First, that the Zr/Hf ratio in the crustal rocks and perhaps in the earth as a whole might differ significantly from that in chondrites and second, that the Zr/Hf coherence is in general less well developed than the K-Rb coherence.

9. Air Force. Aerospace Technical Intelligence Center, Wright-Patterson AFB, Ohio
THE APPLICATION OF ELECTRONIC COMPUTERS TO THE CONSTRUCTION OF THE THEORIES OF PLANETARY MOTIONS, by N. G. Polozova, Trans. no. MCL-890, 3 Aug 61, ASTIA AD 262 601, (OTS $6.60), 65 pp., 3 tbls., 16 refs.; trans. of Byull. Inst. Teoret. Astron., v. 7, no. 8, 1960, pp. 599-638.

The construction of the analytical theories of planetary motion of minor planets by the Hill method using electronic computers is treated. All the calculation stages are studied in detail; corresponding programming systems are set up; and first order perturbations of Ceres due to Saturn are computed on the machine Strela as an example.

10. Air Force. Aerospace Technical Intelligence Center, Wright-Patterson AFB, Ohio
MATTER BETWEEN THE EARTH AND THE SUN, by W. Krzeminski, Trans. no. MCL-1219, 28 Aug 61, ASTIA AD 266 041, (OTS $1.10), 3 pp., 2 refs.; trans. of Postepy Astron., no. 8, 1960, pp. 169-170.

Data on interplanetary gas and dust components were determined. In view of the difficulties of polarization measurements, spectroscopic methods were used. The spectrograph was attached to a Schmidt f/0.8 camera located more than 5000 m high in the Andes. The measurements showed that the electron-gas density in the neighborhood of the earth's orbit is lower than has been supposed so far and is, in fact, 150 electrons per cc. It was also found that the intensity of the zodiacal light is correlated with the eruptions on the sun.

11. Air Force. Aerospace Technical Intelligence Center, Wright-Patterson AFB, Ohio
RADIO EMISSION FROM COMETS, by O. V. Dobrovol'skiy, Trans. no. MCL-1221, 1 Sep 61, ASTIA AD 264 497, (OTS $1.60), 16 pp., tbl., 37 refs., addendum; trans. of Byull. in-ta Astrofiz. An Tadzh S.S.R., no. 26, 1958, pp. 3-11.

A current research on radio emission from comets is reviewed. Observer data are tabulated from stations in Ohio, Australia, Holland, Belgium and Germany. The radio mechanisms studied are of both equilibrium and nonequilibrium types. An extensive bibliography is included.

12. Air Force. Cambridge Research Labs., Bedford, Mass. BIBLIOGRAPHY OF LUNAR AND PLANETARY RESEARCH, 1961, by J. W. Salisbury, R. A. Van Tassel, and J. E. M. Adler, Res. instrumentation lab. proj. 8602, Res. note, Jul 62, AFCRL-62-676, ASTIA AD 285 646, (OTS $8.10), 81 pp., 364 refs.

This bibliography of lunar and planetary research published in 1961 contains a list of references both by author and by subject with each reference abstracted. The subject categories are: astrobiology, comets, exploration programs and probes, interplanetary magnetic field, meteorite craters and cratering effects, meteors and meteorites, moon, origin of the solar system, planets, and tektites.

13. Air Force. Cambridge Research Labs., Bedford, Mass. MICROMETEORITE COLLECTION FROM A RECOVERABLE SOUNDING ROCKET, Ed. by R. K. Soberman, GRD res. notes no. 71, Nov 61, AFCRL-1049, ASTIA AD 272 994, (OTS $5.60), 50 pp., 33 figs., tbl., 6 refs.; a brief summary is published in Sky and Telescope, v. 23, no. 2, Feb 62, pp. 84-85, 6 figs.; a summary is also published as STUDIES OF MICROMETEORITES OBTAINED FROM A RECOVERABLE SOUNDING ROCKET, by C. L. Hemenway and R. K. Soberman, Astron. J., v. 67, no. 5, Jun 62, pp. 256-266, 26 figs., 5 refs.

The "Venus Flytrap" micrometeorite collector rocket was fired from White Sands, New Mexico, on 6 June 1961 at 05:31 a.m. local time. Specially prepared particle impactors were exposed between the altitudes of 88 and 168 km and successfully recovered. The experimental surfaces consisted of 0.24 m^2 of 6-μ-thick Mylar foil for impact and cratering studies and 0.13 m^2 of sealed boxes which were loaded with high-purity materials and surfaces suitable for electron microscopy. Some of these materials were shadowed with aluminum before and after the flight to aid in the discrimination of micrometeorite particles from contaminants. Typical particles and size distributions are shown. Approximately 7 particles/mm^2 were collected during the flight. Most of the particles were submicron in size and generally fell into three types: high-density spheres, medium-density irregular particles, and extremely irregular medium density particles (fluffy particles). Some of the larger particles had sufficient momentum to rupture exposed films. Laboratory and nose-cone control surfaces were carefully studied to permit identification of micrometeorite particles. Preliminary results of chemical composition studies using electron-diffraction, electron-beam probe, and neutron-activation techniques are presented.

14. Air Force. Cambridge Research Labs., Bedford, Mass. RESULTS FROM AN ARTIFICIAL IRON METEOROID AT 10 KM/SEC, by R. E. McCrosky and R. K. Soberman, Photochem. lab. proj. 7667, Res. note, AFCRL-62-803, Jul 62, 19 pp., 7 figs., 3 tbls., 15 refs.

Continued

A type 304 stainless steel pellet of approximately 2.2 gm mass was propelled downward into the atmosphere from an altitude of about 190 km to produce an artificial meteor. The pellet was observed visually and photographically moving with an initial velocity of approximately 10 km/sec. The photographs were reduced by the standard precision method normally used for meteors. A value of approximately 8×10^{-19}(cgs and M_{pg}) is obtained for the luminosity coefficient τ_o of the pellet. Various corrections needed to convert this value to a luminosity coefficient valid for meteoric material are discussed.

15. Air Force. Proving Ground Command, Eglin AFB, Fla.
HYPERVELOCITY IMPACT FACILITY LIGHT-GAS PROJECTOR DEVELOPMENT, by R. B. Fendick, Proj. no. 8871V1, Rept. no. APGC TR-61-31 (Aug 60-Apr 61), Jun 61, ASTIA AD 263 373, 18 pp., 13 figs., 5 tbls., 10 refs.

The major accomplishment during this reporting period was launching a 1/8-in. diameter aluminum projectile at a velocity of 22,030 fps. Refinements were made in saboting techniques that produced clean projectile impacts on the target. Launching 1/4-in. diameter tungsten carbide projectiles was successful up to 12,800 fps and 1/4-in. diameter aluminum projectiles to 16,000 fps. Modifications to the lightweight piston (4 oz) were responsible for achieving higher velocities.

16. Air Force. Systems Command, Aeronautical Systems Div., Wright-Patterson AFB, Ohio
IMPACT STUDIES ON LUNAR DUST MODELS AT VARIOUS VACUUMS, by R. L. Greer, Master's thesis, Proj. 8119, ASD Tech. rept. 61-595, Jan 62, ASTIA AD 273 604, (OTS $7.60), 69 pp., 30 figs., 7 tbls., 33 refs., 7 appens.

An analysis of the factors relevant to lunar environmental simulation show that the dynamic behavior of lunar dust models in various vacuums must be studied to establish the degree of vacuum required of a lunar simulator. Various silicic and basaltic rock dusts were selected as lunar dust models and tested under a range of vacuums. Although crater width measurements indicate lunar dust models do not change their resistance to impact at vacuums beyond 1×10^{-3} mm Hg, depth of penetration measurements do show a continuous change in resistance up to 1×10^{-5} mm Hg, the limit of the test. The behavior of lunar dust particles depended upon both particle size distribution and particle microstructure. The effects of hold times at vacuum, container walls, dust shallowness, and the composition of the residual atmosphere on dust behavior are analyzed. Recommendations are made for follow-up studies.

17. Air Force. Systems Command, Arnold Engineering Development Center, Arnold AFS, Tenn.
DESCRIPTION OF TERMINAL BALLISTICS RANGES, by E. H. Goodman, Contr. AF 40(600)-800, Proj. 8871, Rept. no. AEDC TDR 62-104, May 62, ASTIA AD 275 362, (OTS $2.60), 23 pp., 12 figs., tbl., appen.

The AEDC Terminal Ballistics Ranges and available instrumentation systems are described. Current launcher performance, instrumentation, and data reduction techniques are presented.

18. Air Force. Systems Command, Foreign Tech. Div., Wright-Patterson AFB, Ohio
BOLIDES OBSERVED IN POLAND, by J. Pokrzywnicki, Trans. no. FTD-TT-61-223, 30 Apr 62, ASTIA AD 284 156, 61 pp., 9 figs., 117 refs.; trans. of Acta Geophys. Polon., v. 8, no. 3, 1960, pp. 224-257.

Data on bolide observations in Poland from ancient times through 1959 are presented. The survey contains over 160 numerical positions from 84 years, many of which are discussed and commented upon. The data indicate the possibility of a markedly higher number of meteoritic falls between 20h and 24h than would appear from the statistics so far published. This study represents the first statistical elaboration of bolides observed over Poland.

19. Air Force. Systems Command, Foreign Tech. Div., Wright-Patterson AFB, Ohio
IONIZED METEOR TRAIN, by V. E. Shtepan, Trans. no. FTD-TT-62-165, 20 Apr 62, ASTIA AD 281 140, 3 pp., trans. of Astron. Tsirk., no. 208, 30 Jan 60, pp. 25-26.

A general discussion of ionized meteor trains is presented and data obtained by means of binocular observations from August 1952 through September 1959 are given.

20. Air Force. Systems Command, Foreign Tech. Div., Wright-Patterson AFB, Ohio
LOOK OUT: METEOR!, by V. V. Fedynskii, Trans. no. FTD-TT-61-222, 22 Nov 61, ASTIA AD 267 709, (OTS $1.10), 2 pp.; trans. of Kazakhstan Pravda, no. 234 (11067), 4 Oct 61, p. 4.

A general discussion is presented on the meteoric hazard to space vehicles.

21. Air Force. Systems Command, Foreign Tech. Div., Wright-Patterson AFB, Ohio
THE ROLE OF SOLAR CORPUSCULAR AND PHOTON RADIATION IN THE FLASHES OF BRIGHTNESS OF COMETS, by V. I. Cherednichenko, trans. no. FTD-TT-62-179, 7 May 62, ASTIA AD 277 645, (OTS $1.60), 14 pp., 3 tbls., 18 refs.; trans. of Izvest. Glavnoy Astron. Obs. Akad. Nauk Ukrain. S.S.R., v. 3, no. 1, 1960, pp. 94-104.

Continued

The role of solar corpuscular and photon radiation with respect to the increases in brightness of comet Schwassmann-Wachmann (1925 II) is investigated.

22. Air Force. Systems Command, Foreign Tech. Div., Wright-Patterson AFB, Ohio
SAFETY OF COSMIC ROUTES, by V. Shcherbakov, Trans. no. FTD-TT-62-829, 29 Jun 62, ASTIA AD 283 899, (OTS $1.10), 6 pp.; trans. of Tekhn. Molodezhi, no. 12, 1961, pp. 12-13.

The possibility of laser micrometeorite detectors for use in a spacecraft collision avoidance system, is discussed.

23. Alekseeva, K. N.
DIELEKTRICHESKAYA POSTOYANNAYA KAMENNYKH METEORITOV, (DIELECTRIC CONSTANTS OF STONE METEORITES), by K. N. Alekseeva and K. A. Tovarenko, Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 121-123, 3 refs., (in Russian).

Dielectric constants were determined for the meteorites Elenovka, Pinto Mountains, Norton County, and terrestrial pyroxenite. The values of specific inductive capacitance obtained were 49, 14.3, 15, and 20, respectively. These values depend on the quantity and composition of metallic inclusions within these meteorites. The investigation of the dielectric susceptibility of meteorites may be instrumental in obtaining a more thorough understanding of the behavior of meteoritic matter in space.

24. Alekseeva, K. N.
METEORITNYI DOZHD PRZHIBRAM SFOTOGRAFIROVAN, 4. FIZICHESKIE SVOISTVA KAMENNOGO METEORITA PRZHIBRAM, (MULTIPLE FALL OF PŘÍBRAM METEORITES PHOTOGRAPHED, 4. PHYSICAL PROPERTIES OF THE STONE METEORITE PŘÍBRAM), Bull. Astron. Insts. Czech., v. 13, no. 5, 1962, pp. 175-176, 4 refs., (in Russian).

The following properties were measured using a 13-gm piece of Pribram meteorite: the density, the macro-, micro- and total porosity, the specific heat, the magnetic susceptibility and the elasticity coefficient.

25. Alexander, W. M.
THE MISSION OF MARINER II: PRELIMINARY OBSERVATIONS, COSMIC DUST, Science, v. 138, no. 3545, 7 Dec 62, pp. 1098-1099, 5 refs.

The objective of the cosmic dust experiment on Mariner II is to make a determination of the flux of dust particles in interplanetary space by direct measurement techniques similar to those used in recent satellite experiments. So far, 950 hours of data have been studied, and all information indicates

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that the experiment is functioning properly. During the portion of the flight represented by these data, the detector plate was approximately perpendicular to the ecliptic plane and facing in the direction of flight. Thus, it was primarily sensitive to particles in retrograde heliocentric orbits, although impacts from particles in direct heliocentric orbits with low relative collision velocities were a possibility.

During this period, one definite hit was recorded on the more sensitive momentum channel. Some of the data will be reexamined in order to check several possible hits which are classified questionable at the present time. The spacecraft has completed its scheduled 180-degree roll around the sun-probe axis. The detector plate is now primarily sensitive to particles in direct heliocentric orbits.

26. Alexander, W. M.
ROCKET, SATELLITE, AND SPACE-PROBE MEASUREMENTS OF INTERPLANETARY DUST, by W. M. Alexander, C. W. McCracken, L. Secretan, and O. E. Berg, IGY Bull., no. 61, Jul 62, pp. 7-16, 4 figs., 5 tbls.; also in Trans. Am. Geophys. Union, v. 43, no. 3, Sep 62, pp. 351-360.

Measurements obtained with the microphone system carried by the Explorer VIII satellite have provided a basis for analyzing all of the available direct measurements of interplanetary dust particles. An average cumulative-mass-distribution curve, subject to only very minor uncertainties has been established for dust particles in the vicinity of the earth. This average distribution is valid, within an order of magnitude or less, for particles with masses between 10^{-6} gm and 10^{-13} gm.

The available direct measurements of interplanetary dust are not sufficient to define either an average geocentric particle speed or an average mass density. The direct measurements encompass a range of particle masses extending well past the radiation-pressure limits for particles in heliocentric orbits with mass densities of 0.05 gm/cm^3. Mass densities of approximately 1 gm/cm^3 seem more reasonable for the direct measurements range of particle sizes.

The mass-distribution curve obtained from direct measurements differs markedly from those expected on the basis of extrapolations from meteor observations. As a consequence of this difference the accretion of interplanetary matter by the earth may be said to be dominated by small dust particles, having masses less than about 10^{-6} gm. A conservative estimate of the accretion rate on the earth is 10^4 tons per day.

27. Alfén, H.
ON THE MASS DISTRIBUTION IN THE SOLAR SYSTEM, Astrophys. J., v. 135, no. 3, Nov 62, pp. 1005-1015, 3 figs., 3 tbls., 7 refs.

The planets and satellites form groups in which the mass distribution varies. In the group of the giant planets, for

Continued

example, the innermost body (Jupiter) is the biggest one, whereas among the inner Saturnian satellites the innermost body (Mimas) is the smallest one. It is shown that the difference in mass distribution depends on the ratio between the average Kepler period τ_i of the members of the group and the period T of axial rotation of the central body.

28. Alfén, H.
ON THE ORIGIN OF THE SATELLITES AND THE PLANETS, by H. Alfén and J. M. Wilcox, Astrophys. J., v. 135, no. 3, Nov 62, pp. 1016-1022, 3 figs., tbl., 6 refs.

A previously described theory of the origin of the planets and the satellites is summarized and discussed in the light of recent developments. A theoretical assumption about the interaction of a neutral gas and a plasma in relative motion has been supported by experiment.

29. Almor, F.
METEOROS Y METEORITOS, (METEORS AND METEORITES), Aster (Barcelona), v. 14, no. 123, Oct-Nov-Dec 62, pp. 94-97, 3 figs., (in Spanish).

A general discussion of the relationship of meteors and meteorites and of the origin of the latter. Brief descriptions of the Tunguska phenomenon and Meteor Crater are included.

30. Amiruddin, A.
TUNGSTEN ABUNDANCES IN METEORITIC AND TERRESTRIAL MATERIALS, by A. Amiruddin and W. D. Ehmann, Geochim. et Cosmochim. Acta, v. 26, Oct 62, pp. 1011-1022, 7 tbls., 31 refs.

The abundances of tungsten in 17 chondrites, 6 achondrites, 5 siderites, one sample of meteoritic olivine, one sample of meteoritic troilite, 5 types of tektites, one meteoritic impact glass, 3 obsidians, 4 samples of a deep-sea sediment core, and 2 standard rocks have been determined by means of neutron activation analysis. A cosmic atomic abundance for tungsten of 0·11 ($Si = 10^6$) has been calculated on the basis of the chondrite analyses. This value is lower than the interpolated value of Suess and Urey (1956) and slightly lower than the calculated value of Clayton and Fowler (1961). It is, however, in good agreement with the calculated value of Cameron (1959) and the recent experimental measurements of Atkins and Smales (1960) on 5 chondrites. Information on the geochemical distribution of tungsten in separated meteoritic phases and certain terrestrial rocks has been obtained. Some implications of the data to theories of nucleosynthesis and meteorite formation are discussed.

31. Anania, J.
NICKEL IN MOLDAVITES, (Abstract), by J. Anania and A. J. Cohen, J. Geophys. Research, v. 67, no. 9, Aug 62, pp. 3538-3539.

The trace nickel contents of tektites from eighteen different sites in the moldavite-strewn field of Czechoslovakia range from 8 to 18 ppm and average 13 ppm. Bohemian tektites from twelve sites average 12 ppm of nickel; Moravian tektites from six sites average 14 ppm. In the specimens studied, the nickel contents generally follow the ferrous iron. The nickel contents of glasses from several localities in the Ries of Nördlingen are given. (The spectrophotometric method for nickel using α Furildioxime gives results that compare favorably with those determined by activation analyses of an indochinite from Dalat, australites, and Libyan-desert glass.) One may conclude from the low nickel contents of moldavites that little or no nickel-iron vapor dissolved in these glasses at the time they were produced by impact.

32. Anders, E.
METEORITE AGES, Revs. Modern Phys., v. 34, no. 2, Apr 62, pp. 287-325, 15 figs., 20 tbls., 237 refs.

There are five principal events in the history of meteorites that can be dated by radioactivity. Stated in somewhat oversimplified terms, they are

1. Nucleosynthesis
2. Melting of meteorite parent bodies
3. Cooling of meteorite parent bodies
4. Breakup of meteorite parent bodies
5. Fall of meteorite.

The first of these is dated by extinct radioactivity, e.g., 16.4 million years I^{129}; the second and third by long-lived radioactivity, such as 4.51×10^9 yr U^{238} and 1.3×10^9 yr K^{40}; and the fourth and fifth, by cosmic-ray-induced radioactivity, such as 12.3-yr H^3, 3.08×10^5-yr $C\ell^{36}$, and 325-yr Ar^{39}. These dating methods and results therefrom are discussed in approximately the reverse order.

33. Anders, E.
METEORITIC HYDROCARBONS AND EXTRATERRESTRIAL LIFE, Ann. N.Y. Acad. Sci., v. 93, art. 14, 29 Aug 62, pp. 650-657, 4 figs., 16 refs.; see also DISCUSSION OF THE PAPER, by B. Nagy, W. G. Meinschein, and D. J. Hennessy, pp. 658-660, 11 refs.; and RESPONSE BY THE AUTHOR, by E. Anders, pp. 661-662; also FURTHUR DISCUSSION, by B. Nagy, W. G. Meinschein, and D. J. Hennessy, pp. 663-664.

Ten specific criticisms of the work and interpretations of B. Nagy, W. G. Meinschein, and D. J. Hennessy (Ann. N.Y. Acad. Sci., v. 93, art. 2, 5 Jun 61, pp. 25-35) concerning their

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study of the hydrocarbons in the Orgueil meteorite are presented by E. Anders. Nagy, et al., reply to E. Anders criticisms to which the latter further states his viewpoints, followed by further discussion by Nagy, et al.

34. Anders, E.
SEARCH FOR ORGANIZED ELEMENTS IN CARBONACEOUS CHONDRITES, by E. Anders and F. W. Fitch, Science, v. 138, no. 3548, 28 Dec 62, pp. 1392-1399, 7 figs., 25 refs.

On the basis of observations presented in this paper it would seem that the organized elements of Claus and Nagy might best be divided into two classes: particles of simple and highly-structured morphology, respectively. Particles of the first class are definitely indigenous to the meteorite, although their numbers seem to have been over-estimated by Nagy, et al. The case for a biological origin rests entirely on their featureless morphology. It would seem that further, independent criteria must be developed before a biological origin of these particles can be safely postulated.

The particles of the second class pose a problem exactly opposite to that posed by the first class: although it is almost certain that they are of biological origin, it is very unlikely, in the majority of cases, that they are indigenous to the meteorite.

The problem of organized elements merits further investigation. However, the problem is a much more difficult one than has been implied in previous publications.

35. Anders, E.
TWO METEORITES OF UNUSUALLY SHORT COSMIC-RAY EXPOSURE AGE, Science, v. 138, no. 3538, 19 Oct 62, pp. 431-433, 2 figs., 18 refs.

The chondrites Cold Bokkeveld and Farmington seem to have reached the earth less than 200,000 years after they left their parent body. Either these meteorites came from the moon, or, more probably, the collision life times of interplanetary objects are much shorter than has been assumed heretofore.

36. Anderson, F.
RADIO TECHNIQUES OF METEOR OBSERVING, Monthly Notes Astron. Soc. Southern Africa, v. 21, no. 5, 31 May 62, pp. 66-73, 2 figs.

A general discussion is presented on: (1) frequency dependence of reflections; (2) reflections by columns of ionization; (3) trail orientation; (4) wind distortion of trails; (5) meteor radiant determination; (6) meteor studies by forward propagation; (7) orbital information; and (8) the value of the radio technique.

37. Aristov, S. A.
DZHUNGARSKII (ARMANTY) METEORIT, (THE DZUNGARIA (ARMANTY) METEORITE), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 112-113, 2 figs., (in Russian).

A brief description of the Armanty octahedrite is given. The meteorite is still located where it originally fell, in Sinkiang Province, China, and is 260 cm long, 180 cm wide, and 160 cm high. Its weight is estimated at 50-60 tons. It is covered with a thin layer of oxide. The fall of such a large mass must have produced a crater of several or even several tens of meters deep. Inasmuch as the meteorite now lies on the surface of the ground, it is evident that the surrounding debris has since been blown away by the strong desert winds prevailing in the area. This indicates that the meteorite must have fallen a long time ago.

38. Armed Services Technical Information Agency, Arlington, Va.
COMETARY TAILS, A REPORT BIBLIOGRAPHY, ASTIA rept. biblio. no. 10 857, Jul 62, 13 pp., 27 refs.

An annotated bibliography of ASTIA documents covering the period from January, 1953, to July, 1962, arranged chronologically by ASTIA number.

39. Armed Services Technical Information Agency, Arlington, Va.
MICROMETEORITES, A REPORT BIBLIOGRAPHY, ASTIA rept. biblio. no. 12 246, Oct 62, 29 pp., 60 refs.

An annotated bibliography of ASTIA documents covering the period from January, 1953, to October, 1962, arranged chronologically by ASTIA document number.

40. Army. Ballistic Research Labs., Aberdeen Proving Ground, Md.
EFFECTS OF METEOROID IMPACTS ON SPACE VEHICLES, by R. J. Eichelberger and J. W. Gehring, Proj. 503-04-011, BRL rept. no. 1155, Dec 61, ASTIA AD 272 340, (OTS $4.60), 41 pp., 20 figs., tbl., 16 refs.; also presented at the A.R.S. Space Flight Report to the Nation, New York, 9-15 Oct 61, and published as A.R.S. paper 2030-61, 14 pp.; a revised version is published in A.R.S. J., v. 32, no. 10, Oct 62, pp. 1583-1591, 20 figs., 2 tbls., 21 refs.

A description is given of the fundamental characteristics of crater formation in hypervelocity impact. It encompasses both penetration into semi-infinite targets and perforation of thin sheets; in the latter case the effects behind the target resulting from the perforation are taken into account. The description is based mainly on an extensive series of fundamental experiments. The various observations are discussed in detail and synthesized into a phenomenological model of the process, which is in turn compared with theoretical treatments.

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The implications of the model with respect to meteoroid damage to space vehicles are discussed in general. Quantitative experimental results are given and quasi-empirical formulas developed, using the theory and model as a foundation. From the results, predictions can be made of the nature and extent of damage resulting from hypervelocity impact over a wide range of conditions. Specific estimates of damage by meteoroids to space vehicles are not given because of the uncertainities concerning properties of meteoroids.

41. Arpigny, C.
MÉCANISME D'ÉMISSION DU RADICAL NH_2 DANS LES COMÈTES, (THE EMISSION MECHANISM OF THE NH_2 RADICAL IN COMETS), by C. Arpigny and A. Woszczyk, Bull. Soc. Roy. Sci. Liege, v. 31, nos. 5-6, 1962, pp. 390-395, 8 refs., (in French).

Intensity irregularities among the emission lines of the triatomic radical NH_2 have been observed on high dispersion spectrograms of comet 1957d. They show that the excitation mechanism of NH_2 is fluorescence, as in the case for diatomic radicals.

42. Avco Corp., Avco Everett Research Lab., Everett, Mass.
ELECTRIC SHOCK TUBE FOR HIGH VELOCITY SIMULATION, by J. C. Camm and P. H. Rose, Contr. AF 19(604)-7458, Research rept. no. 136, Jul 62, ASTIA AD 282 729, NASA N62-14864, (OTS $6.60), 61 pp., 26 figs., 22 refs., 2 appens.

Shock tubes have been developed capable of producing a gas sample of known conditions at velocities as high as 43,000 ft/sec. The driver of these shock tubes employs a capacitor bank which discharges electrical energy into helium, heating the helium to temperatures of 10,000-20,000°K, and raising the pressure to 10,000-20,000 psi. The high pressure bursts the scribed diaphragm and the resulting shock wave propagates into the test gas. Extensive diagnostic techniques have been employed in the resulting hot gas samples. The growth of this sample has been observed optically and correlations have been achieved with theoretical calculations. The observed radiation has been compared with and can be used to extend the known radiative properties of high temperature air. Time resolved luminous pictures and spectra have also been taken to show the purity of the test gas. The speed and attenuation of the shock front have been measured. The observed operation of this shock tube has been compared to theoretical predictions, and although no precise correlation can be made, the driver gas energy transfer and losses in the shock tube boundary layer can be accounted for.

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43. Bahcall, J. N.
THE EXCLUSION PRINCIPLE AND PHOTOBETA REACTIONS IN NUCLEOGENESIS, Astrophys. J., v. 136, no. 2, Sep 62, pp. 445-452, 3 tbls., 18 refs.

The effects of the exclusion principle and photobeta reactions on the formation of heavy elements by slow-neutron capture are discussed. It is shown that a measurement of the isotopic abundance of Zr^{93} in giant stars exhibiting technetium lines would permit inferences concerning the temperature of the nuclear reacting core in which the heavy elements were produced.

44. Bainbridge, A. E.
THE TRITIUM CONTENT OF THREE STONY METEORITES AND ONE IRON METEORITE, by A. E. Bainbridge, H. E. Suess, and H. Wänke, Geochim. et Cosmochim. Acta, v. 26, Apr 62, pp. 471-474, tbl., 17 refs.

Tritium determinations for the chondrites, Bruderheim and Harleton, gave values in line with determinations of other radio isotopes. For Walters a terrestrial age of a little over one tritium half-life can be estimated. This supports the generally accepted view that its time-of-fall is identical with the observation of a spectacular fireball in the same area shortly before the find. As others have previously found, the iron, Aroos, contains an order of magnitude less tritium that is expected on theoretical grounds.

45. Baker, G.
AUSTRALITE VON WINGELLINA, WEST-AUSTRALIEN, (AUSTRALITES FROM WINGELLINA, WESTERN AUSTRALIA), Chem. Erde, v. 21, no. 1, 1961/62, pp. 118-130, 4 figs., 2 tbls., 16 refs., (in German).

A collection of australites from Wingellina, Western Australia, consists of strongly abraded and etched specimens which contrast sharply with the much better preserved examples recovered from the more temperate regions of the Australian strewnfield. Their weights, specific gravity values, shapes and sculpture patterns have been investigated, and it is noted that these can be very significantly different compared with the original properties possessed by the australites when they first landed on the earth's surface.

46. Baker, G.
A COMPLETE OVAL AUSTRALITE, Proc. Roy. Soc. Victoria, v. 74, pt. 1, 25 Apr 61, pp. 47-54, fig., pl., 7 refs.

Continued

A rare, button-like, exceptionally well-preserved australite with oval outline and a complete, perfectly developed circumferential flange, reveals excellent structures that lend strong support to the Aerodynamical Control Theory of the secondary shaping and sculpturing of primary forms of australites.

The anterior surface of the specimen has a clockwise apiral flow ridge, pronounced radial flow lines, and a dimple-like depression that represents a remnant of an internal cavity exposed and modified by front surface ablation. These phenomena testify to sculpture of the leading surface of a primary oblate spheroid of extraterrestrial glass during aerodynamically oriented flight at high speeds through the earth's atmosphere.

The posterior surface of the lens-like portion of the australite reveals primary flow swirls and occasional bubble pits whereas the posterior surface of the secondarily developed circumferential flange is generally smooth apart from a few narrow flow lines with a concentric trend.

The excellent state of preservation of the specimen indicates its short geologic history,

47. Baker, G.
EINIGE ERSCHEINUNGEN DES ÄTZVERHALTENS DER AUSTRALITE, (ETCHING OF AUSTRALITES AND SOME OF THE PHENOMENA OBSERVED), Chem. Erde, v. 21, no. 1, 1961/62, pp. 101-117, 5 figs., 2 tbls., 11 refs., (in German).

Three weathered australites of different size, shape, specific gravity and natural sculpture pattern from Wingellina, Central Australia, were etched in thirteen stages with dilute hydrofluoric acid until the smallest specimen was reduced to a microscopic speck, a process that lasted 1180 3/4 hours. Each specimen maintained its own individual sculpture pattern for the duration of the etching tests, without varying significantly from the initial sculpture pattern possessed by the weathered specimen at the time of discovery. The largest specimen dissolved nearly six times as fast as the smallest and twice as fast as the specimen of intermediate size, which in turn dissolved three times as fast as the smallest specimen. The sculpture patterns studied at various states of solution etching add confirmation to the contention that sculpture patterns of many australites etched by natural processes are reflections of their complex internal flow line structures. The etching out of australite glass is largely directionalized along the trends of the internal schlieren as they become progressively exposed at various solution levels on the specimens, while many circular and elongated pits containing smaller pits on their walls, are fundamentally etch pits developed where bundles of flow lines emerge normal or obliquely to the surface undergoing etching. Variations in specific gravity determinations made when solution levels had reached advanced stages, are manifestations of changes in chemical composition from the outer zones to the inner regions of the australites.

48. Baker, G.
THE LARGEST KNOWN AUSTRALITE AND THREE SMALLER SPECIMENS FROM WARRALAKIN, WESTERN AUSTRALIA, J. Roy. Soc. W. Australia, v. 45, pt. 1, 1962, pp. 12-17, fig., 2 pls., 6 refs.

A large oval australite core recently discovered near Warralakin, Western Australia, is incomplete because of artificial fracturing and relatively severe natural weathering but it is nevertheless the largest australite so far brought to the notice of the scientific world. Even with the fracture fragments missing, the specimen weighs 20 grams more than the heaviest australite recorded to date. It weighs 238 grams; its weight at the time of landing upon the earth's surface has been estimated at approximately 280 grams. Reconstruction of this australite reveals that about 35 percent of its original bulk was lost by ablation from aerodynamic friction during passage through the earth's atmosphere at high velocities.

Three smaller australites subsequently found in the same general area, six to nine miles south of the Warralakin-Warrachuppin railway line, are briefly described.

49. Baker, G.
A NATURALLY ETCHED AUSTRALITE FROM NAREMBEEN, WESTERN AUSTRALIA, J. Roy. Soc. W. Australia, v. 44, pt. 3, 1961, pp. 65-68, pl., 8 refs.

A large, boat-shaped australite weighing a little over 100 grams from Narembeen, Western Australia, has been naturally etched to produce abundant solution grooves on all surfaces. It is one of the very few, among some 40,000 known specimens of australites, that shows a sculpture pattern with prominent straight, circular and vermicular grooves resembling the U-shaped grooves on some specimens of billitonites and the "gouttieres" on some indochinites. The grooves and pits on all surfaces of the specimen are essentially due to solution-etching that was primarily initiated along more readily etchable bundles of schlieren in the tektite glass. The longer grooves followed schlieren more or less parallel with the surface of the specimen; the pits and the circular grooves enclosing islands, thus producing structures resembling "hôfchen" and "tischschen" on billitonites are an expression of differential solution along bundles of schlieren more or less normal to the surface of the specimen.

50. Baker, G.
VOLUMEBEZIEHUNGEN VON WOHLERHALTENEN AUSTRALIT-KNÖPFEN, -LINSEN UND-KERNEN ZU IHREN PRIMÄREN FORMEN, (VOLUME RELATIONSHIPS BETWEEN WELL PRESERVED AUSTRALITE BUTTONS, LENSES AND CORES, AND THEIR PRIMARY FORMS), Chem. Erde, v. 21, nos. 3/4, 1961/62, pp. 269-320, fig., 3 pls., 20 tbls., 8 refs., (in German).

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The volume, mass and surface curvature relationships of excellently preserved, well-developed australite buttons with attached complete flanges from Port Campbell, Victoria, have been determined and compared with the volumes and mass deduced for the primary extraterrestrial forms of tektite glass from which the buttons were derived. Before secondary modification by ablation and thin-film-melting during ultrasupersonic flight with aerodynamically stable orientation through the earth's atmosphere, the deduced primary shapes were either true spheres or nearly spherical forms having the shapes of oblate spheroids in which the polar axis was a little short of the length of the equatorial diameter. Tertiary modification by subaerial erosion has been at a minimum in the buttons, lenses and cores under consideration, hence the secondary shapes, more especially the perfect, complete buttons, generated during high speed transit through the atmosphere from the primary shapes, are truly reflected by the virtually perfect state of these objects as found on the earth's surface in parts of the Port Campbell district of the Western District of Australia.

Differences in the mass and volumes of the primary shapes compared with their secondary modifications--the buttons and their component parts (the lens-like cores and attached circumferential flanges), the separate lenses, the detached circumferential flanged, and the cores, have revealed that (a) the primary forms lost from 13 to 75 percent of their volumes by ablation from forwardly directed surfaces during aerodynamic heating, and (b) they can lose a further 5 to 35 percent of original volumes by the shedding of circumferential flanges from the equatorial regions of the secondary shape types--the flanged buttons--leaving residual cores and lenses. The flange glass represents the melt glass swept around the posterior edges of the equatorial regions of the secondary shape types, and in most forms, can be much less than the amount of glass completely lost by the processes of ablation. Loss of the flange glass was due to fracture on impact with the earth, removed during diurnal temperature changes after landing, or partly shedding during the end stages of earthward flight.

51. Ballart, J.
LOS COMETAS, (COMETS), Aster (Barcelona), v. 14, no. 123, Oct-Nov-Dec 62, pp. 89-93, 4 figs., (in Spanish).

A general description of comets, including their composition, density, and orbital behavior.

52. Baranov, V. I.
VOZRAST I EVOLYUTSIYA METEORITNOGO I ZEMNOGO VESHCHESTVA V SVETE POSLEDNIKH ISSLEDOVANII, (AGE AND EVOLUTION OF METEORITIC AND TERRESTRIAL MATTER IN THE LIGHT OF RECENT INVESTIGATIONS), by V. I. Baranov and K. G. Knorre, Meteoritika, Akad. Nauk S.S.S.R., no. 21, 1961, pp. 15-31, 2 figs., 4 tbls., 27 refs., (in Russian).

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The identity reflected in the isotopic compositions of the elements in various terrestrial and meteoritic materials indicates a similarity of conditions of nucleogenesis and an identical primary composition. The lower age limits of elements, determined from the presence of isotopes having the shortest lifespan, is $\sim(1\text{-}2) \times 10^8$ years. The upper limit of the heavy elements, determined from the isotopic composition of uranium is $\sim$6 billion years. Various methods applied to the determination of the age of terrestrial rocks yield a mean value of $\sim$ 4 billion years. The K/Ar, U/Pb, Pb/Pb, and Re/Os methods were applied to determine the age of 6 stone and 12 iron meteorites. On the basis of the results obtained, it is concluded that both terrestrial and meteoritic materials originated $\sim$4.5 billion years ago. On the basis of other published data, the radiation ages of meteorites are found to lie within the range of 2-1600 million years.

53. Barber, D.
SOME RADAR OBSERVATIONS OF METEORS AND AURORAE AT 300 AND 500 Mc/s USING A LARGE RADIO TELESCOPE - I. OBSERVATIONS OF METEORS, by D. Barber, H. K. Sutcliffe and C. D. Watkins, J. Atmospheric and Terrest. Phys., v. 24, Jul 62, pp. 585-597, 5 figs., 2 tbls., 8 refs.

The characteristics of radar echoes from meteor trails have been studied at 500 and 300 Mc/s with a high power transmitter used in conjunction with a large radio telescope. At the higher frequency the sporadic meteor rate varied between one every few hours up to about two per hour depending on the elevation of the beam, the time of year and the time of day. During the Perseid meteor shower the average rate increased to about three times the sporadic rate. At the lower frequency the sporadic rate was about twenty times that at 500 Mc/s. It is concluded that the echoes arose from meteor trails having initial linear densities in the region 10^{13}-10^{14} electrons per cm.

A class of echoes has been identified in which the specular condition for reflection is relaxed. The echoes were characterized by a symmetrical rise and fall of amplitude in time. It is believed that these echoes were obtained from short lengths of highly ionized trail moving immediately behind the larger meteors and that the amplitude variation arose from either the reradiating polar diagrams of the short trail or the main beam of the aerial.

54. Barnes, V. E.
ORIGIN OF INDOCHINITE TEKTITES, by V. E. Barnes and K. Pitakpaivan, Proc. Nat. Acad. Sci. U.S., v. 48, no. 6, Jun 62, pp. 947-955, 5 tbls., 6 refs.

A study of the internal features of the Muong Nong-type indochinites and of their chemical composition, as compared with

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the lateritic materials with which they are associated, furnishes strong evidence that they are the result of fusion of the ground before laterization. That the Muong Nong-type and normal-type tektites were formed by the same event is supported by the identical chemical composition of the two. Evidence from regional variation in nature and number of lechatelierite particles, bubbles, and "fingers" in normal-type indochinites indicates that a large area in the central part of the strewn-field was hotter than the margins, and information from bubble shapes indicates that many splash forms fell back to earth while still plastic. The evidence is against an extraterrestrial source or origin by dense body impact for the indochinite strewn-field. It could be explained, however, by the head-on impact of a diffuse object such as a comet is thought to be or by some yet unvisualized and therefore uninvestigated nuclear or electrical phenomenon.

55. Barnes, V. E.
TEKTITES, Sci. Am., v. 205, no. 5, Nov 61, pp. 58-65, 11 figs., 5 refs.; also published as ON THE ORIGIN OF TEKTITES, Gems and Minerals, no. 299, Aug 62, pp. 16-21, 17 figs.

A fully satisfactory explanation of the origin of tektites must agree with all the facts that can be established about them: their chemical composition, the peculiarities of their structure, and their distribution over the face of the earth. Recent tektite studies are reviewed with emphasis on their bearing on tektite origin.

The discovery in Thailand of large (up to 50 lbs) chunky masses of tektite glass, interspersed with tektites indicates both types of tektites were formed by the same event: the impact of an asteroid or comet. The impact produced an explosion sufficient in magnitude to form and distribute the tektites while the accompanying heat and shock wave either fused the larger masses of glass in the site in which they were found or they were hurled from the point of impact by the explosion. The Thailand deposits add additional evidence that tektites are terrestrial in origin. It is postulated that the impact responsible for the australites may have occurred somewhere in Wilkes Land (Antarctica), 3000 to 3500 miles from the periphery of the australite shower, approximately 5000 years ago.

56. Barringer, R. W.
LIST OF METEORITES IN THE COLLECTIONS OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA, List presented to the Meteoritical Soc. Ann. Meet., Nantucket, Mass., 17 Jun 61, Rev. Apr 62, 21 pp.

The collection is currently composed of 359 specimens of 124 falls, with a total weight of approximately 53,900 g

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(119 lbs). The catalogue is presented in divisions corresponding to the trays in which the meteorites are kept at the Academy. The list for each tray is arranged alphabetically by geographic locality, the meteorites themselves being alphabetically listed under each locality. Given for each meteorite are: name; serial number; date and time (if known) of fall and/or find; total weight and number of fragments of the fall; weight of the specimen in the Academy collection and whether the specimen is polished or etched. A list of meteorites now missing (as of June, 1961) from the collection is also given.

57. Beckmann, P.
THE AMPLITUDE DISTRIBUTION OF RADIO WAVES SCATTERED BY METEOR TRAILS, Bull. Astron. Insts. Czech., v. 13, no. 6, 1962, pp. 232-236, 3 figs., tbl., 9 refs.

The probability distribution of the amplitude of signals scattered from an isolated underdense meteor trail is derived theoretically and compared with experimental values. For applications in radio astronomy, a method for determining the exponent in the distribution of peak values is proposed. The distribution of the received signal amplitude in the permanent presence of a large number of weak trails and sporadic occurrence of one strong underdense trail is derived qualitatively.

58. Belenski, J. D.
"The Application of Correlation Techniques to Meteor Burst Communications," Paper presented at the 1962 Western Electronic Show and Conv., Los Angeles, Calif., 21-24 Aug 62, Wescon paper 14.4, 6 pp., 7 figs., 4 refs.; in 1962 WESCON CONVENTION RECORD, PART 7, SESSIONS ON COMMUNICATIONS, Los Angeles, Wescon, 1962, 36 pp.

A technique that provides a means for minimizing the effects of multipath propagation and external interference on communication performance has been investigated on a 550-mile meteor-burst communication link. The link incorporates matched-filter correlation principles in the modulation and detection process. Examination of the fine structure associated with a variation in received signals provided information regarding the improvement in the use of available transmission time. Results also indicate that the usual threshold levels required for bursts that do not encounter rapid variations in signal strength may be lowered substantially.

59. Belgium. Liege Univ.
DENSITY OF C_2 MOLECULES IN THE HEAD OF COMET MRKOS 1955e, by L. Houziaux, Contr. AF 61(052)-24, Rept. on Relations Between Cometary and Upper Atmospheric Physics, Tech. note no. 9, 14 Mar 61, AFCRL-615, ASTIA AD 269 914, (OTS $1.60), 14 pp., fig., 2 tbls., 11 refs.

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The energy emitted in the 1-0 band of the Swan system of C2 is derived from photoelectric observations. The intensity distribution as a function of the distance from the nucleus is used to determine the mean densities of C2 molecules for various diameters of the head. These densities vary from 2828 molecules/cc in regions close to the nucleus to 67 molecules/cc in regions located at one minute angular distance from the nucleus about 5 X 10^4 km.

60. Bell Aerosystems Co., Buffalo, N.Y.
"Micrometeoroids," pp. 181-182, 2 refs.; in RESEARCH ON ZERO-GRAVITY EXPULSION TECHNIQUES, by A. Krivetsky, W. H. Bauer, H. L. Loucks, J. Padlog, J. V. Robinson, and W. H. Watters, Contr. NASr-44, Rept. no. 7129-933003, Final rept., Mar 62, ASTIA AD 274 044, (OTS $19.75), 344 pp.

A general description is presented on the micrometeoroid environment.

61. Bengelsdorf, I. S.
THESE MAY BE TINY SAUCERS FROM SPACE, L.A. Times, Part II, Thurs. Morn., 4 Oct 62, p. 5.

A brief review of seven theories which have been proposed in attempts to account for the origin of tektites.

62. Bennett, J. C.
OBSERVATIONS OF COMET SEKI 1961f, by J. C. Bennett and S. C. Ventner, Monthly Notes Astron. Soc. Southern Africa, v. 21, nos. 1/2, 28 Feb 62, pp. 4-6.

Positions and magnitudes of Comet Seki (1961f) are given for a number of observations made during November, 1961.

63. Bernal, J. D.
COMMENTS, Nature (London), v. 193, no. 4821, 24 Mar 62, pp. 1127-1129, 8 refs.

The implications of the observation by Claus and Nagy of what appeared to be organisms in carbonaceous meteorites are extremely far-reaching, and we are faced with very serious difficulties in their interpretation. Difficulties realized by Urey (Nature (London), v. 193, no. 4821, 24 Mar 62, pp. 1119-1123) are by no means the only difficulties; other problems that arise are investigated. It is concluded that either "life" is a complex of phenomena which only follow for intrinsic necessity a very narrow range of chemical reactions, or there is only one sequence of evolution of life and the forms observed on the meteorites and on earth are genetically related. The first alternative seems inherently improbable but the second strains the imagination as to how these transfers may have been effected.

64. Beyer, M.
PHYSISCHE BEOBACHTUNGEN VON KOMETEN. XII, (PHYSICAL OBSERVATIONS OF COMETS. XII), Astron. Nach., v. 286, no. 5, Jul 62, pp. 219-240, 10 tbls., 12 refs., (in German).

The amount of comet data was recently increased by publication of results of physical observations conducted in 1958-61 by the Hamburg Observatory using a 26-cm refractor. New information was obtained on the brightness evolution of the heads and nuclei of nine comets, as well as expansion of their comae and tails. For evaluation of total brightness, procedures utilized for the past thirty years were applied, thus assuring data homogeneity. Photoelectric and photographic brightness measurements of these expanded and unevenly compressed bodies did not yield reliable results.

In the autumn of 1959, all phases of an outburst of the periodic comet Schwassmann-Wachmann I were observed, and the propagation velocity of the interplanetary medium was determined.

On April 24th, 1960, a new condensation in the tail of comet Burnham (1959k) was characterized by its strongly accelerated motion in the direction opposite to the sun. The behavior of this condensation is an enigma.

65. Black, S. D.
SETTING THE STRUCTURAL DESIGN CRITERIA FOR SPACE DEBRIS EFFECTS IN CISLUNAR AND OUTER SPACE TRAVEL, Paper presented at S.A.E. Nat. Aeronautic Meet., New York, 3-6 Apr 62, S.A.E. Paper no. 520E, 14 pp., 14 figs., 4 tbls., 75 refs.

Although much is known about the space debris environment, there are enough knowledge gaps in this area to cause concern to space vehicle designers. This paper is directed toward evaluating the limits to be set in material selection and structural design so that the existing space debris environment can be tolerated by a space vehicle. Equations depicting the present state of knowledge are presented, and interpretations of these and other data by various scientists are offered. Particle impact, pitting and erosion, and sputtering and vaporization are discussed, with equations and present-day theories presented for each section.

66. Boeing Co., Seattle, Wash.
A METHOD FOR DETERMINING SPALLATION CRITERIA IN SOLIDS, by D. V. Keller and D. M. Young, Contr. AF 29(601)-2833, Proj. 5776, Doc. no. D2-90064, Nov 61, AFSWC TDR-61-102, ASTIA AD 270 652, (OTS $3.60), 27 pp., 4 figs., 10 refs.

A combined theoretical and experimental program was started to provide information on the one--dimensional equation of state of solids under tension and on the correct criteria for

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spall. The first material studied was Lucite. Electrically exploded foils were used to accelerate thin Lucite plates to high velocity before impact with a Lucite target. Two types of these plate slaps experiments were performed. The first showed that Lucite spallation occurred instantaneously (within 10 to the -7th power sec) upon the attainment of a critical tension. The second determined the depth at which the rarefaction generated as the projectile free surface overtook the head of the shock in the target. Correlation of these experimental results with a finite-difference hydrodynamic code revealed inherent inadequacies in this type of code for treating spall phenomena. A code was therefore written which uses the method of characteristics to solve the hydrodynamic equations for the case of impact of like materials.

67. Boeing Scientific Research Labs., Geo-Astrophysics Lab., Seattle, Wash
INFRARED MAPPING OF LUNAR CRATERS DURING THE FULL MOON AND THE TOTAL ECLIPSE OF SEPTEMBER 5, 1960, by J. M. Saari and R. W. Shorthill, Contr. AF 18(600)-1824, Rept. no. D1-82-0176, Jul 62, ASTIA AD 288 263 (OTS $7.60), 73 pp., 44 figs., 10 tbls., 20 refs.

Infrared measurements were made over certain lunar crater regions during the eclipse of September 5, 1960, and the full moon. Five rayed craters were observed to cool less rapidly than their environs during the eclipse, the anomaly being greatest for Tycho and progressively less for Aristarchus, Copernicus, Proclus, and Kepler. The findings are discussed in terms of the thermal properties of the surface, including thickness of insulating layer and age of the crater. Localized variations were found during illumination, evidently attributable to variations in albedo and geometry.

68. Boston Univ., Mass.
CONTRACT FOR STUDY OF METEOR DUST CLOUDS, Contr. AF 19(604)-5733, Proj. 7667, Final rept., Oct 61, AFCRL-62-407, ASTIA AD 281 572, 6 pp., 15 refs.

After considering infrared, optical, and radio techniques, together with the satellite techniques presently employed by the Photo Chemistry Laboratory of the Geophysics Directorate, it was decided that the simplest ground based method for detecting the influx of small particles in the upper atmosphere was the method of twilight photometry. The bulk of this report is composed of an abstract of a literature survey conducted in support of this contract.

69. Boston Univ., Dept. of Physics and Astronomy, Mass.
FINAL REPORT TEKTITE PROJECT, 1959-62. A STUDY OF TEKTITES, by G. S. Hawkins, NASA Grant NsG-21-59, Res. rept. no. 14, (Astron. Contribs. Boston Univ., Ser. II, no. 17), Jun 62, NASA N62-16862, (OTS $5.60), 51 pp., 5 figs., pl., 7 tbls., 66 refs.

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A three-year research program at Boston University is described. A field survey was made in Texas, Georgia, Martha's Vineyard, and southern states along the Jackson formation. It was found that bediasites are weathering out of the Wellborn formation and that Georgia tektites may be of a similar geological age. Other outcrops of the Jackson formation seem to be devoid of tektites. The new evidence has been combined with existing data in a logic table to assess the various theories of origin of tektites. Arguments and interpretations are given on the basis of this table to show that tektites are produced as splashes of fused material from terrestrial craters formed by impact with a meteorite or asteroid.

70. Boston Univ., Dept. of Physics and Astronomy, Mass.
TEKTITE PROJECT, by S. H. Wolfson, NASA Grant NsG-21-59, Res. rept. no. 9, (Astron. Contribs. Boston Univ., Ser. II, no. 10), Aug 61, NASA N62-14407, (OTS $7.60), 22 pp., 10 figs., 2 tbls., ref.

Theories of tektite origin may be divided roughly into two categories - terrestrial, and extraterrestrial. The strongest evidence supporting a theory of extraterrestrial origin is the australite flight form whose shape suggests high speed flight through the atmosphere. A description is given of an experimental simulation of tektite entry into the atmosphere. Australite glass is found to be capable of withstanding the extremes in temperature accompanying exposure to a plasma jet. It is believed that this glass could survive high velocity entry into the earth's atmosphere. In addition, the material proves to be highly resistant to ablation and to fusion stripping. Although ablation was negligible for the conditions under which the experiment was performed, it is believed that the stable flanges and pressure ridges characteristic of australite flight forms may very well be produced by employing higher flight velocities, longer heating times, and bodies whose longitudinal cross sections have blunt shapes (such as spheres), or abrupt changes in curvature. The results of this experiment are found to be compatible with the hypothesis that australite flight forms are produced by high velocity flight through the atmosphere.

71. Brandt, J. C.
A NOTE ON THE GAS TAILS OF COMETS, Astron. J., v. 67, no. 3, Apr 62, p. 180, 9 refs.

Some problems concerning the formation of the gas tails of comets are discussed on the basis of an icy-conglomerate model with a magnetic field imbedded in the nucleus.

72. Brier, G. W.
VISUAL METEORITIC ACTIVITY AND RAINFALL SINGULARITIES, J. Atmospheric Sci., v. 19, no. 1, Jan 62, pp. 56-59, 5 figs., 2 tbls., 7 refs.

Recently published data on the average hourly rates of visual meteors for each night of the year have been compared with the average daily precipitation of a number of stations for a 50-year period. No significant relation was found between meteor showers and precipitation although there was a very slight suggestion of a maximum in precipitation around 30 days after peak meteor activity.

73. Briggs, M. H.
COMPLEX ORGANIC MICROSTRUCTURES IN THE MOKOIA METEORITE, by M. H. Briggs and G. B. Kitto, Nature (London), v. 193, no. 4821, 24 Mar 62, pp. 1126-1127, 2 figs., 11 refs.

It is concluded that the Mokoia meteorite contains complex organic micro-structures of extraterrestrial origin, a minority of which resemble unicellular organisms, but most are present as unorganized fragments. The evidence is compatible with either a biogenic or an abiogenic origin for the micro-structures. Whatever be the origin of the micro-structures, it is fairly clear that the meteorite parent body must have possessed an atmosphere and a hydrosphere, and was consequently at least of lunar size. In an asteroided orbit the surface temperature of the parent body would have been too low for any abundant hydrosphere, unless solar luminosity was significantly greater in the Pre-Cambrian.

74. Briggs, M. H.
PROPERTIES OF THE ORGANIC MICROSTRUCTURES OF SOME CARBONACEOUS CHONDRITES, Nature (London), v. 195, no. 4846, 15 Sep 62, pp. 1076-1077, 10 refs.

A report is presented on the results of an examination to determine the nature of organic microstructures in three carbonaceous chondrites (Mokoia, Murray, and Orgueil). It is concluded that the meteorite samples examined did not contain anything identifiable as "organized elements." On the other hand, all these meteorites do contain a variety of microstructures which in certain features resemble the "organized elements." However, it would seem that these microstructures are of several types: (a) various mineral grains; (b) droplets of organic solvent-soluble carbon compounds, possibly associated with elemental sulfur; and (c) organic solvent-soluble carbon compounds that perhaps could be high molecular weight hydrocarbon polymers. At present there is certainly no convincing evidence for the existence of any material within carbonaceous chondrites of extraterrestrial, biological origin.

75. Briggs, M. H.
RECENT ADVANCES IN THE INVESTIGATION OF METEORITES, Sci. Progr. (London), v. 50, 1962, pp. 376-387, 6 tbls., 55 refs.

Discussed are: (1) fundamental properties of meteorites; (2) advances in meteorite chemistry; (3) relationships of meteorites, meteors, and comets; and (4) the origin of meteorites.

76. Briggs, R. E.
STEADY-STATE SPACE DISTRIBUTION OF METEORIC PARTICLES UNDER THE OPERATION OF THE POYNTING-ROBERTSON EFFECT, Astron. J., v. 67, no. 10, Dec 62, pp. 710-723, 14 figs., 2 tbls., 20 refs.

A model is proposed for the distribution of interplanetary meteoric particles that is based upon orbital data from observed meteors and upon comparisons with zodiacal light. Orbits obtained from a random sample of photographic meteors are used to construct a distribution function for the number of meteoric particles continuously injected into the solar system. The Poynting-Robertson effect is then introduced with the result that every particle must ultimately be destroyed by a close approach to the sun. The resulting steady-state distribution of orbits is derived, and from it relative values of the space density of particles are computed at many points in the solar system. Absolute values of the space density are determined by comparison of zodiacal-light observations with the theoretical apparent brightness of the system of particles due to scattered sunlight. Brighter portions of the zodiacal light are well reproduced with either of the two scattering laws used. Both laws include a diffraction term; one law also produces a gegenschein effect. Numerical results at the earth's distance are found to be in substantial agreement with recent density estimates by Ingham. Particles in the 1 to 50μ range play the dominant role in the scattering of light. Their average albedo is 0.12, and their surfaces are somewhat smoother than that of asteroidal material.

77. Bronshten, V. A.
K VOPROSU O DVIZHENII V ATMOSFERE TUNGUSSKOGO METEORITA, (ON THE PROBLEM OF THE MOTION OF THE TUNGUSKA METEORITE THROUGH THE ATMOSPHERE), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 72-86, 5 figs., 6 tbls., 16 refs., (in Russian).

The method proposed and used by V. G. Fesenkov in the study in the Sikhote-Alin meteorite is applied in an investigation of the motion of the Tunguska meteorite. The following values were computed for the initial and final masses and velocities of the meteorite: $10^5 < m_{in} < 10^7$ tons; $2 \times 10^4 < M_{fin} < 7.5 \times 10^4$ tons; $28 < V_{in} < 40$ km/sec; $16 < V_{fin} < 30$ km/sec. Sufficient data are not available in order to establish with certainty whether the meteorite had a direct or retrograde

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motion with respect to the earth. The trajectories suggested by I. S. Astapovich (retrograde motion) and E. L. Krinov (direct motion) can both be presently regarded as possible.

78. Bronshten, V. A.
OB OBSTOYATELSTVAKH PADENIYA KAALIYÄRVSKOGO METEORITA, (CIRCUMSTANCES OF THE FALL OF THE KAALIYÄRV METEORITE), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 42-46, fig., 2 tbls., 12 refs., (in Russian).

An attempt is made to reconstruct the circumstances surrounding the fall of the main mass of the Kaalijärv iron meteorite. Formulae used by K. P. Stanyukovich, R. M. L. Baker, and L. G. Jacchia are applied. The initial mass of the meteorite is estimated at about 1000 tons. Since the ellipse of scattering of meteorite fragments is small (its major axis is only 1 km long and the minor axis is 0.5 km in length), it is assumed that the meteorite disintegrated at a low altitude (5-10 km). The final weight of the main mass is estimated at 20-80 tons and its impact velocity at 10-20 km/sec.

79. Brysk, H.
SPECULAR ECHOES FROM DENSE METEOR TRAILS, Can. J. Phys., v. 40, no. 4, Apr 62, pp. 393-401, 3 figs., 12 refs.

The scalar wave equation is solved for scattering of a normally incident wave by a cylindrical Gaussian distribution of electrons. The backscattered intensity is computed for various line densities, as a function of the radius of the Gaussian. The echo intensity for specular backscattering from meteor trails of arbitrary density is thus obtained, including its variation with time.

80. Buettner, K. K.
LUNAR SURFACE PARAMETERS (Abstract), J. Geophys. Research, v. 67, no. 9, Aug 62, pp. 3546-3547.

Infrared and radio-emission data from the moon may yield valuable knowledge on thermal and electrical surface parameters. These in turn may indicate mechanical qualities. The calculation of surface parameters is not straightforward, however. Specific heats of minerals increase with temperature as explained by Einstein and Born. According to an experiment at Boeing Airplane Company, the heat conductivity of basalt dust at 0.1 mb air-pressure rises $\propto T^{2.3}$ if T is the temperature in °K. If matter is loose or porous, the surface is ill-defined and infrared emission may come from deeper layers. Craters and rays show Bond albedos of up to 18 percent. This could indicate a surface of finely divided material that would permit a certain penetration of solar radiant heat creating subsurface layers warmer than the surface at full-moon. During

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an eclipse this would cause a delayed fall of surface temperature. This could explain Shorthill and Saari's observations which showed the warmest spot during total eclipse to be the crater Aristarchus, which has the highest albedo known. If the upper layers are heavily damaged by radiation, they may have gained some metallic properties, and estimates of electrical parameters based on data from dust or rock may therefore be in error.

81. Bunch, T. E.
PRECAMBRIAN COESITE (Abstract), by T. E. Bunch and A. J. Cohen, J. Geophys. Research, v. 67, no. 4, Apr 62, pp. 1630-1631, ref.

Coesite has been discovered in trace quantities in selected drill core material from Holleford Crater in Southeastern Ontario, Canada. A detailed description of this crater is given by C. S. Beals (Publs. Dominion Observatory (Ottawa), v. 24, no. 6, 1960, pp. 117-142) who made available the core samples used in this investigation. The crater, 1.46 miles in diameter and 100 feet deep, is in Precambrian rock. Several hundred feet of breccia lies in this bowl-shaped depression of Precambrian rock and is covered by Paleozoic sediments. Beals estimates the age of the crater to be between 5 and 6 X 10^8 years. Coesite was discovered optically in siliceous fragments of brecciated rock in core sections from hole 2, drilled 2500 feet from the center of the crater, at depths of 704 and 737 feet. The presence of coesite in material from a depth of 704 feet was confirmed by X-ray diffraction. The Holleford coesite is thus the oldest known, and its presence strengthens the earlier suggestions that the Holleford structure is a meteorite crater.

82. Burkser, E. S.
SODERZHANIE GERMANIYA V KAMENNYKH METEORITAKH, (ABUNDANCE OF GERMANIUM IN STONE METEORITES), by E. S. Burkser, K. I. Lazebnik and K. N. Alekseeva, Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 94-96, 4 tbls., 4 refs., (in Russian).

The chondrites Norton County, Krymka, Orlovka, Nikolskoe, Elenovka, Saratov, and the Yardymly iron meteorite were analyzed for their Ge and Ni content. The results obtained are presented in tabular form. Most of the Ge is contained in the magnetic fraction and varies in quantity from 32.1 to 276.5 g/ton. The dependence observed by Lovering between the abundance of Ge and Ni in iron meteorites does not exist in chondrites. The investigations conducted by Wardani as to the abundance of Ge in the meteorites Duchesne, Edmonton, Toluca, Henbury, Canyon Diablo, and Magura are presented in tabular form.

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83. California Inst. of Tech., Pasadena
NUCLEOSYNTHESIS DURING THE EARLY HISTORY OF THE SOLAR SYSTEM, by W. A. Fowler, J. L. Greenstein, and F. Hoyle, Apr 61, 143 pp., 13 tbls., 72 refs.; a condensed version is published in Am. J. Phys., v. 29, no. 7, Jul 61, pp. 393-403, tbl., 14 refs.; published in full in Geophys. J., v. 6, no. 2, Feb 62, pp. 148-220.

Abundances in terrestrial and meteoritic matter indicate that the synthesis of D^2, Li^6, Li^7, Be^9, B^{10} and B^{11} and probably C^{13} and N^{15} occurred during an intermediate stage in the early history of the solar system. In this intermediate stage, the planetary material had become largely separated, but not completely, from the hydrogen which was the main constituent of primitive solar material. Appropriate physical conditions were satisfied by solid planetesimals of dimensions from 1 to 50 meters consisting of silicates and oxides of the metals embedded in an icy matrix. The synthesis occurred through spallation and neutron reactions simultaneously induced in the outer layers of the planetesimals by the bombardment of high energy charged particles, mostly protons, accelerated in magnetic flares at the surface of the condensing sun. The total particle energy was approximately 10^{45} ergs while the average energy was close to 500 Mev per nucleon. Recent studies of the abundance of lithium in young, T Tauri stars serve as the primary astronomical evidence for this point-of-view. The observed abundances of lithium and beryllium in the surface of the sun are discussed in terms of the astronomical and nuclear considerations brought forward.

The isotope ratios $D^2/H^1 = 1.5 \times 10^{-4}$, $Li^6/Li^7 = 0.08$, and $B^{10}/B^{11} = 0.23$ are the basic data leading to the requirement that 10 percent of terrestrial -- meteoritic material was irradiated with a thermal neutron flux of 10^7 n/cm^2 - sec for an interval of 10^7 yrs. The importance of the (n,α) reactions of Li^6 and B^{10} is indicated by the relatively low abundances of these two nuclei. It is shown that the neutron flux was sufficient to produce the radioactive Pd^{107} and I^{129} necessary to account for the radiogenic Ag^{107} and Xe^{129} anomalies recently observed in meteorites. The short time interval, $\sim 5 \times 10^7$ years, required for the radioactive decays to be effective applies to the interval between the end of nucleosynthesis in the solar system and the termination of fractionation processes in the parent bodies of the meteorites. It is not necessary to postulate a short time interval between the last event of galactic nucleosynthesis and the formation of large, solid bodies in the solar nebula.

84. California Inst. of Tech., Jet Propulsion Lab., Pasadena "Cosmic Dust Detector," pp. 23-24, 2 figs., 4 refs.; in SCIENTIFIC EXPERIMENTS FOR MARINER R-1 AND R-2, Ed. by R. C. Wyckoff, Contr. NAS 7-100, Tech. rept. no. 32-315, 15 Jul 62, 33 pp.

The specific aims of the cosmic dust experiments on the Mariner R mission are: (1) to measure the flux of cosmic dust particles in interplanetary space as a function of direction, distance from the sun, and momentum with respect to the spacecraft; (2) to investigate any concentration of these interplanetary particles in streams and to determine the nature of these streams; and (3) to determine the variation of cosmic dust flux with distance from both the earth and Venus. The instrumentation of the cosmic dust experiment is briefly described.

85. California Inst. of Tech., Jet Propulsion Lab., Pasadena COSMIC RADIATION AND THE K^{40}-A^{40} "AGES" OF IRON METEORITES, by R. R. Marshall, Contr. NASw-6, Tech. rept. no. 32-147, 10 Aug 61, ASTIA AD 271 649, 12 pp., 3 figs., 3 tbls., 39 refs.; a revised version is published in Geochim. et Cosmochim. Acta, v. 26, Oct 62, pp. 981-992.

The potassium-argon data of Stoenner and Zähringer (Geochim. et Cosmochim. Acta, v. 15, nos. 1/2, Nov 58, pp. 40-50) are consistent with an age for the iron meteorites of 5.0 ± 0.5 aeons. For iron meteorites with moderate to high concentrations of He^3, the A^{40} which has been produced by nuclear spallation and the A^{40} produced by the decay of primordial K^{40} can be calculated accurately (provided that the radiation age of the meteorite is known) and their sum compared to the measured A^{40}. Cosmogenic neon and argon predominate in inclusions of troilite and schreibersite in large iron meteorites. The enhanced yield of these elements seems to be due to the interaction of cosmic rays with elements below iron in atomic mass, such as chlorine, sulfur, and phosphorus.

The K^{39}/K^{41} ratio of potassium recovered from the Canyon Diablo iron meteorite differed by less than 2% from the ratio in terrestrial potassium, but was consistent with the low radiation age of 0.145 aeon calculated by Fisher and Schaeffer, (Geochim. et Cosmochim. Acta, v. 20, no. 1, Sep 60, pp. 5-14) for this meteorite.

86. California Inst. of Tech., Jet Propulsion Lab., Pasadena DYNAMIC PENETRATION STUDIES IN CRUSHED ROCK UNDER ATMOSPHERIC AND VACUUM CONDITIONS, by D. J. Roddy, J. B. Rittenhouse, and R. F. Scott, Contr. NAS 7-100, Tech. rept. no. 32-242, 6 Apr 62, NASA N62-14085, (OTS $1.60), 6 figs., 8 tbls., 8 refs.; also presented at A.R.S. 17th Ann. Meet. and Space Flight Exposition, Los Angeles, Calif., 13-18 Nov 62, and published as A.R.S. paper 2713-62, 11 pp., 4 figs., 4 tbls., 10 refs.

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A device was constructed to study dynamic penetration in crushed rock in high-vacuum (10^{-5} mm Hg) conditions. The apparatus was designed to drop cylindrical, metal rods, pointed on one end, into cohesionless crushed rock material. Dynamic penetration was studied as a function of several particle sizes. Other factors considered were the density of packing, probe dimensions, vacuum pressure, and vacuum degassing rates. Experimental results show that the density of packing of the crushed rock particles is the dominant factor affecting the dynamic penetration. The maximum penetration occurs in air in the crushed rock with low density packing. The minimum penetration occurs in air in densely packed material. Dynamic penetration in vacuum for the low-density and high-density packing lies between the results of penetration in air for the same packing conditions. At vacuum pressures above approximately 0.1 mm Hg all penetration values approach the air penetration measurements.

87. California Inst. of Tech., Jet Propulsion Lab., Pasadena "Effects of Meteoroids," pp. 49-64, 3 figs., 53 refs., in; BEHAVIOR OF MATERIALS IN SPACE ENVIRONMENTS, by L. D. Jaffee and J. B. Rittenhouse, Contr. NASw-6, Tech. rept. no. 32-150, 1 Nov 61, 116 pp., 9 figs., 9 tbls., 330 refs., also presented at A.R.S. Space Flight Report to the Nation, New York, 9-15 Oct 61, and published as A.R.S. paper no. 2033-61, 30 pp.; also published in A.R.S. J., v. 32, no. 3, Mar 62, pp. 320-346; a summary is published as HOW MATERIALS BEHAVE IN SPACE, Mater. Design Eng., v. 56, no. 3, Sep 62, pp. 97-104, 2 figs., 5 tbls.

A discussion of the meteoroid environment is presented; erosion by meteoroids is significant only close to the earth. The probability of penetration by meteoroids falls sharply with increasing distance from the earth. Much more frequent than penetration is spalling of fragments from the inside of walls struck by meteoroids. The efficiency of walls in preventing penetration and spalling can be increased by splitting the walls into a thin front plate and a thicker main plate; quantitative bases for the design of such spaced armor are presented.

88. California Inst. of Tech., Jet Propulsion Lab., Pasadena LUNAR SEISMOLOGY, by R. L. Kovach and F. Press, Contr. NAS 7-100, Tech. rept. no. 32-328, 10 Aug 62, NASA N62-15115, (OTS $1.60), 10 pp., 5 figs., tbl., 19 refs.

A knowledge of the seismicity of the moon will provide an insight into its thermal and tectonic history. Analyses of lunar seismograms from a simple passive experiment should give an estimate of the composition of the moon and indicate its main internal structural features, such as the presence of a lunar

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crust and core. Meteor impacts will most probably be recorded by a lunar seismograph, even though the task of distinguishing such impacts from natural moonquakes may prove to be difficult. A single-axis seismometer will be carried aboard Ranger 5, and the data from any lunar seismic disturbances will be telemetered to earth for subsequent analyses. More sophisticated active seismic experiments can contribute important information on the regional and local variations in the internal structure of the moon and should rank high in priority for future lunar missions.

89. California Inst. of Tech., Jet Propulsion Lab., Pasadena
MASS SPECTROMETRIC STUDY OF THE LEAD IN CARBONACEOUS CHONDRITES, by R. R. Marshall, Contr. NAS 7-100, Tech. rept. no. 32-216, 19 Mar 62, 15 pp., 2 figs., 6 tbls., 39 refs.; also in J. Geophys. Research, v. 67, no. 5, May 62, pp. 2005-2015, 31 refs.

Measurements of the isotopic ratios of lead from the Indarch, Murray, Mokoia, and Orgueil carbonaceous chondrites show that their leads differ only slightly from the primordial type of lead which Patterson found in the Canyon Diablo iron meteorite. Formal calculation of the lead-lead ages of Murray and Mokoia yields 4.7 and 4.6 X 10^9 years, respectively. Empirical justification for these lead-lead ages comes from the agreement of similarly calculated ages for ordinary chondrites with those obtained by completely independent methods. There seems to be an additional small component of the radiogenic lead isotopes. The amount of this excess is comparable to that which has been observed in the Holbrook chondrite. Indarch contains an excess of Pb^{207}. Either this meteorite is older (about 5.1 X 10^9 years), or (more likely) some variations in isotopic composition were present at the beginning of the solar system. Carbonaceous chondrites seem to have originated from chondritic material by the addition of certain elements and the loss of others. They acquired of the order of 1 to 4 ppm of primordial lead of the Canyon Diablo type.

90. California Inst. of Tech., Jet Propulsion Lab., Pasadena
"Meteorite Research," by A. A. Loomis, pp. 24-30, 7 figs., 5 tbls., 13 refs.; in SPACE PROGRAMS SUMMARY NO. 37-15, VOLUME IV, (Supporting Research and Advanced Development), Contr. NAS 7-100, (1 Apr-1 Jun 62), 30 Jun 62, 178 pp.; also in SPACE PROGRAMS SUMMARY NO. 37-15, VOLUME VI, (Space Exploration Programs and Space Sciences), Contr. NAS 7-100, (1 Mar-1 Jun 62), 30 Jun 62, pp. 83-89, 10 refs.

Chondritic material is nearly always equated with the bulk composition of the earth and moon although the iron partition problem remains unsolved. The use of a chondrite model for the earth and moon has been made mostly because chondrites

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constitute three-fourths of all meteorite falls. The abundances of radioactive elements in chondrites are used to compute thermal models for the moon, even though such a high rate of heat production suggests considerable melting at the present time.

Chondrites contain plagioclase which is more sodic than that of the average of the achondrites, and, considering free iron as FeO originally, contain more iron-rich normative ferromagnesian minerals. They also contain a higher percentage of alkalies and, therefore, probably radioactive elements as well. Chondrites could well be truly volcanic rocks (as has been suggested from textural evidence since the 19th century) formed by partial melting of material with the composition of the achondrite average.

If most meteorites as we see them (compact rocks commonly of the size of a foot or so in diameter) were thrown from the surfaces of bodies during impact of smaller bodies it is expected that many more pieces of near-surface rocks (volcanic chondrites?) and progressively few Ca-rich and Ca-poor achondrites, would be found, which is the observed relation.

If chondrites can be shown not to represent primordial material, present thermal and compositional models for the earth and moon will have to be revised. Experimental melting work is underway.

91. California Inst. of Tech., Jet Propulsion Lab., Pasadena
"Some Physical Features of the Odessa Iron Meteorite," by R. R. Marshall, pp. 13-18, 6 figs., 4 refs.; in SPACE PROGRAMS SUMMARY NO. 37-17, VOLUME IV, (Supporting Research and Advanced Development), Contr. NAS 7-100, (1 Aug 62-1 Oct 62), 30 Oct 62, 207 pp.

The inclusions in the Odessa iron meteorite are more complex than was originally suspected. This complexity adds weight to the concept that the distribution of the mineral phases throughout the meteorite is in some way related to variations in the isotopic composition of lead. Schreibersite seems considerably dispersed in the iron phase and may contain most of the bismuth (and perhaps most of the lead in this portion of the meteorite).

The marked assymetrical distribution of mineral phases in Odessa should be further investigated for clues to gravitational fields possibly present during solidification of the minerals.

The use of oblique illumination in photography promises to be very useful in delineating cohenite from co-existing schreibersite.

92. Calif. Inst. of Tech., Jet Propulsion Lab., Pasadena
THE SPACE ENVIRONMENT (Addendum No. 1), by M. Neugebauer, Contr. NASw-6, Tech. release no. 34-229, 28 Jul 62, 7 pp., 39 refs.

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This Addendum represents an effort to list and briefly summarize publications of any major advances made in our state of knowledge during the 18 months since the publication of JPL Technical Release No. 34-229, THE SPACE ENVIRONMENT. Included are: (1) energetic charged particles; (2) interplanetary magnetic field; (3) electromagnetic radiation; (4) dust particles; and (5) summaries of interplanetary environment.

93. Cameron, A. G. W.
FORMATION OF THE SOLAR SYSTEM, Paper presented at 8th Ann. Nat. A.A.S. Meet., Washington, D.C., 16-18 Jan 62, A.A.S. preprint 62-4, 22 pp., 5 figs.; the analyses and results summarized in this paper are published in detail as THE FORMATION OF THE SUN AND PLANETS, Icarus, v. 1, no. 1, May 62, pp. 13-69, 7 tbls., 102 refs.

The evidence concerning the presence of the products of extinct radioactivities in meteorites and in the atmosphere is reviewed and analyzed. Such radioactivities are assumed to be present in the interstellar medium when condensation to form the solar system begins. Determinations of the anomalous abundances of their product isotopes gives a measure of the time interval between the start of the condensation and the cessation of chemical fractionation in the system in which they are found.

The radioactive content of the interstellar medium depends on the history of galactic nucleosynthesis. Some mechanisms of nucleosynthesis are reviewed, and it is shown that the elements can be divided into products of primary and secondary processes. The extinct radioactivities are secondary products. A model of the stellar activity throughout galactic history is devised, and its parameters are determined by the abundances of the uranium and thorium isotopes. In this model stellar activity decreases exponentially with time, but there is a localized increase immediately prior to formation of the solar system.

The following chronology is then deduced for events associated with the early history of the solar system: If the main heat source required to melt iron in meteorite parent bodies is Al^{26} (there is some doubt about this), the time interval between the start of condensation and the formation and thermal insulation of the meteorite bodies is less than 6×10^6 years. From the anomalous silver composition in iron meteorites it is deduced that the time interval to the solidification of iron in meteorite parent bodies is 2 to 4×10^7 years. From the anomalous xenon composition of meteorites it is concluded that the time interval to the cessation of xenon diffusion in the meteorite parent body is about 1.5×10^8 years. From the anomalous xenon composition of the atmosphere it is deduced that no xenon was retained in the atmosphere until about 10^8 years after xenon diffusion ceased in the meteorite parent bodies, and that about 30% of the atmospheric xenon was once contained in the sun.

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Some physical processes probably associated with the formation of the solar system are discussed. It appears that an interstellar cloud must be fairly dense ($\sim 10^3$ hydrogen atoms/ cm^3) and fairly massive ($\sim 10^3$ M $\odot$) before it can undergo gravitational collapse. It appears likely that it will attain instability through the action of an unusually large external pressure, possibly by being surrounded by an HII region or bombarded by part of the interstellar medium accelerated by the passage of a supernova shell. The collapse and fragmentation of the cloud requires of the order of 10^6 years. The subsequent evolution of the protostars is very rapid. When the central temperature becomes 1800°K, they have probably become rotationally unstable at the equator and are on the verge of a dynamical instability associated with dissociation of hydrogen molecules and ionization of hydrogen and helium. In the collapse most or all of their mass goes into the formation of a nebular disk. The evolution and dissipation of this disk probably takes only a few million years at most. The time scale for this history appears to be consistent with the chronology deduced from the evidence of the extinct radioactivities.

94. Canada. Defence Research Board, Directorate of Scientific Information Service
"Study of Micrometeorites," p. 9; in ROCKETS, SPUTNIKS, AND THE EXPLORATION OF THE UPPER ATMOSPHERE, by B. A. Mirtov, trans. by E. R. Hope, Trans. no. T 336R, Feb 62, ASTIA AD 276 181, 10 pp., 9 figs.; trans. of Priroda, no. 10, 1961, pp. 23-31.

A note describing micrometeorite measurements made by Russian rockets and sputniks.

95. Canada. Saskatchewan Univ., Saskatoon
METEOR SIGNAL STUDIES, by P. A. Forsyth and D. W. Rice, Contr. AF 19(604)-7329, Radio Studies rept. no. RS-9, 30 Sep 61, AFCRL-921, ASTIA AD 273 021, (OTS $8.10), 80 pp., 39 figs., 17 refs.

Meteors can be used effectively as probes for investigating various aspects of the disturbed and undisturbed ionosphere. Combinations of VHF forward-scatter and back-scatter circuits were examined to assess their utility in measurements of the ambipolar diffusion coefficient by means of meteor signal decay rates. Experimental work using other circuit combinations indicates that the most useful arrangement is a forward-scatter circuit used in conjunction with a UHF radar. Observations of the decay rates of forward-scattered signals indicate the presence of the same large dispersion that was reported for back-scatter measurements. A qualitative mechanism, based upon an irregularly ionized meteor trail, appears adequate to account for the dispersion.

96. Canada. Suffield Experimental Station, Ralston, Alta.
SOME COMMENTS ON CRATERING, by G. H. S. Jones, DRB Proj. D89-16-01-05, Suffield Special publ. no. 22, Apr 62, ASTIA AD 276 943, 28 pp., fig., tbl., 41 refs.

Large scale craters are treated with emphasis placed on some aspects of the scaling problem. There is some discussion of the techniques used to investigate certain types of crater, and the uncertainty in measurement and definition is stressed. Attention is directed mainly to craters produced by conventional explosives, but the discussion is widened to include comments on nuclear craters and high velocity impacts. The research is not intended as a specialist presentation so much as a general summary for briefing workers in other fields.

97. Canada. Suffield Experimental Station, Ralston, Alta.
SURFACE BURST OF 100 TON TNT HEMISPHERICAL CHARGE, GROUND DISPLACEMENT, by G. H. S. Jones, J. Krohn, and J. M. Dewey, DRB Proj. D89-16-01-05, Tech. paper no. 250, 14 May 62, ASTIA AD 276 949, 18 pp., 5 figs., 14 tbls., 14 refs.

The measurements of permanent and transient ground displacements in the immediate vicinity of the charge are given. These include the crater dimensions, the permanent displacement of the surface surrounding the crater, and the transient displacement of the ground for a period of approximately one week after the detonation. In addition, an analysis is made of all the cratering data obtained to date at SES. It is shown that there is a significant departure of the crater diameter and depth from cube root scaling, but it is suggested that the crater volume in SES soil may vary directly as the charge mass.

98. Carleton, N. P.
THE RELATION OF THE RECENT ATMOSPHERIC DUST MEASUREMENTS OF VOLZ AND GOODY TO THE PROBLEM OF METEORIC INFLUX, J. Atmospheric Sci., v. 19, no. 5, Sep 62, pp. 424-426, 12 refs.

It is not possible to infer from existing data anything very accurate concerning the influx of small particles (about 10^{-4} gm down to the order of 10^{-11} gm) into the atmosphere, since their velocities are not known. It is the purpose of this paper to show, by considering a new experimental datum, that because these particles must be essentially in orbit about the earth, their contribution to the total mass accretion is not overwhelming and any effects of ionization or excitation are negligible.

99. Carpenter, R. J.
HIGH RESOLUTION PULSE MEASUREMENTS OF METEOR-BURST PROPAGATION AT 41 Mc/s OVER A 1295-KM PATH, by R. J. Carpenter and G. R. Ochs, J. Research Nat. Bur. Standards, D. Radio Propagation, v. 66D, no. 3, May-Jun 62, pp. 249-263, 17 figs., 9 refs.

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Studies of multipath radio signals have been made over a 1295-km path from Long Branch, Illinois to Boulder, Colorado. Three microsecond pulses with a peak power of 800 kilowatts were employed. Signals propagated via ionized meteor trails, ionospheric scatter, sporadic E and aurora were observed. Most single meteor trails show no detectable multipath. However, spreading of the received pulse over a 10 microsecond range with several components was visible occasionally. The simultaneous occurrence of several meteor signals resulted in multiple paths differing in time by as much as 500 microseconds, although shorter delays were more probable. Continuous scatter signals cover a 40 microsecond delay range. Strong E_s signals usually show no detectable pulse distortion. When weak, however, they may cover a 40 microsecond delay range.

100. Carrington, T.
FLUORESCENCE IN COMETS AS A MARKOV PROCESS, Astrophys. J., v. 135, no. 3, May 62, pp. 883-891, 3 figs., 13 refs.

A simple fluorescence mechanism for the emission of electronic spectra of diatomic radicals in comet heads is discussed. The mechanism, as proposed by Swings and elaborated by Hunaerts, involves the following factors: (1) absorption of sunlight, followed by fluorescence, tending to increase the rotational and vibrational energy of molecules in the electronic ground state, and (2) rotation vibration and pure rotation transitions, tending to decrease this energy. For a molecule with known radiative transition probabilities, in a known field of solar radiation, one can formulate probabilities of transition between any two molecular energy levels that are independent of time and of previous states occupied by the molecule. The competition between processes 1 and 2 can therefore be described as a Markov process continuous in time. The results of this treatment are contrasted with the less rigorous iterative calculations based essentially on a discrete time Markov model. In this latter case it is assumed that most molecules make the same number of absorption-emission cycles before they undergo a spontaneous pure rotation transition downward.

It is the main purpose of the paper to construct a rigorous statistical treatment of the Swings-Hunaerts model and to compare and contrast this with previous less rigorous calculations. For simplicity in this presentation, the treatment is not applied to any particular comet but is illustrated by model calculations.

101. Cech, R. E.
METALLOGRAPHY OF THE WASHINGTON COUNTY METEORITE, Geochim. et Cosmochim. Acta, v. 26, Oct 62, pp. 993-998, 10 figs., 6 refs.

Continued

Metallographic studies were carried out on the Washington County meteorite to record the macro and microstructural features of the object. The structures were interpreted by relating them to the known metallurgical behavior of alloys in the iron-nickel system. It was found that this specimen was at some time molten, was solidified rapidly and cooled over a period of hours to a temperature far below the melting point. In spite of the fact that the Washington County meteorite is the only one, to the author's knowledge, which has been interpreted as a rapidly cooled solidification structure, it does not necessarily follow that it is the only one which has undergone such a thermal history. No attempt is made to speculate on the cosmic events responsible for the temperature sojourn experienced by the meteorite.

102. Ceplecha, Z.
BAZISNYE FOTOGRAFII PADENIYA METEORITNOGO DOZHDYA PRIBRAM, (PAIRED PHOTOGRAPHS OF THE FALL OF THE BRIBRAM METEORITIC RAIN), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 178-184, 8 tbls., (in Russian).

The results of analyzing paired photographs of the Pribram multiple fall are presented. The photographs were made on a 40 km base. The atmospheric trajectory of the meteorite was computed. The altitude of the meteorite's appearance was 97.8 km and the altitude of its disappearance was 13.3 km. The slope angle of the trajectory was found to be 43°; the maximum brightness was magnitude -19. At an altitude of 47 km a bright flare occurred followed by fragmentation of the meteorite. Tracks of 17 fragments, their trajectories, and the deceleration ratio of the meteorite were measured. The extra-atmospheric velocity was found to be 20.93 km/sec. Five fragments weighing from 0.105 to 4.48 kg were recovered. One fragment weighing 420 gm was found at a distance of 12 meters from the computed trajectory of fall. The following data were obtained from the solution of motion equations of the meteorite: resistance coefficient λ was 0.068 for $V = 20$ km/sec, and 0.025 for $V = 10$ km/sec. The total mass of fragments reaching the earth's surface is estimated at ~ 100 kg; the mass of the meteorite prior to entry into the atmosphere is estimated to be of the order of 400 to 1000 kg.

103. Chakrabartty, M. M.
COMPARISON OF PROTON BOMBARDMENTS OF LIGHT ELEMENTS WITH COSMIC-RAY IRRADIATION OF STONE METEORITES (Abstract), by M. M. Chakrabartty, P. J. Cressy, P. S. Goel, J. H. Kaye, T. P. Kohman, and J. P. Shedlovsky, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3548.

The activities of cosmogenic Al^{26}, Be^{10}, C^{14}, Mn^{53}, and Ni^{59} in several stone meteorites and of several short-lived

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nuclides in the Harleton chondrite, which fell May 30, 1961, have been measured. The yields of several of these and other nuclides have been or are being measured in several light-element targets, including a mock chondrite and samples of Harleton, bombarded with protons of various energies from 0.15 to 3 bev. Comparisons of activity ratios permit limits to be given to possible variations in the cosmic-ray intensity averaged over various periods in the past.

104. Chao, E. C. T.
METALLIC SPHERULES IN TEKTITES FROM ISABELA, PHILIPPINE ISLANDS, by E. C. T. Chao, I. Adler, E. J. Dwornik, and J. Littler, Science, v. 135, no. 3498, 12 Jan 62, pp. 97-98, 2 figs., 18 refs.

Iron-nickel spherules, as much as 0.5 mm in diameter, have been found in some philippinites. The spherules consist mainly of kamacite with unidentified pink inclusions. The meteoritic origin of these spherules seems reasonable, suggesting that the tektites containing them were formed by asteroidal or meteoritic impact. It is possible that further study of the composition and mineralogy of the spherules may cast some light on the place of impact.

105. Chao, E. C. T.
THE PETROGRAPHY OF IMPACTITES AND TEKTITES WITH SPECIAL REFERENCE TO A DENSE IMPACTITE GLASS FROM THE RIES CRATER, GERMANY (Abstract), by E. C. T. Chao and J. Littler, J. Geophys. Research, v. 67, no. 9, Aug 62, pp. 3548-3549.

As has long been recognized, impactites differ petrographically from tektites. Most terrestrial impactite glasses are very heterogeneous and highly vesicular, and they contain abundant crystalline inclusions; tektites, however, are relatively homogeneous. In some fresh impactites, ferric oxide gives the glass a dark streaky appearance; in tektites, ferrous iron predominates. The occurrence of nickel-iron spherules with low nickel content in some philippinites suggests that tektites may be a special kind of impactite. Further support of this hypothesis has been gained by the recent discovery that a rare dense impactite glass from the Otting quarry of the Ries crater in southern Germany contains typical lechatelierite-like inclusions and has an identical flow structure to that of tektite. Its magnetic susceptibility, measured by F. Senftle, is 6.62×10^{-6} emu/g, similar to values of some of the indochinites and philippinites. Although this dense glass differs from tektite in that it contains crystalline fragments, its flow structure, lechatelierite-like inclusions, and magnetic susceptibility indicate that it was formed by the same basic process that produced the tektites but under somewhat different conditions. It is suggested that tektites have been formed, by

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impact, at either a higher temperature than that experienced by the Ries impactite or in an environment of low oxygen pressure.

106. Charalambus, St.
TRITIUM AND ARGON-39 IN THE BRUDERHEIM METEORITE, by St. Charalambus and K. Goebel, Geochim. et Cosmochim. Acta, v. 26, Jun 62, pp. 659-663, 2 figs., 2 tbls., 13 refs., appen.

The T and A^{39} contents of the Bruderheim stone meteorite were measured. At the time of fall the average T activity of three different samples of 0.44 count/min per g was obtained. The A^{39} was 0.01 counts/min in agreement with measurements in other laboratories. From both pairs, T-He^3 and A^{38}-A^{39}, an exposure age of 28 million years ±3 was calculated. This agrees with exposure ages obtained by other methods using Na^{22}, Al^{26} and Cl^{36}, which yielded a value of 30 X 10^6 years.

107. Cherry, R. D.
THORIUM AND URANIUM CONTENTS OF AUSTRALITES, Nature (London), v. 195, no. 4847, 22 Sep 62, pp. 1184-1186, tbl., 17 refs.

The thorium and uranium contents of six australites have been measured. The absolute values of uranium and thorium for the "mean" tektite from our group are 2.0 and 9.4 ppm respectively; the thorium/uranium ratio for the group averages out at 4.9 and is quite comparable with that obtained for common terrestrial material. A high positive correlation between the count rate C and the potassium content was found. Such a positive correlation should be taken into account by any theory which postulates tektite origin on the basis of a mixing hypothesis, such as the recently suggested hypotheses of quartz-shale and chondritic-soil mixtures. Perhaps the most striking feature of the results is the small spread in the uranium and thorium values over the six samples counted. The implications of low variance in tektite composition relative to terrestrial rocks have been discussed in detail by Lowman who concludes that it is a weighty factor against theories which suggest that tektites are produced by a mechanism which results in the fusion of terrestrial materials. Anders has pointed out that tektites might possibly have been derived from smaller areas than the six million square miles assumed in Lowman's study, and has suggested that rock analyses should be selected from a few areas for legitimate comparison with tektite variances. A desirable experiment at the present junction is proposed.

108. Clarke, R. S., Jr.
THE COMPOSITION, MORPHOLOGY, AND MINERALOGY OF THE HARLETON, TEXAS, METEORITE (Abstract), by R. S. Clarke, Jr. and E. P. Henderson, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3550.

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An 18-lb, 7-oz chondrite fell near Harleton, Texas, on May 30, 1961, at 2230 CST. It buried itself in the sandy soil about 30 inches deep, but was recovered immediately. The most significant feature noted in the minerals is the droplets of glass at the edge of some grains. These contain droplets of metallic iron and troilite, and some of the troilite contains glassy inclusions.

109. Clarke, R. S., Jr.
GEORGIA TEKTITES AND RELATED GLASSES, by R. S. Clarke, Jr. and E. P. Henderson, Georgia Mineral Newsletter, v. 14, 1961, pp. 90-114, 6 figs., 14 pls., 3 tbls., 49 refs.

The relationship between Georgia tektites and the other tektite groups is not clear. There is a relationship between Georgia tektites and the Martha's Vineyard tektite, and probably these are related to the Muldoon, Fayette Co., Texas tektites. The relationship between these Muldoon tektites and the bediasites is not settled, although Barnes has suggested that they represent two separate occurrences. The conclusion is hard to reconcile with the observations that the Georgia tektites and bediasites have approximately the same potassium-argon age, and that the Muldoon tektite has a composition very close to the Georgia tektite.

The compositional similarity of the specimens from Martha's Vineyard, Massachusetts, Empire, Georgia, and Muldoon, Texas is surprising. There is no reason to suspect that the first tektites studied from three localities, approximately equally spaced along an 1800 mile arc, should be so much alike. It is undoubtedly significant that the Martha's Vineyard tektite contains a unique zirconium containing inclusion, and a search is being made for similar inclusions in tektites from all localities.

110. Cleminshaw, C. H.
TWO GREAT SIBERIAN METEORITES, Griffith Observer, v. 26, no. 9, Sep 62, pp. 121-125, 6 figs.

A discussion of the Sikhote-Alin' multiple fall of 12 February, 1947, and the fall of the Tunguska "meteorite" (30 June 1908). The Griffith Observatory has recently received a gift of a two-pound speciman of the Sikhote-Alin' fall.

111. Cohen, A. J.
THE TERRESTRIAL ORIGIN OF LIBYAN DESERT SILICA-GLASS, Phys. Chem. Glasses, v. 2, no. 3, Jun 61, pp. 83-86, fig., tbl., 14 refs.

The gallium and germanium contents of seven Libyan Desert sands from the silica-glass area, a sample of red earth underlying this sand, and three Libyan Desert silica-glass specimens

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were determined and compared. Samples of sands, sandstone, and quartzite from other areas of the Libyan Desert are included for comparison. The average germanium contents of the seven sands are practically the same as for three specimens of the silica-glass. The average gallium content of the silica-glass is higher than that of the sand indicating some loss of silica as SiO. The red earth underlying the Libyan Desert has over four times as much gallium as the glass. As a result of the high temperature reached during melting, the silica-glass would be expected to have equal or more gallium present and equal or less germanium than the material from which it was fused. Therefore, the silica-glass could not have been formed from the red earth underlying the desert sand. It is concluded that Libyan Desert silica-glass is formed from the Libyan Desert sand and not from the Nubian sandstone.

112. Cole, D. M.
A POSSIBLE MILITARY APPLICATION OF A CIS-MARTIAN ASTEROID, Paper presented at 8th Ann. Nat. A.A.S. Meet., Washington, D.C., 16-18 Jan 62, A.A.S. preprint 62-32, 40 pp., 4 figs., 2 tbls., 46 refs.

One of the close-approach or cis-Martian asteroids could conceivably be diverted from its orbit in such a manner as to impact on a preselected earth target area. This could be done by employing a Nova-class rocket vehicle to carry a crew of men or remotely controlled devices to such an object and applying a velocity increment through explosion of hydrogen bombs on the surface. The energy release at impact on the earth would be on the order of one thousand times as great as the energy of a multimegaton bomb which could be carried by the same Nova-class vehicle on an ICBM trajectory to the same target. This unusual weapon shares with the biological weapons the possibility for masquerading as a natural catastrophe. The attacker could hope to escape blame and retribution from surviving retaliation forces. While such an irreverant meddling with cosmic forces may seem highly implausible or even impossible on superficial examination, the need for careful consideration of such a system is supported by the highly favorable energy ratio and strategic advantages which it could supply.

113. COMET HUMASON DISPLAYS UNUSUAL ACTIVITY, Sky and Telescope, v. 24, no. 3, Sep 62, pp. 124-125, 136, 4 figs.

Sudden and striking changes in appearance, often in less than a day, have been recorded during observations of comet Humason. Photographs made when the comet was 250 million miles from the sun (in the asteroid belt) show it to have been as bright as 8th magnitude. Either comet Humason must be an exceptionally large object, or it has encountered unusual solar stimulation.

114. COMET HUMASON OBSERVATIONS, Sky and Telescope, v. 24, no. 4, Oct 62, pp. 216-217, 4 figs.

Comet Humason (1961e), discovered September 1st, is still slowly approaching the hub of the solar system and will not reach perihelion until December 10, 1962. Despite its remoteness from the sun, the comet early developed a tail, and has displayed a succession of violent changes in appearance. Its behavior is so strongly marked that this is perhaps a more fragile comet than many.

115. COMET HUMASON STILL ACTIVE, Sky and Telescope, v. 24, no. 6, Dec 62, pp. 336-338, 14 figs.

Very soon after its discovery on September 1, 1961, comet Humason (1961e) was recognized as an unusual object, because it was visible at Jupiter's distance from the sun. The next peculiarity was the development of a tail, which seldom occurs for a remote comet. Furthermore, the tail varied strikingly in appearance. Comet Humason travels around the sun in a very elongated orbit, taking about 2900 years for a full revolution. Hence it will not return before perhaps A.D. 4900. The direction of motion is retrograde in a plane tilted 27 degrees to the ecliptic. Accompanying photographs of the comet extend the record of 1961e's remarkable activity.

116. COMET SEKI-LINES, Sky and Telescope, v. 23, no. 4, Apr 62, p. 211, fig.

Comet Seki-Lines (1962c) was discovered on 4 February, 1962. The orbit of the comet is noteworthy for its unusually small perihelion distance; the comet will reach a minimum distance of 2.8 million miles from the sun on 1 April.

117. COMET SEKI-LINES PICTURE ALBUM, Sky and Telescope, v. 23, no. 6, Jun 62, pp. 304-309, 19 figs.

Nineteen photographs of comet Seki-Lines (1962c) are reproduced and discussed.

118. COMET SEKI-LINES WELL OBSERVED IN APRIL EVENING SKY, Sky and Telescope, v. 23, no. 5, May 62, pp. 272-273, 2 figs.

A description of observations of comet Seki-Lines (1962c) made during April, 1962.

119. Cook, A. F.
METEOR TRAIL WIDTHS, by A. F. Cook, G. S. Hawkins, and F. M. Stienon, Astron. J., v. 67, no. 3, Apr 62, pp. 158-162, 4 figs., 3 tbls., 3 refs.

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A discussion of the measurement of the optical width of meteor trails observed during the Geminid shower of 1957. The broadening effects upon the photographic image are eliminated by a comparison of the meteor trails with trailed images of stars. The effect of a difference in focus between the meteors and the star trails was allowed for empirically from a measurement of out-of-focus star trails. The results indicate that the trail width is usually of the order of 1m, although in individual cases the width may be as much as 6 m.

120. Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
"Condensed Matter," pp. 51-61, 7 figs., tbl., 19 refs.; in EFFECTS OF OUTER-SPACE ENVIRONMENT IMPORTANT TO SIMULATION OF SPACE VEHICLES, by E. M. Hart, Contr. AF 33(616)-6858, (Rept. for 1 Nov 59-30 Sep 60), Aug 61, ASD TR 61-201, ASTIA AD 269 014, (OTS $2.50), 106 pp.

A discussion is presented on the effects of meteorites, meteors, and dust on space vehicles.

121. Cornell Univ., Center for Radiophysics and Space Research, Ithaca, N.Y.
SECOND PRELIMINARY REPORT ON EXPERIMENTS RELATING TO THE LUNAR SURFACE: 1. PHOTOMETRIC STUDIES. 2. PROTON BOMBARDMENT OF MINERALS, by B. W. Hapke, NASA Grant NsG 119-61, CRSR rept. no. 127, 1 Jul 62, NASA N62-14775, (OTS $6.60), 41 pp., 26 figs., 17 refs.

Preliminary results of two experiments relating to the nature of the lunar surface are described. These experiments are photometric studies of surfaces and proton bombardment of minerals. To scatter light in the same manner as the moon a surface must be extremely intricate. Surfaces of solid rocks, slag or coarsely-grained rock powders are not sufficiently complex. However, when the particle size of the pulverized rock decreases below about 20 microns in the laboratory these particles build extremely intricate surfaces which are capable of backscattering light strongly. An upper limit to particles which compose the outermost layers of the moon is estimated to be 50 microns with 10 microns being more probable. In order to backscatter light the particles must be nearly opaque.

The effects of proton bombardment depend on the chemical constitution of the irradiated material. Metallic Fe and Ag were reduced from Fe_2O_3 and Ag_2S respectively, while Al_2O_3, MgO and SiO_2 were largely unaffected by 10 kev protons. No welding or sintering of the mineral powders was observed.

122. Crozier, W. D.
FIVE YEARS OF CONTINUOUS COLLECTION OF BLACK, MAGNETIC SPHERULES FROM THE ATMOSPHERE, J. Geophys. Research, v. 67, no. 6, Jun 62, pp. 2543-2548, 2 figs., 9 refs.

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Rates of deposition of magnetic spherules from the atmosphere in central New Mexico are given for a 5-year period, 1956 through 1960. Both time and size distributions are shown. The average numerical rate over the period for spherules larger than 5μ in diameter was 2.8×10^3 m^{-2} sec^{-1}. The average rate of mass accretion to the earth for spherules larger than 5μ, assuming a uniform deposit, was 1.6×10^5 metric tons per year. The deposition rate drops rapidly as diameters exceed 40μ. A virtual cutoff appears at about 60μ, though a few larger spherules were seen. The rates of spherule deposition in New Mexico are within a factor of 4 of the rates deduced by Thiel and Schmidt for spherules in antarctic ice, for the range of sizes covered in their study. There appears also to be reasonable consistency between the New Mexico spherule deposition rates and the deposition rates for all micrometeorites recently calculated by McCracken, Alexander, and Dubin from rocket and satellite data, after due allowance is made for experimental uncertainties and for the uncertainties relating to the conversion of micrometeorites (including "dust balls") into spherules.

123. Currie, B. W.
THE NEED FOR CANADIAN OBSERVATIONS OF NOCTILUCENT CLOUDS,
J. Roy. Astron. Soc. Can., v. 56, no. 4, Aug 62, pp. 141-147, fig., tbl., 9 refs.

There are several possible reasons for the notable difference between Europe and North America in reported appearances of noctilucent clouds. Persons in Canada most likely to observe the clouds may not be acquainted with their appearance and the rather special circumstances under which they are observed, assuming that they are the ordinary twilight clouds or even confusing them with faint auroral glows. A remarkable regional difference may actually exist. If this should prove to be the case, meteorological factors must play an important part in the formation of the clouds. These might include the transfer of the cloud material upward in the atmosphere, or turbulence at the cloud levels which would help to make them visible, or a combination of both. The form and color of noctilucent clouds, geometrical conditions for viewing, and observing techniques are discussed.

124. Cuttitta, F.
NEW CHEMICAL DATA ON TEXAS TEKTITES, 1, MAJOR ELEMENTS (Abstract), by F. Cuttitta, M. K. Carron and E. C. T. Chao,
J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3552.

The major chemical constituents of 21 carefully selected Texas tektites, known as bediasites, have been determined by a monitored system of high-precision method. These new data indicate that the silica content of bediasites has limits of

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variation ranging approximately from 71 to 81 percent. Alumina, ferrous iron, and titania of bediasites increase with increasing index of refraction and decreasing silica content. Compared with most other tektites, bediasites are characterized by low time and magnesia. Bediasites of high silica content, which are often greenish in color, are similar in composition to the Georgia tektites and the Martha's Vineyard tektite. The chemical evidence does not suggest that more than one shower of tektites fell in Texas. Bediasites may be compared with terrestrial rocks by recalculating the chemical analyses on a water-free basis with respect to a standard rock cell containing 160 oxygen atoms; differences in compositions can then be expressed in terms of "gain" and "loss" necessary to transform a given rock into tektite. Bediasites are more like rhyolitic igneous rocks than graywacke sandstones. They could have been derived from rhyolitic igneous rocks if alkalies were lost during fusion.

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125. Davies, J. G.
THE FORMATION OF THE GIACOBINID METEOR STREAM, by J. G. Davies and W. Turski, Monthly Notices Roy. Astron. Soc., v. 123, no. 5, 1962, pp. 459-470, 5 figs., 3 tbls., 9 refs.

The motion of particles moving in orbits close to that of comet Giacobini-Zinner has been investigated, using a digital computer to integrate the equations of motion. It is shown that the great showers of 1933 and 1946 are compatible with the ejection of particles from the comet in 1894, with velocities of ejection less than 10 meters per second.

126. Davison, E. H.
DIRECT EVALUATION OF METEOROID HAZARD, by E. H. Davison and P. C. Winslow, Jr., Paper presented at 30th Ann. I.A.S. Meet., New York, 22-24 Jan 62, I.A.S. paper no. 62-7, 30 pp., 11 figs., 3 tbls., 15 refs.; also in Aerospace Eng., v. 21, no. 2, Feb 62, pp. 24-33.

The hazard to space vehicles from natural space debris is explored and a survey of available information pertinent to this problem is presented. It is concluded that a definite hazard exists but that it can only be poorly assessed on the basis of present information. The need for direct measurement of this hazard is obvious and some of the problems involved in making these direct measurements are explored.

127. Davydov, Y.
MYSTERY OF THE TUNGUS METEORITE, U.S.S.R., no. 1, Jan 62, pp. 52-54, 3 figs.

Continued

An historical review of studies of the fall of, and the destruction caused by the Tunguska meteorite. Theories concerning the nature of the body responsible for the destruction are briefly discussed, including those of questionable validity.

128. Deflandre, G.
REMARQUES CRITIQUES SUR LA PRÉSENCE SUPPOSÉE DE MICROORGANISMES D'ORIGINE EXTRATERRESTRE DANS LES METEORITES, (CRITICAL REMARKS ON THE ALLEGED PRESENCE OF EXTRATERRESTRIAL MICROORGANISMS IN METEORITES), Compt. Rend., v. 254, no. 19, 7 May 62, pp. 3405-3407, 4 refs., (in French).

Claus and Nagy have written about the remains of microscopic organisms found in stony meteorites. They have established a special classification system for them on the assumption that the organisms are of extraterrestrial origin. A critical examination of several of their preparations, made by crushing, contradicts their opinion. Only rigorous methods applied to the making of thin sections will be able to demonstrate the existence of organized elements belonging to extraterrestrial organisms.

129. Department of the Interior, Bureau of Mines, Pittsburgh, Pa.
HYPERVELOCITY IMPACT PHENOMENA, by K. R. Becker, R. W. Watson, and F. C. Gibson, Preliminary background rept., Nov 61, ASTIA AD 270 930, (OTS $1.60), 15 pp., 5 figs., 2 tbls., 5 refs.

An investigation is being conducted to study the parameters governing the failure of thin metal plates under the impact of high-speed fragments; special emphasis is placed on the lightweight structural alloys. The geometrical features of the perforations, together with the spatial, mass, and velocity distributions of the ejecta produced in the perforation process, are of immediate interest. Longer range interests include perforation growth times and other variables considered important in the evaluation of recent theoretical approaches to the problem.

130. Department of the Interior, Bureau of Mines, Pittsburgh, Pa.
HYPERVELOCITY IMPACT PHENOMENA, by K. R. Becker, R. W. Watson, and F. C. Gibson, Quart. rept. (1 Mar-31 May 62), 22 Jun 62, ASTIA AD 278 641, (OTS $1.60), 37 pp., 14 figs., 7 tbls., ref.

The parameters governing the failure of thin metal plates under the impact of high-speed fragments are being studied; special emphasis is placed on the lightweight structural alloys. The geometrical features of the perforations, together with the spatial, mass, and velocity distributions of the ejecta produced in the perforation process, are considered. A few select target materials, e.g., Al and Pb are currently being investigated under impact conditions that involve the same projectile geometry but different impact velocities.

131. Department of the Interior, Geological Survey, Washington, D.C. EXPERIMENTAL HYPERVELOCITY CRATERS IN ROCK, by H. J. Moore, D. E. Gault, and R. V. Lugn, Administrative rept., Mar 62, NASA N62-13994, (OTS $2.60), 20 pp., 10 figs., 6 refs.

Hypervelocity impact craters in rock are formed by a combination of plastic flow accompanied by crushing and shearing of the rock target and by ejection of the strongly shocked debris and of relatively undeformed fragments torn loose along tensile fractures. The formation of the crater begins with penetration of the projectile, probably under nearly hydrodynamic conditions, and the propagation of a strong shock into the rock target. Crushing and shearing of the rock occurs in the region of plastic flow behind the shock front out to the distance at which the stress differences near the shock front drop below the dynamic shear strength of the rock. Tensile fractures are propagated beyond this distance in the direction of propagation of the shock front. Other tensile fractures are initiated by tensile stress across a rarefaction wave produced by reflection of the shock wave from the free surface of the target block. The outer part of the crater is formed by ejection of relatively coarse fragments torn loose by tensile fracturing. Individual pieces derived from the peripheral parts of the crater are bounded by parts of the initial target surface and by a combination of radial, spall, and concentric fracture surfaces. Many of the features observed in craters produced by hypervelocity impact in rock, such as the crushed rock, shear fractures, radial fractures, spall fractures, and concentric fractures, are also present in craters produced by high explosives in rock and soil.

132. Department of the Interior, Geological Survey, Washington, D.C. FLUID IMPACT CRATERS AND HYPERVELOCITY-HIGH VELOCITY IMPACT EXPERIMENTS IN METALS AND ROCKS, by H. J. Moore, D. E. Gault, and R. W. MacCormack, Open file rept., Nov 62, 24 pp., 3 figs., tbl., 13 refs.

The effective deformation strength for a hemispherical water crater is equal to the sum of strength due to hydrostatic pressure head, the strength due to surface tension and the estimated viscous head loss, as shown in the following equation:

$$S_w = \frac{3}{8}\rho g p + \frac{3\gamma}{p} + \mu \frac{1}{t} \int_0^t \frac{\frac{d(z)}{dt}}{\frac{Vol_p}{\pi p^2}} dt,$$

where: ρ is the density of water, g is the acceleration of gravity, p is the maximum crater depth, γ is the surface

Continued

tension of water, μ is the viscosity of water, t is the duration of the cratering event, $d(z)/dt$ is the radial velocity of the fluid shell, and Vol_p is the volume of the projectile. Deformation strengths of water which are computed in this manner are in substantial agreement with calculations of deformation strengths using a formula derived on a theoretical basis by Charters and Summers for impact craters formed in metal targets in the fluid-impact regime.

Fluid-impact or near-fluid-impact craters in metals and rocks may be correlated with fluid-impact craters produced by water drops impacting with water when the deformation strength of rocks and metals are related to the shear or compressive strengths of the target materials. Although the correlation using strengths at low confining pressures is not in perfect accord with theory, the use of the product of the heat of fusion and density of the target material as a maximum possible deformation strength suggests that the effective deformation strength for rocks and metals during impact lies between the unconfined compressive strength and the product of the heat of fusion and density of the target material. The use of shear strengths and densities of the target at 49-kilobars confining pressure improves the correlation between craters produced in metals near the fluid-impact regime, the theory of Charters and Summers, and craters produced by water drops impacting water. Craters in rock do not correlate exactly with water craters and metal craters when the target shear strengths and densities at 49-kilobars are used, but such a difference should be expected.

133. Diedrich, J. H.
MATERIALS PROBLEMS ASSOCIATED WITH THE DESIGN OF RADIATORS FOR SPACE POWERPLANTS, by J. H. Diedrich and S. Lieblein, Paper presented at A.R.S. Space Power Systems Conf., Santa Monica, Calif., 25-28 Sep 62, A.R.S. paper no. 2535-62, 56 pp., 16 figs., tbl., 17 refs.

The basic radiator problem related to space powerplants is reviewed. Two basic radiator types (tabular and nonfluid) are discussed together with their associated essentials of construction. The effects of environmental factors and design and operating conditions on the selection of radiator materials are enumerated. Meteoroid impact and damage represent the greatest potential hazard to space radiators and unfortunately reflect the greatest area of uncertainty so far as design criteria are concerned. A comparison of specific materials is made and the problem areas associated with their use in space radiators is discussed. The major conclusion reached indicates the need to develop design and fabrication technologies for relatively brittle materials as well as the need to accurately determine the behavior of such materials under space operating conditions.

134. Divari, N. B.
OTSENKA SKOROSTI PADENIYA NEKOTORYKH EKZEMPLYAROV SIKHOTE-ALINSKOGO METEORITNOGO DOZHDYA, (ESTIMATE OF THE IMPACT VELOCITIES OF SOME SPECIMENS OF THE SIKHOTE-ALIN MULTIPLE FALL), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 31-41, 5 figs., 2 tbls., 10 refs., (in Russian).

An attempt is made to compute the impact velocities of those fragments of the Sikhote-Alin fall which did not disintegrate upon impact. Two formulae are derived for the computation of the impact velocities of fragments having spherical or nearly spherical shape. The impact velocities so computed vary from 160 to 850 m/sec. Two other formulae are derived for the calculation of impact velocities irrespective of the fragment shape. In the case of spherical fragments these formulae yield a velocity range from 180 to 850 m/sec. Impact velocities of irregularly-shaped fragments are found to vary from 100 to 1020 m/sec.

135. Donahue, T. M.
RELATIONSHIP OF THE SODIUM IN THE UPPER ATMOSPHERE TO MAJOR METEOR STREAMS, (Abstract), by T. M. Donahue and J. E. Blamont, J. Geophys. Research, v. 67, no. 4, Apr 62, p. 1636.

Large variations in sodium abundance have been observed in the sodium dayglow at the observatory of Haute Provence. There are peaks containing about 50 X 10^9 atoms/cm^2 in November, January, March, and July. The ratio of day to twilight abundance varies from about 8/1 at the summer solstice to about 2/1 at the winter solstice. It is proposed that the sodium is distributed from about 75 km to above 100 km and that in the day the reactions $Na + O + M \rightarrow NaO + M$ and $NaO + h\nu \rightarrow Na + O$ keep the sodium dissociated but that above the twilight layer it rapidly combines the first reaction during twilight. The seasonal effects depend on the concentration of oxygen in the 90- to 100-km level which is controlled by the elevation of the sun. The major peaks and several minor peaks in abundance occur 80 days after major meteor showers. All major nonperiodic showers are correlated, largest effects being associated with active, young showers whose perihelion distances are greater than 0.3 AU. A model of a meteor stream orbit in which the stream is a plasma and small charged micrometeorites enter the earth's atmosphere in high geomagnetic latitudes is presented. The sodium entering in this way drifts toward lower latitudes after neutralization. It will be shown that the twilight sodium variation at Saskatoon can be explained if the day/twilight ratio varies as at Haute Provence, but the daytime peaks observed at Haute Provence occur 45 days earlier at Saskatoon. The observed correlation of magnetic micropulsations and major showers may be related to the collision between the meteor stream plasma and the geomagnetic field. Other geophysical effects are also to be anticipated.

136. Dossin, F.
OBSERVATIONS SPECTRALES ET PHOTOGRAPHIQUES DE LA COMÈTE HUMASON (1961e), (PHOTOGRAPHIC AND SPECTRAL OBSERVATIONS OF COMET HUMASON-1961e), Compt. Rend., v. 255, no. 19, 5 Nov 62, pp. 2373-2375, fig., 2 tbls., (in French).

Comet Humason (1961e) has an unusual spectrum dominated by emissions from the tail. Moreover, photographs revealed an intense activity of the cometary gases.

137. Dubin, M.
MEASUREMENTS OF DISTRIBUTIONS OF INTERPLANETARY DUST, by M. Dubin and C. W. McCracken, Astron. J., v. 67, no. 5, Jun 62, pp. 248-256, 6 figs., tbl., 37 refs.

Of the various methods for investigating the distributions and properties of interplanetary dust, direct measurements with satellites and probes are the most effective for studying the characteristics of particles with radii less than 100μ. Since 1958, more than a dozen major space vehicles have included such instrumentation. At the present time, a significant amount of data has been accumulated and several characteristics of the interplanetary dust in the vicinity of the earth may be described. The cumulative distribution curve of the influx rate of dust particles as a function of particle mass may be described approximately by the equation

$$\log I = -17.0 - 1.70 \log m ,$$

where I is the influx rate in particles $m^{-2}sec^{-1}$ and m is the mass in grams in the range from 10^{-10} g $\leq m \leq 10^{-6}$ g. The impact rates measured with satellites undergo large fluctuations in times of only a few hours. There is good evidence that on two occasions dust particle streams with influx rates two orders of magnitude greater than the average were detected.

The accretion of interplanetary material by earth is dominated by dust particles with masses less than about 10^{-8} g and amounts to about 10^4 tons per day. The mass densities of the particles are probably greater than 1 g cm^{-3}.

The direct measurements are compared to the information derived from the studies of meteors and the zodiacal light. No discernible evidence of significance exists in the space vehicle data for a geocentric concentration. A comparison of the direct measurements with the spatial densities at 1 a.u. inferred from zodiacal-light measurements indicates that the spatial density near the earth may be about 10^3 times greater than in interplanetary space. The direct measurements indicate that the particles are probably not in geocentric orbits. Various geocentric concentration mechanisms are reviewed, and it is evident that additional measurements are needed to demonstrate the existence and explain the source of such a phenomenon.

138. Dubin, M.
"Meteoroid Effects on Space Exploration," pp. 310-318, 5 figs., tbl., 36 refs.; in PROCEEDINGS OF THE NATIONAL MEETING ON MANNED SPACEFLIGHT, (Unclassified Portion), (Held at St. Louis, Mo., 30 Apr-2 May 62), New York, Institute of the Aerospace Sciences, 1962, 318 pp.

Although the meteoroid hazard has not been adequately evaluated for proper design of spacecraft for missions through cislunar and interplanetary space, the extent of meteoroid interactions on space explorations may be estimated. The available information about meteoroids and cosmic dust obtained from ground-based observations and satellite measurements is reviewed. These data are presently limited to meteoroids and cosmic dust with heliocentric orbits intersecting the plane of the ecliptic of one astronomical unit and interacting with the earth-moon system. From such information the expectation of the number of impacts with interplanetary matter as a function of exposed spacecraft surface area, exposure time, and meteoroid mass is presented. An estimate of the hazard has been made using appropriate hypervelocity cratering criteria. Some results of other authors are compared with the expectation of meteoroid interaction effects herein presented. The probability of damage to spacecraft is apparently considerably different and a bit less than some earlier estimates.

139. Dubin, M.
"Meteors," by M. Dubin and C. F. Campen, Jr., Chapt. 11, p. 11-1 to 11-10, 9 figs., 3 tbls., 11 refs.; in HANDBOOK OF GEOPHYSICS, Ed. by C. F. Campen, Jr., et al., Rev. ed., New York, Macmillan, 1961, 680 pp.

Discussed are: (1) introduction; (2) meteor composition; (3) meteor speeds; (4) size and number of meteors encountered; (5) meteor showers; (6) dynamics of interaction of meteors and atmosphere; (7) penetration of surfaces by meteors; and (8) radio reflections from meteor trails.

140. Dudley Observatory, Albany, N.Y.
COLLECTION AND ANALYSIS OF MICROMETEORITES, by C. L. Hemenway, H. A. Cohen, and R. E. Coon, NASA Grant NsG 155-61, Semi-annual status rept. (1 Jun 61-1 Dec 61), 1961, NASA N62-10876, (OTS $1.60), 13 pp., 7 figs., ref., appen.

Work has begun on two phases: the detection of cobalt in meteoric sources by neutron activation analysis and γ-ray scintillation spectrometry and the design and construction of a micrometeorite particle collector to be flown on top of balloons. A breakdown of expenses incurred and a derivation of a formula for limiting mass detectability are appended.

141. Dufay, J.
SPECTRE DE LA COMETA WILSON-HUBBARD 1961d, (SPECTRUM OF COMET WILSON-HUBBARD 1961d), by J. Dufay and A. Baranne, Compt. Rend., v. 254, no. 15, 9 Apr 62, pp. 2694-2696, 2 tbls., 5 refs., (in French).

The very strong emission of the D doublet of sodium which characterized the spectrum of July 26, 1961, doubtlessly arose due to the elevated temperature of the cometary nucleus as it approached the sun and from its large heliocentric velocity. On a continuous spectrum the Fraunhofer lines were separated, the emission bands of NH_2 and C_2, whose rotational structure was partially resolved, were also separated, and the CH bands were very weak.

142. DuFresne, E. R.
ON THE CHEMICAL EVOLUTION OF THE CARBONACEOUS CHONDRITES, by E. R. DuFresne and E. Anders, Geochim. et Cosmochim. Acta, v. 26, Nov 62, pp. 1085-1114, 4 figs., 11 tbls., 56 refs.

X-ray diffraction microtechnique has been applied to nine carbonaceous chondrites, so that a definite knowledge of their mineral composition has been obtained. The existence of magnesium sulphate, elemental sulphur and a magnetic spinel containing Fe^{3+} ion, has been confirmed. However, troilite is rare, and absent in many cases. Dolomite has been observed in meteorites for the first time, and pentlandite has also been found. Hydrous silicates, apparently alteration products of olivine, occur in several varieties which are distinct from chlorite and serpentine. Two unknown minerals have been found in Mokoia.

Evidence is presented to show that these meteorites and their peculiar minerals can be accounted for by the preterrestrial action of water on olivine, troilite, iron, etc. The crystal perfection of the dolomite is evidence that the acqueous phase acted over a prolonged period certainly longer than 1000 years. Equilibrium studies make it clear that no special oxidizing agent is required to produce the sulphate or Fe^{3+}. It is shown that one need not assume a planetary origin to account for the long-term presence of water. Calculations show, rather, that an "internal atmosphere," sealed by an ice layer from a low pressure exterior, could have persisted for at least several million years if the parent body were at an asteroidal distance from the sun.

143. DuFresne, E. R.
ON THE RETENTION OF PRIMORDIAL NOBLE GASES IN THE PESYANOE METEORITE, by E. R. DuFresne and E. Anders, Geochim. et Cosmochim. Acta, v. 26, Feb 62, pp. 251-262, 3 figs., 3 tbls., 30 refs., appen.

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A sample of the Pesyanoe meteorite has been examined by X-ray diffraction microtechnique, in an effort to find minerals of known gas-trapping tendency and thus explain the high helium content of the meteorite. Determinations of enstatite, feldspar, and troilite by earlier workers have been confirmed. The existence of many variant minor pyroxene phases, including clinopyroxene and rhombic pyroxene with stacking faults, shows that the history of the meteorite must have involved several complex heating and cooling cycles. In addition, there exists a variety of sulfides, which includes not only both magnetic and nonmagnetic troilites, daubreelite, and oldhamite, but also a new mineral, MgS, the composition of which has been checked by spectrographic analysis. All the sulfides present show a high degree of crystal imperfection. Vaterite (μ - $CaCO_3$) has been found, but it is not known whether it is of terrestrial or antecedent origin.

The high concentration of dislocations in the sulfides indicates a comparable abundance of other lattice defects. It is suggested that lattice defects of various kinds are the most probable loci of the gas atoms. The gases apparently entered the sulfide crystals during their growth, either in a closed magma chamber or in a hot gas stream containing both noble gases and sulfur compounds. Some circumstantial evidence favours the latter alternative.

144. Duke, M. B.
THE PETROLOGY OF NUEVO LAREDO METEORITE, (Abstract), by M. B. Duke and L. T. Silver, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3555.

The Nuevo Laredo meteorite is a brecciated eucrite that fell near Nuevo Laredo, Tamaulipas, Mexico, in May 1926. A single stone which weighed approximately 450 grams and had a nearly complete fusion crust was recovered immediately after the fall. The meteorite is a compact, very poorly sorted fragmental aggregate, similar to terrestrial tuff breccias. Individual lithic fragments are as large as 5 cm. The groundmass has crystal fragment sizes as small as a few microns or less. A number of well-developed hemispherical fragments and hemispherical surfaces within the groundmass have been observed. These are not, however, typical "chondritic" chondrules. The larger fragments exhibit fine- to medium-grained sub-ophitic and intergranular textures. A few fragments are composed of devitrified black "glass" with rare coarse crystals of clinopyroxene. All textural varieties seem to be parts of a single compositional system. The principal minerals are bytownite-anorthite (An_{90}), ferropigeonite ($Mg_{25}Fe_{67}Ca_8$), and ferroaugite ($Mg_{25}Fe_{43}Ca_{32}$), with minor amounts of ilmenite, troilite, chromite, and orthopyroxene. Free silica occurs in the form of cristobalite and quartz. Less than 0.1 percent of metallic iron containing less than 1 percent nickel is present. Two

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distinct episodes, a magmatic crystallization event and a brecciation-aggregation event, are indicated in the prefall history of the meteorite. The extreme range of fragment sizes and the textural inhomogeneities of the various fragments suggest that substantial sampling errors are probable in any investigation of the meteorite.

145. Dyakonova, M. I.
KHIMICHESKII SOSTAV 18 KAMENNYKH METEORITOV IZ KOLLEKTSII AKADEMII NAUK S.S.S.R., (CHEMICAL COMPOSITION OF 18 STONE METEORITES FROM THE COLLECTION OF THE RUSSIAN ACADEMY OF SCIENCES), by M. I. Dyakonova and V. Ya. Kharitonova, Meteoritika, Akad. Nauk S.S.S.R., v. 21, 1961, pp. 52-59, tbl., 17 refs. (in Russian).

The chemical compositions of 15 chondrites and one achondrite are presented. Both the grey and black portions of the chondrites Kunashak and Pervomaiskii Poselok were analyzed, thus accounting for the "18" meteorites in the title of this paper. In the black portions of these two chondrites higher metallic and alkali contents and lower CaO and FeO in the silicate fraction were observed as compared to the grey portions. Iron and sulfide contents remained constant. The ratio of Na_2O to K_2O is 5 to 6. The variations observed may be explained by the effects of local heating due to radioactive or other processes. A comparison of the chemical composition of the Vavilovka meteorite with that of the chondrites permits identification of this meteorite as a chondrite.

146. Dyakonova, M. I.
KIMICHESKII SOSTAV KHONDR METEORITOV NIKOLSKOE I SARATOV, (CHEMICAL COMPOSITION OF CHONDRULES FROM THE NIKOLSKOE AND SARATOV METEORITES), by M. I. Dyakonova and V. Ya. Kharitonova, Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 71-73, 3 tbls., ref., (in Russian).

Selected, cleaned chondrules of the meteorites Nikolskoe and Saratov were analyzed in order to make a comparison of their composition with the general composition of these chondrites. Specimens ranging in size from 0.5 mm to 4 mm in diameter were studied. Their specific gravity varies between 3.358 and 3.465. The specific gravity of Nikolskoe is 3.743 and that of Saratov is 3.731. It appears that the density of the chondrules is dependent upon their composition and is not related to size. The results of chemical analyses indicate that the only significant difference in chemical composition between the chondrules and chondrites is that the former have a higher SiO_2, MgO, and Al_2O_3 content. The abundance of other elements and oxides varies only slightly.

E

147. Edmiston, R. M.
THE PRODUCTION OF METEOROID HOLE AREA IN A SPACE VEHICLE NEAR THE EARTH, Paper presented at 30th Ann. I.A.S. Meet., New York, 22-24 Jan 62, I.A.S. paper no. 62-29, 28 pp., 9 figs., 3 tbls., 16 refs., 2 appens.

A method is presented for determining the time dependence of the production of meteoroid hole area in the skin of a space vehicle in the vicinity of the earth. It is assumed that the vehicle is constructed of a single wall. Also assumed is that the penetrating particle makes only one hole in the skin, i.e., it does not pass through the vehicle and out the opposite wall. The present work indicates that for relatively long missions of a sizeable vehicle, a reasonable probability that the hole area will be limited to a small value cannot be assured without tremendous weight penalties if a single wall is employed. Extension of the present analysis is required in order to make it applicable to multiple wall concepts.

148. Ehmann, W. D.
THE ABUNDANCE OF NICKEL IN SOME NATURAL GLASSES, Geochim. et Cosmochim. Acta, v. 26, Apr 62, pp. 489-493, fig., tbl., 5 refs.

The nickel content of four australites, one billitonite, two meteorite impact glasses, and three obsidians have been determined by neutron activation analysis. The iron contents of these specimens have been determined by gravimetric techniques and nickel to iron weight ratios tabulated. On the basis of this ratio, the tektites form a group that is distinct from both the obsidians and the meteorite impact glasses. This is consistent with previous analyses on other specimens of each of these types. The nickel to iron ratio was found to be virtually constant for australites distributed geographically over a range of more than 1000 miles. The nickel content for the billitonite specimen analysed was found to be much lower than previously reported for this occurrence. It is suggested that tektites from Billiton may represent two overlapping occurrences, similar to the Indochina tektites. Implications of the data to the origin of tektites are discussed.

149. Electro-Optical Systems, Inc., Pasadena, Calif.
PHYSICAL INVESTIGATIONS IN COSMIC SPACE, by V. A. Leshkovtsev, trans. by J. L. Zygielbaum, Contr. DA-49-146-XZ-100, 1890-Trans. 3, 29 pp., 11 figs., tbl.; trans. of Fiz. v Shkole, no. 1, Jan-Feb 60, Moscow Journal of Ministry of Education.

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The results of experiments carried aboard the Sputniks and Luniks launched in 1959 are given. Described are: (1) study of cosmic rays; (2) radiation belts around the earth; (3) investigation of corpuscular solar radiation and interplanetary gas matter; (4) meteoric particles; and (5) investigation of the moon.

150. Erickson, W. C.
A SEARCH FOR DECAMETRIC RADIATION FROM THE COMET WILSON 1961d, Astrophys. J., v. 136, no. 3, Nov 62, pp. 1138-1139, fig., 6 refs.

A note describing the search for decametric radiation from the comet Wilson, which produced a definite negative result.

151. Eshleman, V. R.
RADAR STUDIES OF 15TH-MAGNITUDE METEORS, by V. R. Eshleman and P. B. Gallagher, Astron. J., v. 67, no. 5, Jun 62, pp. 245-248, 5 figs., 6 refs.

Radar studies of the trails produced by 15th-magnitude meteors (trail electron densities of 10^{10} m^{-1}) have been conducted using a 100-kw transmitter at a wavelength of 13 m, and a 2000-ft linear array made up of 48 four-element Yagi antennas. Number-mass, number-velocity, and number-time distributions of these very small particles show some features similar to those predicted from studies of larger meteors, but other characteristics are markedly different. Of particular interest is the fact that the meteor echo rate, measured at the same time of day for several years, shows day-to-day fluctuations much greater than would be obtained from independent sporadic meteors, with little or no correlation with the well-known showers of larger particles. This rate variation does not appear to be due to radio-wave absorption or other atmospheric effects. It is suggested that the "sporadic" background of meteors is in reality a mixture of short-lived showers, with about 10 shower groupings being simultaneously present on the average.

152. EXPLORER 16 SATELLITE PROVIDES EXCELLENT MICROMETEOROID DATA, Aviation Week and Space Technol., v. 77, no. 26, 24 Dec 62, p. 23.

The satellite was launched at 9:33 a.m. EST December 16, 1962, from Wallops Island, Va., as the payload of the tenth Scout vehicle. Its orbital elements are: apogee, 733 mi; perigee, 466 mi; period, 104.4 min; and inclination to the equator, 52.01 degrees. The satellite is conducting its experiments with five types of detectors. By early last week, the satellite had been interrogated 13 times by Minitrack ground

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stations, and it had responded each time. Data reduction is being performed at Langley, and analyses and evaluation will be done by the individual experimenters. Brief descriptions of the micrometeorite detectors are given.

F

153. Fedchun, M. S.
YARKII BOLID 5 YUNYA 1960 G, (A BRIGHT BOLIDE OF 5 JUNE, 1960), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 110-111, fig., (in Russian).

At 0^h12^{min} on the 5th of June, 1960, a bright bolide was observed over the general area of the city of Zhitomir, Zhitomir Oblast, Ukrainian S.S.R. The bolide, moving from southwest to northeast, travelled a distance of about 100 km in six seconds, and disappeared over the village of Narodichi. In brightness it approached 18th magnitude. The nature of its motion and manner of extinction indicated that the bolide completely disintegrated in the air.

154. Fedynskii, V. V.
THE NINTH PLENUM OF THE COMMISSION ON COMETS AND METEORS, ASTRONOMICAL COUNCIL, USSR ACADEMY OF SCIENCES, Soviet Astronomy (AJ), v. 5, no. 6, May-Jun 62, pp. 867-870; trans. of Astron. Zhur., v. 38, no. 6, Nov-Dec 61, pp. 1133-1136.

The 9th Plenum of the Commission on Comets and Meteors was held on 16-20 May 1961, in Stalinabad, during which 46 scientific papers and reports were heard including survey reports on the progress of meteor and comet astronomy in 1958-1960, on the physics of comets and the mechanical theory of cometary forms, on meteor research with rockets and satellites, on the results of meteor studies during the IGY and the problems met in reducing this material, on the application of meteoric phenomena to the investigation of the upper layers of the atmosphere, on the techniques of radar, photographic, and spectroscopic observations of meteors, and finally information on the work of the institutes and organizations during the period between the 8th and 9th Plenums, and the activity of the Council of the Commission during this period. Reports were also given on the progress of meteor studies in Czechoslovakia.

155. Feibelman, W. A.
A NEW MINOR METEOR SHOWER, Astrophys. J., v. 136, no. 1, Jul 62, pp. 315-316.

A note describing the discovery of a new minor meteor stream, the α Ursa Majorids, found during observations of the 1961 Perseids.

156. Fesenkov, V. G.
METEORIT ILI KOMETA?, (METEORITE OR A COMET?), Pravda, no. 52, (15908), 21 Feb 62, p. 3, 2 figs., (in Russian).

The fall of the Tunguska body on June 30, 1908, was accompanied by the following phenomena:

1. A sharp increase in luminescence of the night sky caused by finely pulverized matter in the upper strata of the atmosphere.
2. An appreciable turbidity of the lower strata of the atmosphere during July-August, 1908. Since this turbidity was not dependent on light wave length and did not produce anomalies in twilight intensity or luminescence of the night sky, it probably was caused by a layer of relatively large particles which did not rise higher than 30 km.
3. Concentration of magnetite and silicate particles (some of them paired) in the soil of the area of fall. Their presence indicates the occurrence of extremely rapid and cooling processes usually associated with explosion phenomena.
4. Radial destruction of the forest in the area of fall.
5. Absence of craters and of macroscopic meteoritic fragments.

Meteorite falls are usually not accompanied by similar phenomena. The facts support the hypothesis that the Tunguska body was a comet which collided with the earth. The collision velocity is estimated at 35-60 km/sec. Since the total mass of the body is estimated at about one million tons, its kinetic energy amounted to at least 2×10^{25} ergs. The energy of the explosion, depending on the effect considered, is estimated as follows: seismic oscillations, 10^{21} to 10^{23} ergs; atmospheric shock waves, 4×10^{23} ergs; and forest destruction, 2×10^{23} ergs. The opinion is expressed that these magnitudes, in general, are consistent.

157. Fesenkov, V. G.
NEKOTORYE PROBLEMY METEORITIKI, (SOME PROBLEMS OF METEORITICS), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 16-26, 40 refs., (in Russian).

The following are discussed: (1) the surfaces of meteoric bodies of cometary and asteroidal origin; (2) the accretion by the earth of meteoritic dust; (3) the hypothesis that tektites may come from the moon; (4) the falls of some recent large meteorites (Pribram, Yardymly, and Ramsdorf); and (5) the study of the composition of meteorites.

158. Fesenkov, V. G.
NE METEORIT, A KOMETA, (A COMET, NOT A METEORITE), Priroda, no. 8, Aug 62, pp. 24-31, 9 figs., tbl., ref., (in Russian).

The circumstances surrounding the fall of the Tunguska body are examined. The southeast trajectory of the body, proposed by E. L. Krinov, is considered most probable. The mass of the body is estimated at one million tons, its kinetic energy at 2 X 10^{25} ergs, and its collision velocity at 35 to 70 km/sec. The 1961 expedition to the area of the fall confirmed the absence of disarrangements of local topography and the fact that the explosion of the body occurred above the ground. Although the collected data are still being evaluated, it is believed possible to advance the hypothesis that the Tunguska body was of cometary origin.

159. Fesenkov, V. G.
ON THE COMETARY NATURE OF THE TUNGUSKA METEORITE, Soviet Astronomy (AJ), v. 5, no. 4, Jan-Feb 62, pp. 441-451, 7 figs., 8 refs.; trans. of Astron. Zhur., v. 38, no. 4, Jul-Aug 61, pp. 577-592.

The Tunguska meteorite which appeared on June 30, 1908, in central Siberia did not produce any craters or even meteoritic fragments, but was followed by quite enormous fall of the forest having a clearly radial character at least at a certain distance from the central area. According to all evidence, this meteorite moved around the sun in a retrograde direction, which is impossible for typical meteorites which are the products of asteroidal disintegration.

Abnormal bright nights observed from June 30 to July 1 were produced by a cloud of very fine dust evidently related to the meteorite and oriented in the direction opposite to the sun. The distribution of this cloud over the earth's surface and the exceedingly small size of its constituent particles appear to confirm the supposition that it was really the tail of a small comet. The dust particles are so small that they are capable of being retained for a while at a height of some hundred km, and of producing an abnormal brightness of the night sky when illuminated by direct solar rays.

The nucleus of the comet could move along some inclined trajectory, penetrate to the height of 5-6 km, and have a series of explosions. The resulting scattered particles were carried over the whole northern hemisphere, which was revealed by a very marked diminution of atmospheric transparency. Estimating the mass of the nucleus consisting of a multitude of particles as one million tons or even more, its linear dimension can be only several hundred meters. The inspection of the central area of the forest fall permits us to draw the conclusion that at least three consecutive bursts occurred at points near the adopted mean trajectory of the meteorite.

160. Fesenkov, V. G.
ON THE DENSITY OF METEORIC MATTER IN THE INTERPLANETARY SPACE IN THE LIGHT OF THE POSSIBLE EXISTENCE OF A DUST CLOUD AROUND THE EARTH, Soviet Astronomy (AJ), v. 5, no. 6, May-Jun 62, pp. 775-778, 6 refs.; trans. of Astron. Zhur., v. 38, no. 6, Nov-Dec 61, pp. 1009-1015.

It is established that direct methods for obtaining the density of cosmic matter in interplanetary space (meteor counts, studies of ocean deposits, etc.) lead to an appreciable higher value than the indirect method based on the brightness of the zodiacal light. Even when entertaining the assumption that particles of zodiacal matter display unusually insignificant albedo, the discrepancy is found to be one of one or even two orders of magnitude. It is conjectured that the earth is surrounded by some local dust cloud replenishing the amount of cosmic matter filtering down into the upper-lying layers of the earth's atmosphere. The gegenschein is probably due to a similar circumterrestrial cloud forming a dust tail sui generis oriented in the direction away from the sun.

161. Fesenkov, V. G.
O PRIRODE KOMET I USLOVIAKH PADENIYA IKH NA ZEMLYU, (ON THE NATURE OF COMETS AND CIRCUMSTANCES OF THEIR FALL UPON THE EARTH), Meteoritika, Akad. Nauk S.S.S.R., v. 21, 1961, pp. 3-14, 13 refs., (in Russian).

The upper limit of comet masses, determined from the absence of perturbations, amounts to 10^{12} tons. Assuming that comet nuclei are compact clusters of individual particles, it is possible to estimate their dimensions from brightness measurements. The absence of bolides in cometary meteor showers indicates the homogeneity of their particles. Comet nuclei do not represent compact aggregates as indicated by the lack of the effect of Roche's limit upon sun-grazing comets; other indications to this effect are the presence in comet spectra of CO, CH, and CN, easily liberated at temperatures below 0°C. At perihelion, even the high melting point particles melt then recondense. It has been recently established that the orbital characteristics of both long- and short-period comets are in agreement with the theory that these bodies originate from a field of parabolic comets. It can be assumed that comets originate in a protoplanetary cloud, or during the passage of the sun through clouds of cosmic dust. Comets disintegrate in the atmosphere before reaching the earth and generate powerful shock waves; only finely divided material reaches the earth's surface. The Tunguska fall is an example of such a phenomenon.

162. Fesenkov, V. G.
O PRIRODE TUNGUSSKOGO METEORITA, (ON THE NATURE OF THE TUNGUSKA METEORITE), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 27-31, 5 refs., (in Russian).

In addition to meteorites (which represent fragments of asteroids), it is possible for comets to also impact upon the earth. Basically, asteroidal fragments have direct orbits and the velocity of their impact is therefore relatively low. On the other hand, some comets have retrograde orbits and consequently the energy released as a result of their collision with the earth could be very large. This is believed to have occurred in the case of the Tunguska "meteorite." The unusual twilight of June 30, 1908, is considered to have been caused by the dust envelope of the comet. Perturbation of the earth's magnetic field at the instant of fall indicates that the volume of the "meteorite" was very large, which corresponds to calculated cometary dimensions. The absence of large meteoritic masses (or of even craters resulting therefrom) is in agreement with the postulated icy nature of the cometary nucleus.

163. Fialko, E. I.
POSITIVE AND RANDOM DETECTION OF UNSTABLE METEOR TRACKS, Radio Eng. (U.S.S.R.), no. 6, Jun 61, pp. 22-32, 6 figs., 16 refs.; trans. of Radiotekhn., v. 16, no. 6, Jun 61, pp. 24-33.

Positive and random detection of unstable meteor tracks are examined under the conditions of normal reflection of radio waves from the ionized trails.

164. Fielder, G.
ORIGIN OF THE MARE IMBRIUM, Nature (London), v. 193, no. 4812, 20 Jan 62, p. 258, tbl., 9 refs.

When details of the lunar surface are considered, it appears that there is no clear evidence that a collision ever occurred in Mare Imbrium. Additional evidence, which is strongly against the collision hypothesis, has now been assembled and is reviewed.

165. Fielder, G.
RAY ELEMENTS AND SECONDARY-IMPACT CRATERS ON THE MOON, Astrophys. J., v. 135, no. 2, Mar 62, pp. 632-637, fig., 3 tbls., 12 refs.

Fifty-nine lunar craters, mostly between 1 and 5 km in diameter, are identified with certain ray elements of the major craters Copernicus and Tycho. A catalogue of the positions of the small craters is given, and it is demonstrated that they are "secondary-impact craters" produced by rock blocks ejected from Copernicus and Tycho. It is shown that

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the elliptical shape of some of the secondary craters does not depend on the direction of impact of the rock blocks. The mechanics of the process of formation of the secondary craters and their ray elements is discussed for maria composed of (a) a dusty medium and (b) a medium such as solid rock.

166. Fielder, G.
SELENOLOGICAL IMPLICATIONS DRAWN FROM THE DISTORTIONS OF CRATERS IN THE HIPPARCHUS REGION OF THE MOON, by G. Fielder and C. Jordan, Planet. Space Sci., v. 9, Jan-Feb 62, pp. 3-9, 4 figs., 7 tbls., 4 refs.

Measurements of craters in the Hipparchus region of the moon are used to show that the craters are distorted preferentially, their longer axes most frequently lying parallel to the most prominent family of the grid system. It is shown that the mean percentage distortions generally increase with the age of a crater, and that the larger craters are generally older than the smaller ones. Taken qualitatively, the present results may be used to confirm the conclusions which were reached earlier for the Vaporum region of the moon; namely, that the compressive stresses which produced the observed distortions acted for a longer time on an old crater than on a young crater. The quantitative differences between the two sets of results may be explained readily in terms of the relative strengths of the two principal stress-systems which produced the grid system in these parts of the moon. These two systems must have formed in the same era, rather than during separate eras.

Finally, the results are used to isolate the most recently formed craters. The probability that these craters are distributed at random is found to be 0.7, so that it is not unlikely that they are of impact origin.

167. Fielder, G.
STRESS SYSTEMS IN THE VICINITY OF LUNAR CRATERS, by G. Fielder and B. Warner, Planet. Space Sci., v. 9, Jan-Feb 62, pp. 11-18, 4 figs., 2 tbls., 6 refs.

Observations of the distribution of ridge-systems around certain lunar craters are discussed in terms of a simple theory of rock-failure. It is shown that, at the time of formation of these craters, the surface layers of the moon were stressed in tension. Solutions are found for the propagation index, a property of the lunar rocks; and for the ratio of the horizontal tensile prestress in the moon to that required to fracture the rocks. A measure of the relative force associated with the origin of two craters is obtained. Consideration of several craters suggests that the horizontal tensile stress does not vary greatly from point to point. Of the two principal theories of crater formation, a quiescent process is favoured because it explains certain observations that the explosive theory does not.

168. Finkelman, E. M.
ANALYSIS OF THE COMBINED INFLUENCES OF THE MICROMETEOROID AND RADIATION ENVIRONMENTS ON SPACECRAFT DESIGN, Paper presented at I.A.S. Nat. Summer Meet., Los Angeles, Calif., 19-22 Jun 62, I.A.S. paper no. 62-128, 14 pp., 11 figs., 5 refs.; also published as OPTIMIZED PROTECTION AGAINST ENVIRONMENTAL HAZARDS IN SPACE, Aerospace Eng., v. 21, no. 12, Dec 62, pp. 41-48.

The combined influences of micrometeoroids and solar flare radiation on manned lunar spacecraft are analyzed. The comparatively large weight penalties involved in providing adequate protection against these hazards stresses the importance of optimizing the shield weights. The only practical way of preventing the weight penalties for radiation protection from getting completely out of hand for lunar missions is to provide some manner of "close-in" shielding. Results indicate that overall reliabilities (for the combined protection system) greater than 98% are difficult to achieve within practical weight limits. Lunar spacecraft without ablative reentry shields would require an equivalent meteoroid shield in order to achieve maximum protection for a given total weight penalty. In addition, the mission time can have a considerable effect on the shielding requirements.

169. Fireman, E. L.
THE EHOLE METEORITE, ITS ACQUISITION AND ITS RADIOACTIVITY, J. Geophys. Research, v. 67, no. 6, Jun 62, pp. 2592-2594, 3 figs., 3 refs.

The Ehole meteorite, a grey crystalline chondrite, fell at Ehole village near Namacunde, Angola, on August 31, 1961. Approximately 2.45 kg of material have been recovered. The meteorite is composed principally of olivine, with some free metal and smaller amounts of sodium feldspar and troilite. The magnitude of the Ar^{39} activity is found to be slightly smaller than that measured in Bruderheim and slightly larger than that of Hamlet. On the basis of the magnitude of the Ar^{39} and Ar^{37} activities and the ratio of tritium to Ar^{39} the Ehole and Hamlet meteorites appear to have been slightly more shielded while in space than was the Bruderheim.

170. Fish, R. A.
AMBIENT XENON: A KEY TO THE HISTORY OF METEORITES, by R. A. Fish and G. G. Goles, Nature (London), v. 196, no. 4849, 6 Oct 62, pp. 27-31, 2 figs., tbl., 30 refs.

The existence of isotopic anomalies in meteoritic xenon has been firmly established by Reynolds and other investigaters. Xenon in many meteorites exhibits a "special" anomaly, in which the isotope Xe^{129} is greatly enhanced with respect to terrestrial xenon, as well as smaller "general" anomalies affecting the

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remainder of the xenon isotopes. Conflicting explanations of the general anomalies have been offered but it does seem clear that the xenon special anomalies are a result of the meteorite parent bodies having formed quickly enough after the last synthesis of I^{129} to permit an excess of the radiogenic daughter Xe^{129} to accumulate in the iodine-bearing minerals. Since it is not certain which processes contributed to the nucleosynthesis of iodine, one can only derive relative rather than absolute decay intervals. It is believed that Reynold's data concerning meteoritic xenon carries, in addition, information about the interiors of meteorite parent bodies, information which rivals in importance the xenon chronometry. In discussing these data, an improvement is suggested on one unsatisfactory aspect of xenon chronometry - that the special anomalies have been determined by comparison with unsuitable reference standards.

171. Fitch, F.
"ORGANIZED ELEMENTS" IN CARBONACEOUS CHONDRITES, by F. Fitch, H. P. Schwarcz, and E. Anders, Nature (London), v. 193, no. 4821, 24 Mar 62, pp. 1123-1125, 3 figs., 7 refs.

An examination has been made of Orgueil and Ivuna meteorite samples from the Paris and Chicago Natural History Museums which showed spherical and oval particles quite similar to those illustrated and described by Claus and Nagy (Nature (London), v. 192, no. 4803, 18 Nov 61, pp. 594-596). Several new observations have been made. It is concluded that the organized elements of Claus and Nagy are either identical with troilite globules, sulphur droplets, or hydrocarbon droplets, or that they are so scarce in the specimens investigated that they lie below the threshold of detection.

172. Florenskii, K. P.
NOVOE V IZUCHENII TUNGUSSKOGO METEORITA 1908G, (NEWS IN THE STUDY OF THE TUNGUSKA METEORITE OF 1908), Geokhimiya, no. 2, 1962, pp. 187-189, fig., tbl., (in Russian).

A brief review of some of the results of the 1958 and 1961 expeditions to the area of fall of the Tunguska "meteorite."

173. Fogle, B.
NOCTILUCENT CLOUDS IN ALASKA DURING 1962, Nature (London), v. 196, no. 4859, 15 Dec 62, p. 1080, fig., 7 refs.

Noctilucent clouds were observed at College, Alaska (64°53'N, 148°03'W) during August, 1962, at a higher latitude than hitherto recorded. Noctilucent cloud displays were also observed on two occasions at Anchorage.

174. Fowler, W. A.
NUCLEAR CLUES TO THE EARLY HISTORY OF THE SOLAR SYSTEM, Paper presented at A.R.S. Space-Nuclear Conf., Gatlinburg, Tenn., 3-5 May 61, A.R.S. paper 1730-61, 15 pp., 2 figs., tbl., 14 refs.; also in Science, v. 135, no. 3508, 23 Mar 62, pp. 1037-1045.

Space research seeks to ascertain, among other things, the history of the origin of the solar system. There already exist certain nuclear clues to this history and additional evidence will be forthcoming in lunar and planetary exploration. This paper discusses the present implication of the observed abundances of D^2, Li^6, Li^7, Be^9, B^{10} and B^{11} in terrestrial and meteoritic matter. The abundances indicate that the synthesis of these light nuclei occurred during an intermediate stage in the early history of the solar system. In this intermediate stage, the planetary material had become largely separated, but not completely, from the hydrogen which was the main constituent of primitive solar material. Appropriate physical conditions were satisfied by solid planetesimals of the dimensions of 1-50 meters consisting of silicates and oxides of the metals embedded in an icy matrix. The synthesis occurred through spallation and neutron reactions simultaneously induced in the outer layers of the planetesimals by the bombardment of high energy charged particles, mostly protons, accelerated in magnetic flares at the surface of the condensing sun. The importance of the (n,α) reactions on Li^6 and B^{10} is indicated by the relatively low abundances of these two nuclei. Anomalous abundances of Xe^{129} and Ag^{107} observed in meteorites can be attributed to the decay of radioactive I^{129} and Pd^{107} produced in the planetesimals. The interval between the irradiation of the small planetesimals and the formation of large bodies in the solar system is found to be between 10^7 and 10^8 years.

175. Friichtenicht, J. F.
TWO-MILLION-VOLT ELECTROSTATIC ACCELERATOR FOR HYPERVELOCITY RESEARCH, Rev. Sci. Instr., v. 33, no. 2, Feb 62, pp. 209-212, 3 figs., 3 refs.

A 2,000,000-v Van de Graaff positive ion accelerator has been modified to accelerate micron-sized charged particles for studies of high speed impact and for micrometeor simulation. Modification was accomplished by replacing the ion source by a particle charging and injection system. The particles are contact charged to values resulting in electric field strengths at the surface of the particle of about 2.5×10^9 v/m. Using iron spheres, final velocities up to 14 km/sec have been observed. Techniques for measurement of particle parameters have been developed and measurements of the focusing properties of the modified accelerator are discussed.

176. Fuchs, L. H.
OCCURRENCE OF WHITLOCKITE IN CHONDRITIC METEORITES, Science, v. 137, no. 3528, 10 Aug 62, pp. 425-426, 2 tbls., 7 refs.

The first reported occurrence of the tricalcium phosphate mineral, whitlockite, in several chondrites is described. The identification of this mineral and previously reported chlorapatite were made by x-ray diffraction; the results do not confirm the existence of meteoritic merrilite. The presence of whitlockite in meteorites cannot be regarded as conclusive evidence for a temperature of formation of less than 1450°C. The stability of the mineral phosphides in contact with the associated minerals at elevated temperatures may affect our ideas concerning the origin of stony meteorites.

177. Furcron, A. S.
GEOLOGIC AGE OF THE TEKTITE SHOWER AND ITS ASSOCIATED ROCKS OF THE GEORGIA COASTAL PLAIN, Georgia Mineral Newsletter, v. 14, 1961, pp. 115-119, 16 refs.

The precision with which geologic interpretations can be applied to ascertaining the geologic age of the "formation" upon which tektites are found in Dodge and Irwin counties is discussed. The georgiaites fell on or possibly in the sands and gravels where they are found, and although these deposits may not all be of the same geologic age, if the geochemists are correct, the tektites are older. The tektite shower post dates the Oligocene, and although geological interpretations are conflicting, there is sufficient evidence to suggest a probable Pliocene-Pleistocene age for the fall.

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178. Gallant, R.
FREQUENCY OF METEORITE FALLS THROUGHOUT THE AGES, Nature (London), v. 193, no. 4822, 31 Mar 62, pp. 1273-1274, 10 refs.

A brief review of evidence substantiating the hypothesis that meteorites have fallen on the earth prior to the pre-late Quaternary.

179. Gaskell, T.
DO METEORITES REVEAL LIFE ON OTHER WORLDS?, New Scientist, v. 14, no. 289, 31 May 62, pp. 458-460, 3 figs.

The discovery last year of microscopic "organized elements" in carbonaceous chondrites has stimulated a great deal of analysis and speculation about the possibility that they are fossil micro-organisms from another planet. Many questions are still unanswered. The principal observations and the attempts to explain them are reviewed.

180. Gast, P. W.
THE ISOTOPIC COMPOSITION OF STRONTIUM AND THE AGE OF STONE METEORITES - I, Geochim. et Cosmochim. Acta, v. 26, Sep 62, pp. 927-943, 2 figs., 8 tbls., 26 refs.

New measurements of the Rb and Sr content and Sr isotope composition are reported for four Ca-rich achondrites and five bronzite or hypersthene chondrites. All the achondrites have identical Sr^{87}/Sr^{86} ratios; one chondrite, Beardsley, is very much enriched in Rb relative to the other chondrites. Several alternative interpretations of the data are discussed; all agree on a period of chemical differentiation 4.3 to 4.7 Aeons ago (Aeon = 10^9 yrs) in the parent body of the meteorites.

181. Gear, A. E.
A CORRUGATED MODEL FOR THE LUNAR SURFACE, by A. E. Gear and J. A. Bastin, Nature (London), v. 196, no. 4861, 26 Dec 62, p. 1305, fig., 7 refs.

It is suggested that a number of previously uncorrelated visual and infrared lunar observations may be explained by assuming that the surface of the moon has indentations the scale of which is too small to be resolved optically by terrestrial observations.

182. Gehrels, T.
PHOTOMETRIC STUDIES OF ASTEROIDS, IX. ADDITIONAL LIGHT CURVES, by T. Gehrels and D. Owings, Astrophys. J., v. 135, no. 3, May 62, pp. 906-924, 21 figs., 6 tbls., 23 refs.

Fifteen asteroids were observed with the 36- and the 82-inch telescopes of the McDonald Observatory. Owing to the fast motions of the 36-inch, precise transfers to the U, B, V system could be made concurrently with the light-curve observations. Iris was observed nearly pole-on, at 8^h05^m right ascension and +20° declination. Large obliquities often occur, and there apparently is some alignment of the poles. The ecliptic longitudes of eight asteroid poles were determined between 104°(284°) and 194°(14°), with none occurring between 14° and 104° or between 194° and 284°.

183. Gehring, J. W.
A STUDY OF THE PHENOMENA OF IMPACT FLASH AND ITS RELATION TO THE REACTION OF THE LUNAR SURFACE TO THE IMPACT OF A LUNAR PROBE, by J. W. Gehring and D. W. Sleck, Paper presented at A.R.S. Lunar Missions Meet., Cleveland, Ohio, 17-19 Jul 62, A.R.S. paper 2476-62, 12 pp., 19 figs., tbl., 15 refs.

A description of the preliminary results of an experimental investigation to evaluate the physical phenomena associated with

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the impact of a lunar probe on the surface of the moon. In view of the tasks proposed by NASA for the future Surveyor and Prospector series of vehicles, it is of utmost importance to learn as much as possible about the lunar surface from the impact of the earlier Ranger Vehicle tests.

The experimental program consisted of a parametric study involving the variables associated with the impacting projectile versus targets designed to simulate the lunar surface. The tests consisted in firing projectiles of varied mass, material, and velocity into a variety of target materials. Observations were made and quantitative data were obtained for the magnitude of the luminosity of the impact flash, the duration of the flash, and the spectrum of emitted light. Also, high-speed optical pictures were made to determine the disposition of the impacting projectile and the debris ejected from the resultant crater. From the analysis of the experimental data, it is possible to make an estimate of the impact flash likely to be observed on impact of a lunar probe of the moon's surface.

Results of this limited study indicate there is a possibility of recording the impact of a space probe or a meteoroid on the surface of the moon by observations made from the earth if the impact takes place on a "dark" moon (illuminated by earth shine only). But if the impact occurs on the bright surface of a full moon, recording of the impact by earth observations would appear to be a most difficult task.

184. Geiss, J.
THE HISTORY OF COSMIC RADIATION AS REVEALED BY ISOTOPIC CHANGES IN THE METEORITES AND ON THE EARTH, by J. Geiss, H. Oeschger, and U. Schwarz, Space Sci. Revs., v. 1, no. 2, Oct 62, pp. 197-223, 13 figs., 61 refs.

In meteorites, in the atmosphere of the earth and at the surface of the moon nuclear transformations are continuously induced by cosmic radiation and solar high energy particles at an appreciable rate. Detectable amounts of a number of stable and radioactive isotopes are produced, the determination of which gives information on a variety of subjects, such as the life history and origin of meteorites, the time scales of terrestrial, prehistorical and geological events, and the intensity, energy spectrum, spatial distribution and possible time variations of the cosmic and high energy solar radiations. Discussed are: (1) the history of cosmic and solar radiations deduced from isotopes produced in the atmosphere; (2) spallation isotopes in meteorites; (3) spallation reactions; (4) the application to stable isotopes in meteorites; (5) the intensity of cosmic radiation during the last 10^7 years; (6) detectability of intensity variations; (7) comparison of radiation intensities at 1 A.U. and 3 to 4 A.U.; (8) long-time intensity variation (10^8-10^9 years); and (9) the spectrum and absolute intensity of cosmic radiation.

185. Gell, C. F.
BIOLOGICAL EFFECTS OF SIMULATED MICROMETEOROID PENETRATION IN A SEALED CHAMBER CONTAINING ANIMAL SPECIMENS, by C. F. Gell, A. B. Thompson, and V. Stembridge, Aerospace Med., v. 33, no. 2, Feb 62, pp. 156-161, 5 figs., 5 refs.

A discussion of the results of firing aluminum pellets at hypervelocities into a small chamber containing rat specimens. The chamber was located inside a vacuum tank and the projectiles fired through a vacuum attained velocities of 23,000 fps or approximately 17,000 mph. Evidence of oxidative explosion within the chamber was secured by photography. Animal experiments demonstrated the pathological effect of these explosions on incarcerated rats as ranging from mild to lethal, depending on certain physical factors and the internal environment of the chamber. To ensure man's safety in prolonged and extensive space trips an exhaustive study should be conducted to evaluate the factors which create the optimum configuration for oxidative explosion if a space ship is penetrated by a meteoroid.

186. GEMINID METEORS WIDELY OBSERVED, Sky and Telescope, v. 23, no. 2, Feb 62, p. 66, fig.

Brief descriptions are given of observations made during the Geminid meteor shower of 11 December, 1961.

187. General Dynamics Corp., Astronautics Div., San Diego, Calif.
INVESTIGATION OF RECOVERED FRAGMENTS FROM ATLAS 109-D BOOSTER, by J. J. Sheppard, Jr., Contr. AF 29(601)-4893, Rept. no. AE 62-0558, 1 Jul 62, 46 pp., 31 figs., 6 tbls.

Some of the preliminary results of a current investigation are presented on four recovered fragments of Atlas 109-D which put the Mercury Capsule Friendship 7 into orbit in the NASA MA-6 orbital flight on 20 February, 1962. The fragments were recovered in the Republic of South Africa and subsequently shipped to General Dynamics/Astronautics. Presented are some tracking data of the Atlas 109-D booster on its passes over North America and on orbital calculation by the NASA to investigate the phenomena which were necessary to cause an impact in the Republic of South Africa. The fragments were subjected to physical, chemical, and visual examinations to determine features which could be related to the fragments' flight history. The fragments exhibit extensive cratering apparently as a result of hypervelocity impacts. The distribution of the cratering is presented in preliminary form.

188. General Dynamics Corp., Astronautics Div., San Diego, Calif.
INVESTIGATION OF RECOVERED FRAGMENTS FROM ATLAS 109-D BOOSTER - SUPPLEMENTAL INFORMATION, by W. H. Gallaher, Contr. AF 04(647)-768, Rept. no. AE 62-0828, 14 Sep 62, 13 pp., 7 figs., 4 tbls., 3 refs.

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Supplemental results are presented of an investigation on four fragments recovered in South Africa from the Atlas 109-D booster as well as results of a preliminary investigation on two other fragments recovered in the same area. Results of an investigation made on the hypervelocity craters exhibited by the fragments are presented.

189. General Dynamics Corp., General Atomic Div., San Diego, Calif. A PROGRAM OF RESEARCH FOR THE DETERMINATION OF RARE-EARTH ABUNDANCES IN METEORITES, by R. A. Schmitt and R. H. Smith, Contr. NASr-75, Rept. no. GA-2782 (Rev.), Quarterly prog. rept. (15 Sep-15 Dec 61), 29 Dec 61, NASA N62-10811, (OTS $3.60), 40 pp., 6 figs., 5 tbls., 26 refs., appen.

Recent meteoritic data indicate that the relative concentrations of rare-earth elements (from Nd to Lu, inclusive) are nearly identical in carbonaceous, enstatitic, and bronzitic chondrites. Since the La/Ce ratio is the same for Murray, St. Mark, and the two achondrites Nuevo Laredo and Pasamonte, the Ce content in the "ordinary" chondrites Allegan and Richardton of 0.52 ppm is probably in error and low by about 50%. Approximately a 25% enrichment of the heavy rare-earth element group (Tb through Lu) occurs in the two achondrites when they are compared with the meteorites Murray and St. Mark.

A neutron-activation analysis of a basaltic sample from Kilauea Iki-22 has shown that the relative rare-earth elements (REE) contents agree with the average REE contents found in Japanese and European mesozoic and paleozoic shales. Such a similarity in relative REE content between the Kilauea sample and the shales suggests that either (1) the Pacific silicate mantle has two different layers: a top layer rich in light REE, and a bottom layer rich in heavy REE, or (2) if the concentration in chondritic meteorites is identical to the REE contents present in the earth's mantle, then the REE in Kilauea Iki-22 basalt are chemically fractionated to the same degree at the volcanic root as were the REE during formation of the earth's crust.

The procedure for determining the rare-earth elements in stony matter was slightly modified, which eliminated the use of the TRIGA reactor, and expedited concentration calculations.

190. General Dynamics Corp., General Atomic Div., San Diego, Calif. A PROGRAM OF RESEARCH FOR THE DETERMINATION OF RARE-EARTH ELEMENTAL ABUNDANCES IN METEORITES, by R. A. Schmitt and R. H. Smith, Contr. NASr-75, Rept. no. GA-3411, Annual rept. (15 Sep61-14 Aug 62), 28 Aug 62, NASA N62-16636, (OTS $8.10), 76 pp., 12 figs., 8 tbls., 70 refs.

Abundances and isotopic ratios have been determined for the fourteen rare-earth elements (Pm excluded) plus Sc and Y by neutron activation analysis in nineteen meteorites and in

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three terrestrial specimens. The meteorites investigated included eleven chondrites (1 carbonaceous specimen, 2 pigeonites, 2 hypersthenes, 3 bronzites, and 3 enstatites), two calcium-rich and three calcium-poor achondrites, one mesosiderite, and two iron meteorites; the terrestrial specimens included a fresh volcanic basalt and a deep-seated peridotitic and an eclogitic specimen.

191. General Electric Co., Advanced Electronics Center, Ithaca, N.Y. "Current Estimates of the Effects of Meteoroids on the Skin of a Satellite Vehicle," by M. Kornhauser, Sect. D, pp. 53-65, 3 figs., 3 tbls., 11 refs.; in ADVANCED DEVELOPMENT OF SATELLITE COMMUNICATIONS SYSTEMS, by J. I. F. King, et al., Contr. DA-36-039-sc-85236, ARPA Task no. 55-59, Special rept. Task III: Space Environment and Vehicular Effects, July 60, ASTIA AD 244 960, 90 pp.

Using the most recent rocket and satellite data on the incidence of meteoroids in space together with the best information on the penetrating and cratering effects of hypervelocity particles, conservative estimates have been made of exposure time versus number of penetrations of the satellite's skin, rate of removal of surface material, and percentage of surface area covered by pits.

192. General Electric Co., Missile and Space Vehicle Dept., Philadelphia, Penn.
INTERPLANETARY WEATHER, by I. Jurkevich, TIS R60SD334, Mar 60, 38 pp., 12 figs., 32 refs.

An attempt is made to outline conditions which are believed to exist in interplanetary space and to point out areas which require a great deal of additional attention. The discussion is divided into three areas. The first deals with solid matter in interplanetary space, the second concerns its electromagnetic state, and the third is devoted to its gas and elementary particle content. The very last part of the discussion, dealing with a forecasting program, should be considered as standing somewhat apart from the remainder of the report.

193. General Electric Co., Valley Forge Space Technology Center, King of Prussia, Penn.
PIC FORMULATION OF VISCO-PLASTIC MODEL FOR HYPERVELOCITY IMPACT, by T. D. Riney, Contr. AF 08(635)-1713, Proj. 9860, Quart. prog. rept. no. 5 (3 Feb 62-22 May 62), Jul 62, APGC-TDR-62-40, NASA N62-15953, 47 pp., 4 figs., 5 tbls., 7 refs.

The visco-plastic equations governing the axisymmetric impact situation are reformulated in a form appropriate to the particle-in-cell method of calculation. A step-by-step

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description of the computational procedure is presented which allows for such contingencies as free boundaries, interior empty cells and the axis of symmetry. A programmer may work directly from this report.

194. Germany. Max-Planck-Institut Für Chemie, Mainz
TRITIUM DETERMINATIONS IN ATMOSPHERIC GASES AND METEORITES, by F. Begeman, Contr. AF 61(052)-465, Summary rept. no. 1 (1 Nov 60-31 Oct 61), 1961, AFCRL-62-295, ASTIA AD 279 568, 12 pp., 3 figs., 2 tbls., 12 refs.

Measurements indicate the tritium content of atmospheric methane seems to have been roughly constant during the last two years. Compared to the T/H ratio of atmospheric hydrogen collected at the same locality at the same time, the tritium content of methane is lower by about a factor of 20 than that of hydrogen. It is to be expected, however, that this ratio will vary with time and place of collection of the samples.

A special vacuum system was set up for the melting and the extraction of rare gases from stone and iron meteorites. The performance of the system was checked in a number of trail runs with and without using tritium as a tracer. After completion of the preliminary tests it turned out, however, that all meteorites in the collection of the Institute are more or less heavily contaminated with artificial tritium and hence cannot be analysed reliably for cosmogenic tritium. A detailed description of the extraction system is therefore postponed until some meteorites can be secured from other sources and the results on these meteorites are available.

195. Giese, R.-H.
OPTISCHE EIGENSCHAFTEN VON MODELLEN DER INTERPLANETAREN MATERIE, (OPTICAL PROPERTIES OF MODELS OF THE INTERPLANETARY MATTER), by R.-H. Giese and H. Siedentopf, Z. Astrophys., v. 54, no. 3, 1962, pp. 200-216, 8 figs., 6 tbls., 11 refs., (in German).

The optical properties of different models of the interplanetary matter consisting of spherical particles of dielectric and metallic materials with or without an additional electron component are considered. Comparison with the observed intensity and polarization along the axis of the zodiacal light shows that the necessary number of particles near the earth's orbit lies for all models in the neighborhood of 10^{-15} cm^{-2} for dielectric and 10^{-13} cm^{-3} for metallic materials and increases slowly towards the sun. For all models consisting of spherical particles an additional electron component with at least 300 electrons/cm^3 near the earth's orbit is necessary to give the observed polarization between elongations of 30° to 80°. If there are only dust particles in the interplanetary matter, they should be of elongated form and aligned by some field of force.

196. Gilvarry, J. J.
DIMENSIONAL CORRELATION OF LUNAR MARIA AND TERRESTRIAL OCEAN BASINS, Nature (London), v. 196, no. 4858, 8 Dec 62, pp. 975-976, fig., 3 refs.

In a previous paper (J. J. Gilvarry, Nature (London), v. 188, no. 4754, 10 Dec 60, pp. 886-891) it was shown that the correlation of diameter versus depth for lunar craters of different apparent ages can be understood in terms of the former presence of a lunar hydrosphere lasting some milliards of years, affecting the relative dimensions at crater formation. Furthermore, this correlation of dimensions included the lunar maria, and was extended later (J. J. Gilvarry, Nature (London), v. 190, no. 4781, 17 Jun 61, pp. 1048-1053) to include the terrestrial ocean basins (corrected for isostasy from the mensuration of present basins). The purpose of the communication is to correct a difficulty in the correlation curves for craters formed explosively in water.

197. Gindilis, L. M.
ABSOLUTE SPECTROPHOTOMETRY OF THE GEGENSCHEIN CONTINUUM, Soviet Astronomy (AJ), v. 6, no. 1, Jul-Aug 62, pp. 67-76, 4 figs., 4 tbls., 14 refs.; trans. of Astron. Zhur., v. 39, no. 1, Jan-Feb 62, pp. 93-106.

A description is given of the procedure and results of an absolute spectrophotometry of the gegenschein. The observations were made at the Sternberg Institute's high-mountain station (H = 3000 m) in the Zailiiskii Alatau Mountains (near Alma-Ata) with a nebular spectrograph (f/0.7; dispersion 2000 A/mm at λ = 5500 A). The observational material, covering the wavelength range 4200-6500 A, is presented in Table 1. Figures 3 and 4 show the determinations of the absolute brightness in the gegenschein spectrum, and Table 3 gives the integrated brightness.

The brightness of the gegenschein fluctuates marked with time and increases with the sky brightness (Fig. 2). Apparently a common agency is responsible for the rise in the brightness of both sky and gegenschein, perhaps a corpuscular stream passing close to the earth and projected onto the antisolar region of the sky.

The integrated brightness of the gegenschein for λ = 4200-6500 A, was 1.1 ± 0.05 erg/cm^2 · sec · sterad on geomagnetically quiet nights, the visual brightness $6^m.1 \pm 0^m.06$ per deg^2 or 37 ± 2.10^m (visual) stars per deg^2, the mean contrast 11%. The gegenschein brightens during geomagnetic disturbances.

The energy distribution in the gegenschein spectrum has been obtained. It corresponds to that for the scattering of sunlight by interplanetary dust particles (scattering coefficient $\propto \lambda^{-x}$, $1 < x < 2$). The nature of the gegenschein is discussed.

198. Glasel, J. A.
THE BOMBARDMENT OF SOLID D_2O BY LOW ENERGY ELECTRONS UNDER ASTRONOMICAL CONDITIONS, Proc. Natl. Acad. Sci. U.S., v. 48, no. 4, Apr 62, pp. 491-496, 2 figs., 8 refs.

About one half of the mass of the universe exists in the form of small grains drifting in the interstellar space. The environmental conditions are: low temperature (of the order of 10 to 100°K) and a continual flux of particle and electromagnetic radiation. While very little is known about the exact size of the grains, it appears that they are small (from 10^{-3} to 10^{-5} cm in diameter) and that they polarize starlight, thus indicating a nonspherical shape. Whatever their present condition, most ideas of their original composition visualize them as mixtures of the simple hydrides, methane, ammonia, and water along with perhaps metallic components. Comets, which exist in the interplanetary space, are much larger bodies but are generally regarded as having a similar composition and to exist under similar conditions.

A simple beam source of electrons with energies of 2 Kev is described. The beam is used to bombard solid D_2O held at 77°K, and observations on the rate of production of D_2 from D_2O are presented. The implications of these experiments concerning the effect of astronomical conditions on simple chemical compounds are discussed.

199. Goel, P. S.
COSMOGENIC CARBON-14 IN METEORITES AND TERRESTRIAL AGES OF "FINDS" AND CRATERS, by P. S. Goel and T. P. Kohman, Science, v. 136, no. 3519, 8 Jun 62, pp. 875-876, tbl., 14 refs.

Carbon-14 has been measured in several stone and iron meteorites. For "falls," the C^{14}/Al^{26} ratios in stones and the C^{14}/Cl^{36} ratios in irons are consistent with constant irradiation. The stone "finds" have radiocarbon ages of up to ≥21,000 years. The Henbury craters are apparently ≤7000 and the Odessa craters ≥11,000 years old.

200. Goles, G. G.
ABUNDANCES OF IODINE, TELLURIUM, AND URANIUM IN METEORITES, by G. G. Goles and E. Anders, Geochim. et Cosmochim. Acta, v. 26, Jul 62, pp. 723-737, 2 figs., 5 tbls., 35 refs.

Neutron activation analysis was employed to determine the abundances of I, Te and U in seven bronzite and hypersthene chondrites, three enstatite chondrites and two carbonaceous chondrites. On the basis of twenty-three analyses, the mean abundances in ppm for the three groups were: iodine, 0.040, 0.17 and 0.27; tellurium, 0.51, 2.1 and 1.9; uranium, 0.013, 0.011 and 0.017. In meteoritic iron (four analyses), these abundances covered a wider range, i.e., 11-320, 17-90 and

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<0.15 - <0.6 ppb, whereas five analyses of troilite gave 24-3600, 1200-5000 and 3.5-17 ppb. These data indicate that Te, and to a lesser extent I, are chalcophile in iron meteorites.

In chondrites, I and Te are strongly correlated, and appear to reside (in part) in the same phase, tentatively identified as CaS or MgS.

Four of the meteorites in the present study had been previously analysed by von Fellenberg. His values are found to be uniformly too high by factors of 5-30. It seems likely that most of the data in his fundamental study of the geochemistry of iodine are systematically too high by comparable factors.

201. Gt. Brit. Manchester Univ.
STUDIES IN LUNAR TOPOGRAPHY, Ed. by Z. Kopal, Contr. AF 61(052)-168, Proj. 8602, Dec 61, AFCRL 852, GRD res. notes no. 67, ASTIA AD 275 135, NASA N62-16658, (OTS $9.10), 188 pp., 52 figs., 39 tbls., 31 refs.

A series of reports on work carried out in 1959-60 by members of the Department of Astronomy, University of Manchester, under the direction of Zdenek Kopal, in collaboration with the Director and staff of the Observatoire du Pic-du-Midi (France).

Contents:
Kopal, Z. and G. Fielder, "Determination of the Heights of Mountains on the Moon."
Clarke, D., "Techniques of Photographic Determination of the Heights of Lunar Mountains."
Turner, G., "Errors Involved in the Photographic Determinations of Lunar Heights, and a Preliminary Study of the Region of Ptolemaeus and Alphonsus."
Fielder, G., "Measured Profiles of the Moon's Surface and the Estimates of Magnitudes of the Errors in Relative Altitudes."
Rackham, T., "A Systematic Microdensitometric Technique and Its Applications to Formations in the Mare Imbrium."
Turner, G., "Measured Heights of Lunar Mountains in the South-Eastern Part of Mare Tranquilitatus."
Turner, G., "Measurements of the Heights of the Walls of the Crater Archimedes."
Turner, G., "A Catalogue of Measured Heights in the Regiomontanus and Hell Plain Regions of the Moon."

202. Green, J.
"The Lunar Crust for Life Support," pp. 385-341, 24 figs., 6 tbls.; in LECTURES IN AEROSPACE MEDICINE, (Held at the School of Aerospace Medicine, Brooks AFB, Tex., 8-12 Jan 62), San Antonio, Armed Forces Press Service, 1962, ASTIA AD 281 775, 447 pp.

Most of the major lunar surface features are considered to be volcanic. This is not to completely disallow some impact

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structures. However, regardless of whether the meteoritic or volcanic theory of the origin of lunar craters is considered to be responsible for the majority of the lunar surface features, from the standpoint of life support, volcanic areas on the moon should be sought out because volcanism offers more advantages in basing then impact. A comparison of lunar and terrestrial volcanic features is made and the advantages of volcanic terrain basing are discussed.

203. Green, J.
THE POLAR LUNAR BASE, by J. Green, J. C. Finn, Jr., and O. D. R. Brown, Astronautics, v. 7, no. 7, Jul 62, pp. 20-24, 3 figs., 18 refs.

A base site in a lunar polar area may perhaps be superior to a nonpolar one because of the juxtaposition or association of the following factors: (1) eternal sunlight for power requirements; (2) eternal sunlight for plant growth; (3) normal abundance of fractures and caves, as primitive installation sites; (4) an above-normal distribution of the eternally shadowed zones; (5) association of potentially mineralized shadow zones with the eternally sunlit zones; and (6) normal distribution of raw materials of possible use in base technology. Presumably iron-nickel would be available in any lunar terrain because of cosmic-infall dust.

204. Green, R.
THERMOELECTRIC CURRENTS IN METEORITES, J. Geophys. Research, v. 67, no. 2, Feb 62, pp. 908-909, fig., 2 refs.; see also REPLY TO THE PROCEEDING DISCUSSION, by F. D. Stacey, J. F. Lovering, and L. G. Parry, pp. 910-911, 2 refs.

A geophysical model is proposed whereby a magnetic field may be produced in meteorites other than that of a planetary body (with a magnetic field of terrestrial type) which has subsequently been disrupted as proposed by Stacey, Lovering and Parry (J. Geophys. Research, v. 66, no. 5, May 61, pp. 1523-1534). Along the iron-nickel interface in a meteorite in space there is presumed to be established a temperature gradient. Across the interface thermoelectric potentials are set up and electric current flows which gives rise to a magnetic field parallel to the interface.

The thermoelectric mechanism postulated by Green is dismissed by Stacey, Lovering and Parry (pp. 910-911) on the grounds that the thermoremanence of certain chondrites, of which the bulk of the material is composed of electrical insulators (i.e., the metal grains are isolated in a silicate matrix), can be explained only in terms of a disrupted parent body and not in terms of Green's calculation, based on pure iron and pure nickel.

205. Greenhow, J. S.
RADAR OBSERVATIONS OF METEOR ECHOES AT A FREQUENCY OF 1300 Mc/s, by J. S. Greenhow, H. K. Sutcliffe and C. D. Watkins, Nature (London), v. 193, no. 4820, 17 Mar 62, pp. 1036-1037, fig., tbl., 8 refs.

Results are presented on a search for meteor echoes at 1300 Mc/s, carried out during the maximum of the Geminid meteor shower in 1961 using a high-power transmitter installed in one of the 80-ft telescopes at the Royal Radar Establishment. In order to assist in the interpretation of possible echoes observations were also made using a 32 Mc/s transmitter installed in the same aerial.

206. Greenland, L. P.
SELECTIVE VOLATILIZATION FROM TEKTITES, by L. P. Greenland and J. F. Lovering, Nature (London), v. 196, no. 4860, 22 Dec 62, pp. 1195-1196, tbl., 8 refs.

Calculations presented in this paper do not give any evidence that tektites have in fact been subjected to ultra-high temperatures; but they indicate that such a possibility, with the concomitant implication of significant selective volatilization must be seriously considered.

207. Greenstein, J. L.
THE VISUAL REGION OF THE SPECTRUM OF COMET MRKOS (1957d) AT HIGH RESOLUTION, by J. L. Greenstein and C. Arpigny, Astrophys. J., v. 135, no. 3, May 62, pp. 892-905, 6 figs., 6 tbls., 19 refs.

Detailed measurements of the emission-line spectrum of the head of Comet 1957d were made on Palomar coudé spectra. Because of the strong continuous spectrum, new weak lines or bands could not be expected. The C_2 bands and the NH_2 bands produced by resonance fluorescence are nearly completely resolved. The Na I lines are asymmetric with respect to the nucleus. No significant velocity shifts are found for NH_2. Wavelengths and details of the identifications can be found in Table 2; a few strong unidentified lines are given in Table 4. Figures 1-4 provide an atlas of the visual region of the spectrum. From a discussion of the absence of atomic lines other than Na I, we conclude that Ca I and Al I could be expected to appear in some comets as well as Si I and Mg I in the rocket ultraviolet. A study of the visual observations of the spectrum of Comet 1882 II suggests that one multiplet of Fe I did appear in this great comet, which had $q \approx 0.008$.

208. Grigoriev, D. P.
O SOSTAVLENII MINERALOGII METEORITOV, (ON THE COMPILATION OF METEORITE MINERALOGY), by D. P. Grigoriev, V. D. Kolomenskii, and V. G. Kuznetsova, Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 172-177, 3 figs., (in Russian).

The authors are in the process of compiling all available data concerning meteorite mineralogy. It is proposed that "cosmic mineralogy" (i.e., the mineralogy of meteorites) be considered as a branch separate from terrestrial mineralogy. An historical review is given of all known meteoritic minerals; characteristics of these minerals which distinguish them from the same minerals of terrestrial origin are discussed.

209. Grygar, J.
VISUAL GEMINIDS 1958, by J. Grygar, L. Kohoutek, Z. Kviz, and J. Mikušek, Bull. Astron. Insts. Czech., v. 13, no. 3, 1962, pp. 108-112, 5 figs., 8 tbls., 16 refs.

Visual observations by a group of eight members in a limited circular region in the zenith led to the determination of the luminosity function for shower and sporadic meteors, especially to ascertaining their slope $X_+ = 2.78 \pm 0.16$ (for the Geminids as much as 3^m) and $X_- = 2.70 \pm 0.07$ (for sporadic meteors as much as 5^m). Given is the course of the reduced hourly rates and mean values of "visual" space densities of the meteors. The occurrence of trains with shower and sporadic meteors ($\sim 25\%$) agrees with previous results. It appears that in observations in a limited region, the probability of perception of meteors depends much more on the number of observers in the group than in observations of the whole sky. The theoretically derived corrections for the effect of the limited field of view are compared with empirically established corrections. However, for the used diameter of the limited region these corrections are of secondary significance.

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210. Halperson, S. M.
NRL HYPERVELOCITY ACCELERATOR (THREE-INCH LIGHT-GAS GUN), by S. M. Halperson, R. H. Fuller, and H. V. Schlemmer, Rept. of NRL Prog., Aug 62, (PB 181 075), pp. 12-16, 5 figs., 5 refs.

There is much current interest in techniques to accelerate fragments to velocities comparable to those of missiles and meteoroids. One proposed method of defeating an enemy ICBM during re-entry is by fragment impact on a vulnerable section. Damage to space craft and satellites by meteoroid

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impact is also of topical interest. The expendable central section light-gas gun developed at NRL is one of the more useful of the laboratory tools developed to attain very high velocities. Recently a light-gas gun facility designed to accelerate masses from 10 to 40 gm to velocities in excess of 6 km/sec was completed at NRL. Some proof tests have been made, but optimization of loading parameters has not been completed. A maximum velocity of 7.82 km/sec has been reached with a 5-gram mass.

211. Hammersley, J. M.
"On the Statistical Loss of Long-Period Comets From the Solar System, II," pp. 17-78, 7 figs., 14 tbls., 13 refs.; in PROCEEDINGS OF THE FOURTH BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS, VOLUME III: ASTRONOMY, METEOROLOGY, AND PHYSICS, (Held at Berkeley, Calif., 20 Jun-30 Jul 60), Berkeley, Univ. California Press, 1961, 335 pp.

This paper deals with the distribution of the lifetimes of comets, and the way in which this distribution of lifetimes affects the total population of observable comets regarded as a function of the age of the solar system.

212. Hargraves, R. B.
REVIEW OF GEOLOGIC EVIDENCE, OPINION, AND CURRENT RESEARCH RELEVANT TO THE IMPACT ORIGIN OF THE VREDEFORT RING, (Abstract), J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3563.

In view of the apparent focal location of the Vredefort ring with respect to the Witwatersrand basin (Brock, 1950), or even to larger-scale structural trends (Truter, 1941; Du Toit, 1954), South African geologic opinion has at least been unanimous in requiring that the forces responsible for its formation (centripetal or centrifugal) be of terrestrial origin. The recent discovery of shatter cones in the Vredefort ring (Hargraves, 1961) has revived interest in the origin of this structure and in the possibility of its formation by meteorite impact (Daly, 1947; Dietz, 1961). W. I. Manton has undertaken systematic study of the orientation of shatter cones and for the most part has found them to point radially inward and upward, once the folded beds that contain them are restored to the horizontal. L. O. Nicolaysen is making age measurements on the alkali granite and enstatite granophyre, two Vredefort rock types selected with a view to determining (1) the approximate age of the structure and (2) the validity of their sequence as required by the impact hypothesis. As far as is known, coesite has not yet been identified in any Vredefort rock.

213. Hartmann, W. K.
CONCENTRIC STRUCTURES SURROUNDING LUNAR BASINS, by W. K. Hartmann and G. P. Kuiper, Communs. Lunar and Planet. Lab., Univ. Arizona, v. 1, no. 12, 20 Jun 62, pp. 51-66, fig., 77 pls., 2 tbls., 9 refs.

A discussion of lunar basins, most of which are the sites of extensive flooding and are known as maria. A primary conclusion of this paper is that multiple-ring structures are typical of the large circular basins. Major impacts formed the basins in a manner analogous to the crater-formation processes discussed by Baldwin (THE FACE OF THE MOON, Univ. Chicago Press, 1949, 239 pp.). Around these larger impact sites, stresses were set up which resulted in faulting at some distances outside the crater rim. Some of the outer ring systems became lost in the rough terrain produced by later crater-forming events. Heating (due to radioactivity) and resulting expansion of the moon could have aided the faulting processes at the surface, releasing strains set up by the original impacts. Toward the end of the internal melting process, lavas reached the surface and partial flooding or melting of the crust occurred. Lavas tended to well up at two typical positions, (1) at the site of an impact, i.e., in the inner basin where the crust was shattered to great depth and where there was a local mass deficienty; and (2) along the fault planes of the outer rings. It is believed that the direction of impact may be derived from the structure of the surrounding walls.

214. Harvard College Observatory, Cambridge, Mass.
Harvard Announcement Cards, 1962.

The following cards, dealing primarily with cometary positions, elements and ephemerides, were issued during 1962:

Card Number	Date	Subject
1556	4 Jan 62	Comet P/Harrington-Abell (1962a)
1557	1 Feb 62	Comets P/Harrington-Abell (1962a) and P/Tuttle-Giacobini-Kresak (1962b)
1558	7 Feb 62	Comet Seki-Lines (1962c)
1559	12 Feb 62	Comet Seki-Lines (1962c)
1560	16 Feb 62	Comets Seki-Lines (1962c); P/Tuttle-Giacobini-Kresak (1962b); P/Harrington-Abell (1962a); P/Perrine (1961h); P/Grigg-Skjellerup(1961g)

Continued

1561	19 Feb 62	Comet Seki-Lines (1962c)
1562	6 Mar 62	Comet Seki-Lines (1962c)
1563	14 Mar 62	Comet Seki-Lines (1962c)
1564	2 Apr 62	Comet Seki-Lines (1962c)
1565	2 Apr 62	New White Dwarfs
1566	25 Apr 62	Comet Humason (1961e)
1567	2 May 62	Comet Honda (1962d)
1568	7 May 62	Comet Honda (1962d)
1569	14 May 62	Comet Honda (1962d)
1570	16 May 62	Comet Honda (1962d)
1571	23 May 62	Comet Honda (1962d)
1572	28 May 62	Comet Ashbrook-Jackson (1956 II)
1573	31 May 62	Comet Whipple (1955 VIII)
1574	9 Jul 62	Peculiar Blue Variable and Supernova
1575	15 Aug 62	Comet Humason (1961e)
1576	18 Sep 62	Peculiar Blue Variable
1577	28 Nov 62	Supernova in NGC 1073 and TX Piscium
1578	14 Dec 62	Comet Seki-Lines (1962c)

215. Harvard Univ., Div. of Engineering and Applied Physics, Cambridge, Mass.
TWILIGHT INTENSITY AT 20 DEGREES ELEVATION. ANALYSIS AND DISCUSSION OF OBSERVATIONS, by F. E. Volz, R. M. Goody, and N. P. Carleton, Contr. AF 19(604)-4546, Proj. 7690, Final rept., May 62, AFCRL-62-856, ASTIA AD 284 482, (OTS $8.60), 95 pp., 27 figs., 4 tbls., 39 refs., appen.

The motivation for this investigation was a desire to obtain information about stratospheric, mesospheric and possible ionospheric dust concentrations. Dust has been a neglected atmospheric constituent at high levels, and computations of heat balance and chemical reaction rates normally take no note of its presence. The phenomenon of noctilucent clouds must in some way be related to the aerosol problem, either as the direct source of material or by supplying nuclei of condensation.

Contents:
Theoretical Considerations.
Ozone and the Spectrum of Twilight.
Tropospheric Cloud and Turbidity.
Twilight Groups.
Approximate Calculation of Dust Densities.
Discussion of Dust Profiles.
Conclusions.
Appendix: Meteors and Atmospheric Dust.

216. Harwit, M.
PLASMA DYNAMICS IN COMETS, II. INFLUENCE OF MAGNETIC FIELDS, by M. Harwit and F. Hoyle, Astrophys. J., v. 135, no. 3, May 62, pp. 875-882, 2 figs., 12 refs.

An attempt is made to find a mechanism consistent with Biermann's theory that tail ions are accelerated through interaction with streams of solar particles. In Paper I it was shown that collective interactions are not likely to explain a large momentum transfer between streems of solar particles and comet tails. In Paper II it is shown that, if predominantly transverse magnetic fields are imbedded in the solar stream, the observed accelerations can be readily imparted to tail ions. It is also possible to account for $\sim$10 km sec^{-1} observed ejection velocities from comet heads and for the filamentary structure of many comet features. Observational tests for the transverse field hypothesis are suggested.

217. Haskin, L.
THE RARE-EARTH DISTRIBUTION IN SEDIMENTS, by L. Haskin and M. A. Gehl, J. Geophys. Research, v. 67, no. 6, Jun 62, pp. 2537-2541, fig., 2 tbls., 21 refs.

Neutron activation analyses confirm the essential constancy of the relative abundances of rare-earth elements for most sediments, as found by E. Minami in 1935. Values for yttrium and some of the lanthanides in the Forest City chondrite are given. The yttrium content of 2.15 ppm corresponds to 4.1 atoms of yttrium per 10^6 silicon atoms for chondrites. Possible reasons for the difference in the sediment and chondrite rare-earth distributions are considered.

218. Hawkins, G. S.
RADAR DETERMINATION OF METEOR ORBITS, Astron. J., v. 67, no. 5, Jun 62, pp. 241-244, 4 figs., 22 refs.

The development of the study of meteor orbits is described from the single station to the multistation systems. Meteor orbits are divided into two classifications, major streams and minor streams plus sporadics. The orbits of the major streams are similar in their distribution to the orbits of short-period and long-period comets, but the second group exhibits different characteristics. More than 99% of sporadic meteors with mass greater than 10 mg are moving in direct orbits. This unidirectional rotation is an important property of the particles in interplanetary space. At fainter magnitudes the results of the Harvard Radio Meteor Project and other researchers reveal an additional component. A large proportion of the smaller particles are moving in almost circular orbits tilted at a steep angle to the plane of the solar system. If this "toroidal group" represents a steady-state system then it is of considerable importance in cosmogony.

219. Hayes International Corp., Birmingham, Ala.
STUDY OF TARGET PENETRATION PREDICTION BY HIGH-SPEED AND ULTRA-HIGH-SPEED BALLISTIC IMPACT, Contr. AF 08(635)-2155, Proj. 9860, Quart. rept. no. 3 (1 Jan-31 Mar 62), May 62, APGC-TDR-62-35, ASTIA AD 276 426, (OTS $1.60), 13 pp., fig., tbl., 17 refs.

Statistical correlation, based on all hypervelocity terminal ballistic data gathered prior to December 1961, attempts to relate the depth of penetration in semi-infinite targets with ten independent variables. Without any initial assumptions being made regarding the process of ballistic impact of the shape of the craters formed, this analysis produced an equation quite similar to the empirical equation used by many investigators to fit their data. Also reported are initial attempts to formulate a theoretical model for the purpose of testing accumulated experimental data. This theoretical model is developed from a consideration of energy conversion during impact.

220. Hayes International Corp., Birmingham, Ala.
STUDY OF TARGET PENETRATION PREDICTION BY HIGH-SPEED AND ULTRA-HIGH-SPEED BALLISTIC IMPACT, Contr. AF 08(635)-2155, Proj. 9860, Quart. rept. no. 4 (1 Apr 62-30 Jun 62), Aug 62, APGC-TDR-62-51, NASA N62-17413, 39 pp., 3 figs., 12 tbls., 13 refs.

A statistical analysis of the penetration depth in semi-infinite targets divided by the diameter of the projectile (P_c/D_p) on 1272 experimental shots has been completed. The data were split into 895 low velocity shots and 297 high velocity shots according to the bulk wave velocity in the target material. Separate analyses of the two groups show interesting relationships with existing theoretical and empirical equations. A semi-rational penetration expression has been developed from work-energy consideration which suggests that the nonrecoverable target compression and shear strain energies may account for most of the kinetic energy of the projectile. Judging from a preliminary comparison with existing experimental data, a penetration model of the form developed herein shows some promise for predicting impact behavior over a wide velocity range for different projectile and target materials.

221. Head, V. P.
A LUNAR SURFACE MODEL FOR ENGINEERING PURPOSES, Paper presented at A.R.S. Lunar Missions Meet., Cleveland, Ohio, 17-19 Jul 62, A.R.S. paper 2475-62, 13 pp., 11 figs., 9 tbls., 22 refs.

Sub-resolution surface geometry and soil strength of the maria are deduced using evidence from several disciplines. Contiguous and overlapping craterlets in sintered granular rock of strength proportional to depth are predicted for the least formidable areas, and demonstrated by table-top models of the lunar

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surface and by statistical and thermomechanical studies. Scale factors required for dynamic model testing of a lunar surface mechanism at earth gravity are derived and tabulated, with consideration for the interaction between model mechanism and environmental model terrain. Vigorous pursuit of engineering interpretations of thermal, photometric, radar-echo, and radar-penetration evidence is shown to be well worthwhile, and close-up visual observation and soil penetration experiments are urged, as vital precursors to the lunar mission.

222. Henderson, E. P.
PRELIMINARY REPORT OF THE IDER, ALABAMA, AND THE CLOVIS, NEW MEXICO, METEORITES, (Abstract), by E. P. Henderson and R. S. Clarke, Jr., J. Geophys. Research, v. 67, no. 9, Aug 62, pp. 3564-3565.

The Ider, Alabama, meteorite was discovered on Sand Mountain in northern Alabama and identified in 1961. This weathered octahedrite may have fallen in Pennsylvanian times, 200 million years ago. Its etched pattern and weathering are similar to a little-known iron found 90 miles to the north. The Ider meteorite should interest those studying the long half-lives of certain isotopes. The Clovis, New Mexico, stony meteorite, weighing 625 lb, was found in Quaternary beds near Clovis in 1961 and is the largest meteorite from that state. One side shows a rounded dome, indicating that it was the front face during flight in the atmosphere; the opposite side is covered with fragments broken during flight or on impact. These fragments are firmly bonded to the meteorite by weathering, but the terrestrial formations are not cemented to the meteorite. The Clovis meteorite is compared with other nearby chondrites.

223. Heymann, D.
SPUTTERING BY 20-Kev Ar^+ IONS AT NORMAL INCIDENCE ON METEORITES, by D. Heymann and J. M. Fluit, J. Geophys. Research, v. 67, no. 7, Jul 62, pp. 2921-2924, 2 tbls., 16 refs.

Information on space erosion of meteorites has been gathered from exposure ages of iron meteorites. In this work meteorite targets have been bombarded with 20-kev Ar^+ ions in an isotope separator. The results show that the iron meteorite Canyon Diabolo erodes faster than the stone meteorites Arapahoe and Richardton. The rates of erosion are 2 mg/coulomb, 1.4 mg/coulomb, and 1.2 mg/coulomb, respectively. In the discussion it is shown that ions heavier than helium ions account for only a small fraction of space erosion by ions. However, erosion by helium ions may be comparable to erosion by protons. The experimental results seem to indicate that space erosion by ion bombardment cannot explain large differences in exposure ages of iron and stone meteorites.

224. High Altitude Observatory, Boulder, Colo.
INFLUX OF METEOR PARTICLES IN THE UPPER ATMOSPHERE AS DETERMINED FROM STRATOSPHERIC CORONAGROPH OBSERVATIONS, by G. Newkirk, Jr. and J. A. Eddy, Paper presented at Third Intern. Space Sci. Sym. and Fifth COSPAR Plenary Meet., Washington, D.C., 30 Apr-9 May 62, NASA N62-15189, 22 pp., 9 figs., 25 refs.

As a part of a program to investigate the feasibility of coronal observations from balloons, the High Altitude Observatory has flown an externally occulted coronagraph up to heights of 82,000 ft to measure the angular and wavelength distribution of the daylight sky. The sky radiance close to the sun is of interest not only to the instrument designer, who is concerned with the contrast between a target such as a planet or an artificial satellite and the sky at high altitudes, but also to the astronomer, who can make inferences about the sedimentation rate of meteoric material into the upper atmosphere. These inferences can serve as a valuable complement to the direct determinations of meteoric influx made from rockets and satellites.

The observations made confirm the conclusion of Junge and his collaborators that an aerosol layer at a height of approximately 65,000 ft exists. The form of such a layer suggests that the majority of particles in it are of terrestrial origin and that the maximum is due either to the concentration of particles by advection or by in situ formation. The sharp drop of particle concentration with height above the maximum of the aerosol layer can be further interpreted under the assumption that a steady state prevails and only two mechanisms--diffusion and sedimentation--govern the flow of particles. The air above 80,000 ft contains more particles in the size range $0.1\mu < r < 3.0\mu$ than can be explained by diffusion from below. The origin of the excess particles is found to be in the sedimentation of meteoric material downward.

225. Hintenberger, H.
UREDELGASE IM METEORITEN BREITSCHEID, (PRIMORDIAL RARE GASES IN THE BREITSCHEID METEORITE), by H. Hintenberger, H. König, and H. Wänke, Z. Naturforsch., v. 17a, no. 4, Apr 62, pp. 306-309, 2 tbls., 13 refs., (in German).

Primordial rare gases have been found in the chondrite Breitscheid, which shows like Pantar light and dark regions. The primordial rare gases are only to be found in the dark portions; they amount to 179×10^{-6} cm^3 STP/g helium and 221×10^{-8} cm^3 STP/g neon. The isotopic compositions of the primordial rare gases have been determined by subtraction of the amounts of the radiogenic and cosmic ray produced rare gases measured in the light portions. Possible alterations of the isotopic abundances of the primordial rare gases in the time

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interval between the end of the nucleosynthesis and their capture in the meteoritic matter are discussed. The radiogenic helium age has now been determined to be 1.63 X 10^9 years.

226. Hirst, W. P.
THE NATURE OF THE LUNAR "RAYS," Monthly Notes Astron. Soc. Southern Africa, v. 21, nos. 1/2, 28 Feb 62, pp. 2-3.

It is suggested that lunar rays may be composed of innumerable spheres of glass-like material formed through the fusion of rocks rich in silica by the impact of large meteoric masses.

227. Hogg, H. S.
THE LEONID SHOWER OF 1833, J. Roy. Astron. Soc. Can., v. 56, no. 5, Oct 62, pp. 215-221, fig., 4 refs.

Extracts are published from some of the less well known eyewitness accounts of the Leonid meteor shower of 1833.

228. Hogg, H. S.
THE LEONID SHOWER OF 1833 (Concluded), J. Roy. Astron. Soc. Can., v. 56, no. 6, Dec 62, pp. 257-261, ref.

Extracts are published from eyewitness accounts which specially describe fireballs, along with other phenomena of the Leonid meteor shower of 1833.

229. Hogg, H. S.
THE TUNGUSKA METEORIC EVENT, J. Roy. Astron. Soc. Can., v. 56, no. 4, Aug 62, pp. 174-179, fig., 5 refs.

Extracts of old reports pertaining to the fall of the Tunguska meteorite are given. The event occurred in the basin of the Podkamennya Tunguska river in Central Siberia on June 30, 1908. The bolide travelled from SE to NW or from SSW to NNE according to different investigators. The fall could be seen in a cloudless sky in Central Siberia over an area about 1500 km in diameter. A thick dust trail remained along the path, and over the place of fall, fire and a cloud of smoke were seen. Strong detonations, thunder, crackling and rumbling were heard after the fireball itself had disappeared. The sound phenomena were heard up to 1000 km from the place of fall. Over the area where light phenomena were seen, ground tremors were felt, buildings shook, and windowpanes broke. A tent of Evenkians on the taiga about 40 km from the fall was lifted into the air, along with the people inside. The forest was charred and flattened over an area of 250 square kilometers. The central uprooted region had a radius of 12-15 km. From the size of the area over which sound was heard, and the force necessary to uproot the forest, Astapovich calculated the energy of the Tunguska meteorite to be 10^{21} ergs/sec.

230. Hopkins, A. K.
METEORITICS AND HYPERVELOCITY STUDIES, Air Univ. Quart. Rev., v. 13, no. 4, Summer 62, pp. 121-131, 5 figs., 15 refs.

Although knowledge of the meteoroid environment is increasing, making it possible to compute the probability of encounter with particles of various masses, the designer is still faced with the problem of determining an optimum vehicle structure to provide both mission capability and reasonable probability of survival throughout the mission. The solution is in increased knowledge of hypervelocity impact effects of simulated meteoroids and micrometeoroids at meteoritic velocities. Discussed are: (1) nature of the environment; (2) meteoric impact; (3) impact effects; (4) experimental observations; and (5) needs for the future.

231. Hopkins, A. K.
"The Meteoroid Hazard and its Simulation," 7 pp., 6 refs.; in NATIONAL SYMPOSIUM ON THE EFFECTS OF SPACE ENVIRONMENT ON MATERIALS, (A meeting of the Soc. of Aerospace Material and Process Engineers held at St. Louis, Mo., 7-9 May 62), Azusa, Calif., Society of Aerospace Material and Process Engineers, 1962, 522 pp.

One of the hazards encountered by vehicles operating in space is the presence of solid particles having velocities ranging from zero to ninety kilometers per second with respect to the vehicle. Outlined herein is the research completed to date, including recent meteoroid distribution data and probabilities of vehicle skin penetration. The nature of the problem is presented as well as methods so far developed and proposed for accelerating particles to the super-velocities desirable for experimentation. The most significant breakthrough in accelerating macro-particles to above twenty kilometers per second is discussed. The observations and analyses of particle impact effects are covered including energy partition, penetration and spallation.

232. Hopkins, A. K.
YOU DON'T WORRY ABOUT THE BIG ONES, Machine Design, v. 34, no. 23, 27 Sep 62, pp. 142-145, 6 figs.

It is necessary to learn more about the spatial and mass distribution of meteoroids over the orbit and range of the earth, as well as increase our understanding of the penetrability of high-speed particles. Research is progressing in both of these areas; known meteoroid facts and simulation studies are briefly surveyed.

233. Hoyle, F.
PLASMA DYNAMICS IN COMETS, I. PLASMA INSTABILITY, by F. Hoyle and M. Harwit, Astrophys. J., v. 135, no. 3, May 62, pp. 867-874, fig., 11 refs.

Biermann has suggested that ionized gas clouds in comet tails are accelerated by collision with a stream of solar particles. In Paper I the field-free case is treated in order to establish conditions for which cometary plasma acceleration may be enhanced by plasma instability. A general criterion is derived for instability of plasmas of arbitrary ionic composition and velocity distribution. The result is applied to determine the stability of a number of different combinations of cometary gas densities and solar particle densities and temperatures. Electron-ion instability is able to grow for a brief period if the solar electrons are cool enough. However, this is a transient effect. As soon as the electrons lose their translational velocity, their temperature becomes high enough to restore plasma stability, even for succeeding generations of inflowing electrons. The total momentum transfer is negligibly small compared with the observed momenta of cometary-tail ions. It is concluded that plasma instability does not appreciably contribute to tail plasma acceleration. (For Paper II on this subject, see M. Harwit - Ed.)

234. Hruška, A.
THE FALL OF METEORIC DUST THROUGH THE ATMOSPHERE WITH INTERNAL MOTIONS, Bull. Astron. Insts. Czech., v. 13, no. 1, 1962, pp. 27-30, fig., 6 refs.

The motion of a small meteoric particle in the atmosphere is discussed. The time of its fall from the height of about 100 km is estimated assuming that irregular vertical motions of the air are present. It is concluded that the ratio of the actual time of fall to the time calculated under the supposition of steady atmosphere is of the order of unity.

235. Huss, G. I.
AUSTRALIA'S DALGARANGA CRATER, PART I, Mineralogist, v. 30, nos. 9/10, Sep-Oct 62, pp. 4-7, 3 figs.

A description of the events leading to an expedition to Dalgaranga Crater, Western Australia. The crater, measuring about 70 feet in diameter and about 10.5 feet deep, was formed by a violent fragmentation but without great heat, as evidenced by the fact that no vaporization products such as metallic spheroids or impactite could be found.

236. Huss, G. I.
AUSTRALIA'S DALGARANGA CRATER, PART 2, Mineralogist, v. 30, nos. 11/12, Nov-Dec 62, pp. 12-14, 16, 5 figs.

Continued

Dalgaranga crater, like the Arizona crater, is more or less square. It measures 70 feet 4 inches from lip to lip at its longest dimension (north-south), and 69 feet 11 inches from lip to lip at its shortest dimension (east-west). The depth from lip to lip was found to range between 7 to 8 feet, depending upon the points from which the measurements were made. From the highest points on the rim crest, the depth measured 12 feet 9 inches.

The greatest concentrations of outthrow or ejectamenta corresponded closely with the areas of greatest rim tilt. The southwest rim and the plain beyond for 50 to 75 feet held a moderately heavy outthrow of coarse, disintegrated granite. The northeast rim consisted of an impressive jumble of large blocks of laterite, the largest 97" X 47" X 20". The plain on the north-northeast and east side of the crater to a distance of 150 to 200 feet held a heavy concentration of ejectamenta consisting almost entirely of laterite.

A total of 207 meteoritic fragments was recovered with a total weight of 2.4 pounds. By excavating, enough was learned about the crater pit to estimate that its greatest depth is about 14 feet 2 inches. A careful examination of the rocks in the crater walls and of the fill material exposed by the excavation led to the estimate that the crater was formed about 25,000 years ago.

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237. Idlis, G. M.
O KOMETNOI PRIRODE TUNGUSSKOGO METEORITA, (ON THE COMETARY NATURE OF THE TUNGUSKA METEORITE), by G. M. Idlis and Z. V. Karyagina, Meteoritika, Akad. Nauk S.S.S.R., no. 21, 1961, pp. 32-43, tbl., 34 refs., (in Russian).

Approximate computations are made assuming that the Tunguska meteorite was in reality the nucleus of a comet. The general characteristics of the body make it possible to evaluate its initial and final velocities at $\sim$60 and $\sim$6 km/sec, respectively, and its explosion energy at 10^{23} ergs. Traces of gas in the dust trail of the body had plasma characteristics. The computed disturbance of the magnetic field amounts to 3×10^{-4} gauss, which is in general agreement with observations made at the Irkutsk Observatory.

All of the computations yielded results in mutual agreement and confirm the assumption concerning the cometary nature of the Tunguska meteorite.

238. Italy. Florence Univ.
ANGULAR DENSITY AND RANGE DISTRIBUTION OF RADAR ECHOES FROM METEOR TRAILS, IN THE CASE OF UNIFORM DISTRIBUTION OF GEOCENTRIC RADIANTS, by N. Carrara, P. F. Checcacci, and L. Ronchi, Contr. AF 61(052)-477, Tech. note no. 4, Nov 61, AFCRL-62-127, ASTIA AD 278 812, (OTS $1.60), 15 pp., 5 figs., 9 refs.

An expression is derived of the range distribution which would be observed by a given radar pointed in a given direction, if the radiant distribution is uniform.

239. Italy. Florence Univ.
STUDIES ON THE DISTRIBUTION OF RADIO ECHOES FROM METEOR TRAILS, by N. Carrara, P. F. Checcacci, and L. Ronchi, Contr. AF 61(052)-477, Final rept., Nov 61, AFCRL-62-128, ASTIA AD 278 318, (OTS $1.60), 17 pp., 20 refs.

Meteor research at the Centro Microonde of the Consiglio Nazionale della Ricerche in Florence, Italy, was started during 1958, under contract AF 61(052)-44, for the purpose of studying the meteor conditions in the sky of Florence, in view of a possible monitoring of a JANET linkage between Rome and The Hague. That contract was then continued by contract AF 61(052)-227, and by the present contract. A summary of studies performed under these contracts is given.

240. Italy. Florence Univ.
THE VOLUME DENSITY OF RADAR ECHOES FROM METEOR TRAILS, IN THE CASE OF UNIFORM DISTRIBUTION OF THE HELIOCENTRIC RADIANTS, by N. Carrara, P. F. Checcacci, L. Ronchi, and G. Tassinario, Contr. AF 61(052)-477, Tech. note no. 2, Jul 61, AFCRL-952, ASTIA AD 274 468, (OTS $3.60), 34 pp., 7 figs., appen.

General formulas are derived, which express the volume density of the reflection points of the meteor trails, as well as the volume density of the echoes revealed by a radar, in terms of the heliocentric velocity distribution. Then, as an application, the volume density of the reflection points is evaluated, in the case of uniform distribution of heliocentric radiants. The expression of the volume density of the radar echoes is presented.

241. Italy. Florence Univ.
THE VOLUME DENSITY OF RADAR ECHOES FROM METEOR TRAILS IN TWO PARTICULAR CASES OF HELIOCENTRIC RADIANT DISTRIBUTION, by N. Carrara, P. F. Checcacci, and L. Ronchi, Contr. AF 61(052)-477, Tech. note no. 3, Sep 61, AFCRL-62-126, ASTIA AD 278 814, (OTS $2.60), 24 pp., 4 figs., 7 refs.

Two particular types of distribution of heliocentric meteor radiants are considered. The corresponding expressions

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of the volume density of radar echoes are determined by introducing the heliocentric velocity distribution the parabolic-step approximation, derived. This kind of approximation allows one to obtain for the volume density of echoes an expression which can easily be evaluated numerically by means of an electronic computer. A program of numerical calculations is also described which will allow one to derive some interesting information about the actual distribution of heliocentric radiants and velocities of meteors.

242. Ivanov, K. G.
GEOMAGNITNYE YAVLENIYA NABLYUDAVSHIESYA NA IRKUTSKOI MAGNITNOI OBSERVATORII VSLED ZA VZRYVOM TUNGUSSKOGO METEORITA, (GEOMAGNETIC PHENOMENA FOLLOWING THE EXPLOSION OF THE TUNGUSKA METEORITE AS OBSERVED BY THE IRKUTSK MAGNETIC OBSERVATORY), Meteoritika, Akad. Nauk S.S.S.R., no. 21, 1961, pp. 46-48, 3 figs., 8 refs., (in Russian).

The existence of recordings of a magnetic disturbance on 30 June 1908, was discovered in 1960. A study of these recordings indicated that a strong variation of the H component began at $0^h19.5^{min}$ UT, i.e., 2.3 min after the fall of the meteorite. The variations differ from the usual bay-like disturbances or those caused by solar flares. They are similar to the effects of a very weak magnetic storm of short duration. The variations were not recorded by the observatories in Sverdlosk, Pavlosk, and Tbilisi. It is believed that the magnetic field irregularities were caused by the passage of a shock wave through the ionosphere, generated by the Tunguska meteorite.

243. Ivanov, K. G.
OB ENERGII VZRYVA TUNGUSSKOGO METEORITA, (ON THE ENERGY OF THE EXPLOSION OF THE TUNGUSKA METEORITE), Meteoritika, Akad. Nauk S.S.S.R., no. 21, 1961, pp. 44-45, 2 refs., (in Russian).

A note in which solution of the problem of a point explosion in a nonhomogeneous atmosphere plus consideration of the initiation of the disturbance of the earth's magnetic field yields an explosion energy of the order of $\sim 10^{23}$ ergs.

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244. Jazwinski, A. H.
A TECHNIQUE OF EVALUATING FUEL LOSSES DUE TO METEOROID PUNCTURE AND SOME TIMELY EXAMPLES, Paper presented at A.R.S. Lunar Missions Meet., Cleveland, Ohio, 17-19 Jul 62, A.R.S. paper 2471-62, 11 pp., 9 figs., 21 refs.

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Four distinct problem areas exist in evaluating fuel losses due to meteoroid puncture. They are: (1) properties of the meteoroid environment which the vehicle traverses; (2) the penetration process whereby holes are produced in the vehicle; (3) flow relations for the escaping fuel; and (4) probabilistic evaluation of the fuel losses. The vehicle designer wishes to know the average or mean effect of the meteoroid environment on his vehicle, as well as some measure of the dispersion from this mean (i.e., the effect which will not be exceeded at some high probability). The analysis is applied to two specific cases: a fuel tank transported to the moon to be used for the earth-return, and a fuel storage tank in an earth-circular orbit. Fuel losses are studied as a function of tank-skin thickness for aluminum and steel skins.

245. Jérémine, E.
LA MÉTÉORITE DE SAINTE-MARGUERITE EN COMINES (NORD) -- CHUTE DU 9 JUIN 1962, (THE METEORITE OF SAINT MARGUERITE EN COMINES (NORD) -- FALL OF 9 JUNE 1962), by E. Jeremine, J. Orcel, and A. P. Sandrea, Compt. Rend., v. 255, no. 4, 23 Jul 62, pp. 749-751, 9 figs., (in French).

The Saint Marguerite en Comines (Nord) meteorite was discovered at 9:30 a.m. on June 9th, 1962, in a potato field in the hamlet Saint Marguerite, France. Inasmuch as the field was visited daily prior to the discovery, the fall must have occurred ater 5:30 p.m. on June 8th and prior to the time of discovery the next day. On impact, the meteorite broke into six fragments with a total weight of 4.950-kg. A reconstruction of the original shape of the meteorite, by fitting together the fragments, revealed an almost circular dome with a flattened base. The entire surface is covered with a fusion crust 0.6 to 1.2 mm thick.

A preliminary study of the meteorite shows it to be a chondrite, consisting mainly of olivine, hypersthene (rich in iron), clinohypersthene, and a small amount of feldspar. The density is 3.18. The metallic part, which constitutes approximately 25% of the total volume, consists of troilite, nickeliferous iron, chromite, and rare traces of taenite and cobalt. The meteorite is to be subjected to a more detailed study.

246. Johns Hopkins Univ., Ballistic Analysis Lab., Baltimore, Md.
THE CALIBRATION OF A COLLECTION MEDIUM FOR THE DETERMINATION OF PARTICLE VELOCITY, Contr. DA 36-034-509-ORD-29, Proj. TB3-0238, Proj. Thor tech. rept. no. 50, Jul 62, ASTIA AD 278 545, (OTS $7.60), 69 pp., 22 figs., 17 tbls.

Previous investigations with efforts to calibrate various media for the determination of particle velocity were usually restricted to steel particles impacting at normal obliquity

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with velocities up to 4000 feet per second. This report provides a useful calibration of a medium for estimating particle velocities over a broad range of particle sizes, velocities, materials, and obliquities of strike. Compact fragments of plastic, magnesium alloy, aluminum alloy, steel, and tungsten alloy have been used in single-fragment firings on a particular variety of fiberboard at the Ballistic Research Laboratories to produce the needed experimental data. A single empirical formula has been fitted to the data, relating striking velocity to impact parameters of thickness of medium penetrated, angle of obliquity of strike, particle size, and presented area. An effort has also been made to determine limiting impact conditions for each fragment material for which the fragment will remain essentially intact during the penetration. Whenever the fragment breaks up or deforms excessively during the penetration, the velocity estimates are no longer valid.

247. Johnson, A. L.
SPACECRAFT RADIATORS, Space/Aeronautics, v. 37, no. 1, Jan 62, pp. 76-82, 7 figs., 6 tbls.

A review of the data and methods available to the designer of active low-temperature radiators as he copes with the problems of meteoroid protection, fluid and coating selection, and minimum weight. Materials parameters are covered in detail, and several basic design procedures are outlined.

248. Jones, R. V.
SUB-ACOUSTIC WAVES FROM LARGE EXPLOSIONS, Nature (London), v. 193, no. 4812, 20 Jan 62, pp. 229-232, 7 figs., 6 refs.

A comparison is made of microbarograph records of the Krakatoa volcanic explosion (August 27, 1883), the Siberian explosion (June 30, 1908), and the Russian multimegaton nuclear explosion of October 30, 1961. Utilizing amplitude of pressure wave data it is possible to estimate the 1908 energy release as being 30 megatons equivalent, within a factor of two either way; assuming that 1 gm of TNT gives about 4×10^{10} ergs, the release was thus about 10^{24} ergs. Radio-astronomical evidence strongly indicates that the maximum velocity for meteorites is about 80 km/sec (consistent with the view that all observed meteorites are members of the solar system). Assuming that the Siberian incident was due to a meteorite member of the solar system, and that the air waves were caused by its energy alone, its mass was probably at least 30,000 tons.

249. Kadushin, A. A.
METOD ISSLEDOVANIYA METEORITOV I TEKTITOV C POMOSHCHYU INFRA-KRASNOI SPEKTROMETRII, (A METHOD OF INVESTIGATION OF METEORITES AND TEKTITES BY MEANS OF INFRARED SPECTROMETRY), by A. A. Kadushin and G. G. Vorobev, Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 104-109, 6 figs., 11 refs., (in Russian).

The application of infrared spectrometry to the analysis of meteorites and tektites is discussed. This method appears to be particularly efficient for the study of tektites and stone meteorites containing silicates (olivine, pyroxenes, plagioclases) and sulfides (troilite). A new spectrometer, the UR-10, manufactured by Carl Zeiss in Jena (East Germany) is described in detail. It operates within the range of 2-25μ (5000-400 cm^{-1}) and has three automatically interchangeable prisms. Its resolving power amounts to approximately 2 cm^{-1}. The results of analyses (absorption spectra) of two meteorites, Nikolskoe and Noyan-Bogdo, and a moldavite, are presented.

250. Kashcheev, B. L.
RADAR DETERMINATIONS OF THE ORBITS OF INDIVIDUAL METEORS, by B. L. Kashcheev, V. N. Lebedinets, and M. F. Lagutin, Soviet Astronomy (AJ), v. 5, no. 4, Jan-Feb 62, pp. 517-525, 8 figs., 3 tbls., 18 refs.; trans. of Astron. Zhur., v. 38, no. 4, Jul-Aug 61, pp. 681-691.

Radar measurements of radiants and meteor velocities by the method whereby a reflected signal is observed at three points is described. The radiants and velocities of 298 meteors of the Geminid stream were measured during December 9-14, 1959. The accuracy of one determination of the coordinates of the radiant is ±2°.5, that of the velocity of one meteor ±1.8 km/sec.

The orbits of all observed meteors are computed. A systematic increase in the semi-major axis and eccentricity of the orbits during the period of observation is noted, the results being in good agreement with those of photographic observations [1, 14]. An attenpt is made to explain these results theoretically.

251. Kashkai, M. A.
STRUKTURA I VESHCHESTVENNYI SOSTAV YARDYMLINSKOGO ZHELEZNOGO METEORITNOGO DOZHDYA, (STRUCTURE AND COMPOSITION OF THE YARDYMLY METEORITIC IRON RAIN), by M. A. Kashkai and V. I. Aliev, Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 137-162, 21 figs., 7 tbls., 18 refs., (in Russian).

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The Yardymly multiple fall occurred on 24 November 1959, at 7^h05^{min} a.m., Moscow time. The completed ellipse of scattering was determined as 8 by 15 km. Six individual fragments having a total weight of 152.56 kg were recovered (fragments weighing 127, 11.3, 5.9, 5.7, 2.3, and 0.36 kg). Kamacite is the main meteoritic constituent with lesser amounts of taenite, plessite, troilite, schreibersite, rhabdite, and graphite. The chemical composition is: Fe, 92-93%, Ni, 6.5%, Co, 0.40%; P, S, C, Si, Al, Mg, Mn, He, and Ge are present in small amounts. The presence of an amorphous (possibly cryptocrystalline) carbonaceous material in graphite inclusions was established by means of X-ray diffraction. The magnetic properties of the meteorite were also determined.

252. Kaufman, L.
HIGH PRESSURE EQUILIBRIA IN THE IRON-NICKEL SYSTEM AND THE STRUCTURE OF METALLIC METEORITES, by L. Kaufman and A. E. Ringwood, Acta Met., v. 9, no. 10, Oct 61, pp. 941-944, 7 figs., 12 refs.

Calculations of phase equilibria in the iron-nickel system at high pressure indicate miscibility gap formation and eutectoid decomposition in the iron-nickel alloys at pressures exceeding 60 kb. This behavior may be the origin of the plessite microstructure, which is an intimate lamellar mixture of low nickel kamacite (b.c.c.) and high nickel taenite (f.c.c.), found in metallic meteorites.

253. Kaye, C. A.
TEKTITE FROM MARTHA'S VINEYARD, MASSACHUSETTS, by C. A. Kaye, C. C. Schnetzler, and J. N. Chase, Bull. Geol. Soc. Am., v. 72, no. 2, Feb 61, pp. 339-340, 4 figs., tbl., 3 refs.

A fragment of an oddly sculptured glass disc found on the cliff of Gay Head, on Martha's Vineyard, Massachusetts, is thought to be a tektite. Unless carried to Gay Head by man from one of the known tektite fields, it raises to three the number of tektite localities in the Western Hemisphere. The freshness of surface features and the clarity of glass indicate a recent origin. If, however, it weathered out of the cliff, it may be Late Cretaceous, Miocene, or Pleistocene in age.

254. Keil, K.
ON THE PHASE COMPOSITION OF METEORITES, J. Geophys. Research, v. 67, no. 10, Sep 62, pp. 4055-4061, 2 figs., 5 tbls., 25 refs.

Seventy-three chondrites were examined. Their content of metallic nickel-iron, troilite, chromite, and silicate was determined quantitatively by planimetric integration of polished sections with an integration ocular, type 1. More than 300 large polished sections were measured, constituting a total

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area of 3700 cm^2. In part, the results deviate markedly from the chemical analyses given in the literature. This deviation may be due to the use of too small samples in the earlier analyses. It was found that chondrites with more than 13 weight percent of metallic nickel-iron belong to the H group; those with less than 13 weight percent belong to the L group (exceptions to this rule are the carbonaceous chondrites). The average composition calculated from the individual results is: 11.0 percent metallic nickel-iron; 5.3 percent troilite; 0.25 percent chromite; 83.4 percent silicate (percent by weight). Because of the obviously inefficient sampling of cosmic matter by the earth, neither statistics of the weight nor frequency of meteorite falls can serve to calculate the average phase composition of the total meteoritic material.

255. Kendall, D. G.
THE ASYMPTOTIC DISTRIBUTION OF THE TIME-TO-ESCAPE FOR COMETS STRONGLY BOUND TO THE SOLAR SYSTEM, by D. G. Kendall and J. L. Mott, Pacific J. Math., v. 11, no. 4, Winter 1961, pp. 1393-1399, 7 refs.

A comet is considered which is in the energy state $x > 0$ (so that the total energy per unit mass is equal to $-x$) and is approaching perihelion, not necessarily for the first time, and T is the total time spent by the comet in describing complete circuits subsequent to this perihelion. The low energy (high x) catastrophes (capture by Jupiter, falling into the sun, etc.) are ignored and the fate of the comet subject to independent energy-perturbations at perihelion is considered, the magnitudes of which are believed to be distributed according to the probability law

$$\frac{1}{2} e^{-|w|/b} dw/b \qquad (-\infty < w < \infty) ,$$

the so-called "double-exponential law." It is then known that T is almost certainly finite. The probability distribution of T cannot be found explicitly, but its Laplace-Stieltjes transform satisfies a differential equation which is treated by a perturbation method. By a careful arrangement of the argument the exact limit law

$$\lim_{x\to\infty} \Pr\left[\frac{T}{\sqrt{x}} \leq c \middle| x\right]$$

for the reduced random variable $T/\sqrt{x}$ can be calculated.

256. Kendall, D. G.
"The Distribution of Energy Perturbations for Halley's and Some Other Comets," pp. 87-98, 5 figs., 3 tbls., 17 refs.; in PROCEEDINGS OF THE FOURTH BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS AND PROBABILITY, VOLUME III: ASTRONOMY, METEOROLOGY, AND PHYSICS, (held at Berkeley, Calif., 20 Jun-30 Jul 60), Berkeley, Univ. California Press, 1961, 335 pp.

A conspicuous role is played by the frequency distribution of energy perturbations suffered by a comet during the transition from one aphelion to the next, and the author collects and discusses some empirical evidence on the form of this distribution, which is available in virtue of earlier computations.

257. Kendall, D. G.
"Some Problems in the Theory of Comets, I," pp. 99-120, 3 figs., 2 tbls., 18 refs.; in PROCEEDINGS OF THE FOURTH BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS AND PROBABILITY, VOLUME III: ASTRONOMY, METEOROLOGY, AND PHYSICS, (held at Berkeley, Calif., 20 Jun-30 Jul 60), Berkeley, Univ. California Press, 1961, 335 pp.

This paper is concerned with the integral equations which arise in <u>any</u> theory of comets when account is taken of the perturbation in energy state which occurs at each penetration of and passage through the planetary zone. The comet can be thought of as executing a random walk along the scale of energy states, where the energy state of a comet is defined as the negative of its total energy per unit mass (so that the energy state is zero when the comet is at rest "at infinity"). The general problem is formulated, then solved, by assuming a double-exponential form for the perturbation distribution. The results are examined in relation to theories which have been proposed for the origin of comets.

258. Kendall, D. G.
"Some Problems in the Theory of Comets, II," pp. 121-147, 6 figs., 2 tbls., 10 refs.; in PROCEEDINGS OF THE FOURTH BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS AND PROBABILITY, VOLUME III: ASTRONOMY, METEOROLOGY, AND PHYSICS, (held at Berkeley, Calif., 20 Jun-30 Jul 60), Berkeley, Univ. California Press, 1961, 335 pp.

This paper is a continuation of "Theory of Comets, I" in which certain aspects of the problem formulated in the first paper are studied in the general case without assuming the double-exponential quantity.

259. Kerr, R. H.
"Perturbations of Cometary Orbits," pp. 149-164, 8 figs., 2 tbls., 7 refs.; in PROCEEDINGS OF THE FOURTH BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS AND PROBABILITY, VOLUME III: ASTRONOMY, METEOROLOGY, AND PHYSICS, (held at Berkeley, Calif., 20 Jun-30 Jul 60), Berkeley, Univ. California Press, 1961, 335 pp.

Continued

Calculations are made based on the energy changes as the comet describes a parabolic orbit. In calculating the energy change it was assumed that the effect of the other planets was small when compared with Jupiter's effect. To show this, similar calculations were performed for Saturn, Uranus, and Neptune and the energy changes in these four major planets were compared. The change in the reciprocal of the semimajor axis of the comets orbit due to perturbative effects was evaluated for six of the comets which have been observed to be hyperbolic at perihelion. The effects of both Jupiter and Saturn are taken into account. In making these calculations, it was assumed that the comets were in parabolic orbits, and that the planets were moving in circular orbits around the sun.

260. Khaskind, M. D.
REFLECTION OF RADIO WAVES BY INCLINED METEORITE TRAILS, Radio Eng. and Electron. Phys. (U.S.S.R.), v. 7, no. 4, Apr 62, pp. 558-567 5 refs.; trans of Radiotekhn. i Electron.

The field of scattered waves when plane electromagnetic waves are incident to an ionized meteorite trail at an arbitrary angle with respect to its axis is analyzed. A microwave approximation is based on the method of polarization currents for trails having an arbitrarily smooth structure. A long-wave approximation is evaluated at large linear electron concentrations in the trails. The complete solution is obtained using special electromagnetic potentials of axially symmetrical plasma, for which a system of simultaneous equations is derived. The limiting properties of these potentials is analyzed.

261. Khaskind, M. D.
SCATTERING OF ELECTROMAGNETIC WAVES BY METEOR TRAILS, Radio Eng. and Electron. Phys. (U.S.S.R.), v. 7, no. 2, Feb 62, pp. 189-205, 9 refs.; trans. of Radiotekhn. i Elektron,

The reflection of normally incident electromagnetic waves from meteor trails is analyzed by approximate methods developed for the scattering of matter waves. The electron concentration in the ionized meteor trail may be represented by a function that decays with distance from the axis throughout the whole volume. Also, some other possible models are considered in which the meteor trails are approximated by plasma cylinders having finite radii.

262. Kiang, T.
ASTEROID COUNTS AND THEIR REDUCTION, Monthly Notices Roy. Astron. Soc., v. 123, no. 6, 1962, pp. 509-519, 3 figs., 4 tbls., 11 refs.

Continued

Counts of asteroid trails were made on four photographs of the Palomar Sky Atlas. These counts and previous counts by Stroobant, Baade, and Johnson were reduced by a uniform procedure. An error in Baade's original reduction is pointed out. Data from the 1950-1952 Yerkes-McDonald Survey were reanalyzed to give comparative values at brighter magnitudes. A linear logarithmic increase seems to fit all the results. The equations:

$$\log N(p_1) = 1.12 + 0.375(p_1 - 10),$$

$$\log n(p) = 0.06 + 0.375(p - 10),$$

$$\log n(p_o) = 0.06 + 0.375)p_o - 10),$$

giving respectively the number brighter than magnitude p_1, the number per unit interval in the apparent magnitude p, and the number per unit interval in the mean opposite magnitude p_o, are believed to hold down to magnitude 20 with uncertainties of about ±0.065 in the log.

263. King, E. A., Jr.
POSSIBLE RELATION OF TUFF IN THE JACKSON GROUP (EOCENE) TO BEDIASITES, Nature (London), v. 196, no. 4854, 10 Nov 62, pp. 569-570, 7 refs.

Most bediasites have been found on rocks of the Jackson Group, and analyses of Jackson tuff and tuffaceous rock are similar to some published analyses of bediasites, especially when water and ignition loss are removed and percentages recalculated to 100 percent. If bediasites are of terrestrial origin, it is possible that tuffs or tuffaceous rocks in the Jackson Group are the parent material of, or genetically related to, bediasites.

264. Kirova, O. A.
MINERALNYI SOSTAV I STRUKTURA ZHELEZNOGO METEORITA SUSUMAN, (MINERAL COMPOSITION AND STRUCTURE OF THE SUSUMAN IRON METEORITE), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 61-70, 15 figs., 2 tbls., 6 refs., (in Russian).

The Susuman meteorite was found in November, 1957, at a depth of 32 meters in a coal mine, located in the basin of the Berelekh river (tributary of the Kolyma river), in Magadan Oblast, Russia. The meteorite, whose shape is similar to an elongated cobblestone, is 35 cm long and weighs 18.8 kg. No fusion crust is present. It is classified as a medium octahedrite. A quantitative count of minerals on a surface ~22 cm^2 yields (in volume percent): kamacite, 74.3%; taenite, 1.3%; plessite, 23.9%; schreibersite, 0.25%; troilite, 0 05%; and magnetite, 0.2%. The specific gravity is 7.82.
B. I. Bronskii's hypothesis that the Susuman and Maldyak meteorites are specimens of the same fall is disproved on the basis of mineralogical, structural, and chemical differences.

265. Kirova, O. A.
O MINERALOGICHESKOM IZUCHENII PROB POCHV IZ RAIONA PADENIYA TUNGUSSKOGO METEORITA SOBRANNYKH EXSPEDITSIEI 1958 G, (MINERALOGICAL STUDY OF SOIL SAMPLES COLLECTED BY THE 1958 EXPEDITION TO THE AREA OF FALL OF THE TUNGUSKA METEORITE), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 32-39, 5 figs., 7 refs., (in Russian).

No specific minerals of meteoritic origin were detected in approximately 90 soil samples examined. The iron particles found appear to be of industrial origin. Magnetite and silicate spherules have been found which average 80μ in diameter. Some of the magnetite and silicate spherules are intergrown, indicating that they originated simultaneously. The discovery of these spherules is in agreement with the postulated cometary nature of the Tunguska body

266. Kohoutek, L.
ATMOSPHERIC TRAJECTORIES OF TELESCOPIC METEORS, by L. Kohoutek and J. Grygar, Bull. Astron. Insts. Czech., v. 13, no. 1, pp. 9-26, 1962, 6 figs., 8 tbls., 19 refs.

Observations of telescopic meteors were performed from a 2.5 km long base line by a group of eight observers during the Mt. Bezovec expedition. In eight nights - from 10th till 27th July, 1958 - 123 pairs were registered, that is 62 percent of all cases recorded. The material was treated by a combined graphic-numeric method: all disturbing factors distorting the height values of the pairs and other quantities characteristic of the meteors were taken into account. The errors in magnitude determinations and direction plottings are acceptable, while the determination of the relative positions and apparent lengths is less dependable. The observed height distribution is inconsistent with the Gaussian law of occidental deviations, and hence, in addition to the arithmetic means, we bring also the modal values of deviations for the individual distributions. The most probable values obtained from the whole material for the height of appearance, maximum brightness, and disappearance are 98 ± 4.93, ± 4.88 ± 3 km respectively. The heights of telescopic meteors are a smooth continuation of the scale of photographic and visual heights, and consistent with radar observations. None of the established actual heights was less than 60 km. Astapovic's statement concerning the existence of an independent group of telescopic meteors with low observed heights is critically discussed. The height change with magnitude in the interval from 0^m to 7^m is negligible in the first approximation. The average geocentric velocity of the meteors in our material is 36 ± 5 km/sec. For stony and iron meteoroids we obtained the mean particle radius $r_o = 0.52$ and 0.41 mm respectively, and the energy spent for heating and evaporating 1 g of meteoric matter $Q_{stony} = 3.5 \times 10^{10}$ erg/g, and $Q_{Fe} = 1.6 \times 10^{10}$ erg/g. The theoretical height of

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the beginning of intense evaporation corresponds within the limits of errors with the mean height of the beginning H_b observed by us. Hence, while telescopic meteors fly through the atmosphere they are passed by a free atmospheric molecule flow. The observed course of the diurnal variation in heights and geocentric velocities leads to the hypothesis that the orbits of telescopic meteors are approximately circular. This is corroborated by the observed radiant distribution.

267. Komovskii, G. V.
TERMOLYUMINESTSENTSIYA KAMENNYKH METEORITOV, (THERMOLUMINESCENCE OF STONY METEORITES), Meteoritika, Akad. Nauk S.S.S.R., no. 21, 1961, pp. 64-69, 3 figs., tbl., 21 refs., (in Russian).

The thermoluminescent method of age determination and its application to stony meteorites is discussed. The chondrites Elenovka, Saratov, Nikolskoe, Zhovtnevyi Khutor, Sevryukovo, Kunashak, Pervomaiskii Poselok, as well as the achondrites Staroe Pesyanoe and Norton County were investigated. The meteorites Sevryukovo, Kunashak and Pervomaiskii Poselok were not luminescent. The ages of Zhovtnevyi Khutor and Saratov differ from those obtained previously by the argon dating method. The luminescence characteristics of achondrites and terrestrial minerals such as kinzite, spodumene, and lepidolite are similar; the luminescence curves of achondrites and chondrites differ significantly.

268. König, H.
UNTERSUCHUNGEN STEINMETEORITEN MIT EXTREM HOHEM EDELGASGEHALT, II. DER CHONDRIT TABOR, (ANALYSIS OF STONE METEORITES WITH EXTREMELY HIGH RARE GAS CONTENT, II. THE CHONDRITE TABOR), by H. König, K. Keil, and H. Hintenberger, Z. Naturforsch., v. 17a, no. 4, Apr 62, pp. 357-358, 2 tbls., 8 refs., (in German).

Large amounts of primordial rare gases have been found in the spherical bronzite-chondrite Tabor which shows a structure similar to the chondrites Pantar and Breitscheid. The absolute amounts and the isotopic compositions of the helium and neon have been measured; they are similar to those found formerly in the Pantar and Breitscheid meteorites. As a result of this work a primordial rare gas ratio He^4: Ne^{20} = 540 has been determined and is the highest value for this ratio which has been found in meteorites to date.

269. König, H.
UNTERSUCHUNGEN AN STEINMETEORITEN MIT EXTREM HOHEM EDELGASGEHALT, III. ÜBER DEN SITZ DER LEICHTEN UREDELGASE IM CHONDRITEN PANTAR, (INVESTIGATIONS OF STONE METEORITES WITH EXTREMELY HIGH RARE GAS CONTENT, III. ON THE SOURCE OF LIGHT RARE GASES IN THE CHONDRITE PANTAR), by H. König and F. Wlotzka, Z. Naturforsch., v. 17a, no. 6, Jun 62, pp. 472-476, 2 tbls., (in German).

An investigation of the separated dark fraction of the chondrite Pantar has been made. Rare gas analyses of separated minerals show that the main components of the meteorite, i.e., silicates, larger grains of nickel-iron and troilite, contain only very small amounts of primordial helium and neon. The main amounts of these gases have been found in fine-grained nickel-iron and troilite which are supposed to have been newly formed after the crystallization of the main minerals of the meteorite. Problems related to the variations of the He/Ne-ratios which have been found are discussed.

270. Kornhauser, M.
THE CRATER CONTRIBUTION TO THE SURFACE ROUGHNESS OF THE MOON, Paper presented at 8th Ann. Nat. A.A.S. Meet., Washington, D.C., 16-18 Jan 62, A.A.S. preprint 62-23, 16 pp., 5 figs., 2 tbls., 6 refs.; also in Astronaut. Sci. Rev., v. 4, no. 1, Jan-Mar 62, pp. 23-24, 26.

By plotting numbers of craters versus size and extrapolating below the size limit of telescopic resolution, it is found that less than 10% of the moon's surface is covered by craters. In local areas, however, the surface may be almost entirely covered by craters. Slopes inside the craters are an inverse function of size, the 10,000 ft diameter crater has a maximum slope of 28° while a 1000 ft diameter crater has a maximum slope of 46°. It is concluded that some areas of the moon should be easy to traverse, while others must be impassable. The crater size distribution on the moon does not correlate well with the size distribution of sporadic meteoroids currently existing in earth-moon space, indicating that this may be a function of geologic time.

271. Kozai, Y.
SECULAR PERTURBATIONS OF ASTEROIDS WITH HIGH INCLINATION AND ECCENTRICITY, Astron. J., v. 67, no. 9, Nov 62, pp. 591-598, 8 figs., tbl., 5 refs.

Secular perturbations of asteroids with high inclination and eccentricity moving under the attraction of the sun and Jupiter are studied on the assumption that Jupiter's orbit is circular. After short-periodic terms in the Hamiltonian are eliminated, the degree of freedom for the canonical equations of motion can be reduced to 1.

Since there is an energy integral, the equations can be solved by quadrature. When the ratio of the semimajor axes of the asteroid and Jupiter takes a very small value, the solutions are expressed by elliptic functions.

When the z component of the angular momentum (that is, Delaunay's H) of the asteroid is smaller than a certain limiting value, there are both a stationary solution and solutions corresponding to libration cases. The limiting value of H

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increases as the ratio of the semimajor axes increases, i.e., the corresponding limiting inclination drops from 39°.2 to 1°.8 as the ratio of the axes increases from 0.0 to 0.95.

272. Krebs, R. P.
ANALYSIS OF A MEGAWATT LEVEL DIRECT CONDENSER-RADIATOR, by R. P. Krebs, D. M. Winch, and S. Lieblein, Paper presented at A.R.S. Space Power Systems Conf., Santa Monica, Calif., 25-28 Sep 62, A.R.S. paper no. 2545-62, 46 pp., 15 figs., 13 refs., appen.

An analytical study of a nonredundant direct condensing finned-tube radiator for a one megawatt Rankine electrical power system shows that the radiator weight may be close to 6000 pounds. This radiator was assumed to use beryllium fins and armor over a columbium alloy tube liner. Protection against damage from meteoroid impact, for the criteria used, constituted the major portion of the total weight. The study indicates the effect of tube diameter, number of tubes, and segmentation into nonredundant panels on the radiator weight and pressure drops. Header weights are of such magnitude that they should be considered in radiator design and analysis. Application of nonredundant segmentation results in some weight saving.

273. Krill, A. M., Ed.
ADVANCES IN HYPERVELOCITY TECHNIQUES, (Proc. of the Second Sym. on Hypervelocity Techniques, Denver, Col., 20-21 Mar 62), New York, Plenum Press, 1962, 795 pp.

Contents:
Shreeve, R. P. and S. M. Bogdonoff, "A Graphite Heated Nitrogen Wind Tunnel for Continuous Operation at Mach Numbers Up to 20."
Gowen, F. E. and V. D. Hopkins, "A Wind Tunnel Using Arc-Heated Air for Mach Numbers From 10 to 20."
van der Bliek, J. A., "Further Development of Capacitance- and Inductance-Driven Hotshot Tunnels."
Bianchetta, J. F. and K. R. Sivier, "Operating Experience With the M.A.C. Hypervelocity Impulse Tunnel."
Fonda-Bonardi, G., "The Use of an Electrodeless Plasma Accelerator as a Hypersonic Wind Tunnel."
Martin, J. F., G. R. Duryea and L. M. Stevenson, "Instrumentation for Force and Pressure Measurements in a Hypersonic Shock Tunnel."
Orlik-Rückemann, K. and J. G. LaBerge, "Oscillatory Experiments in a Helium Hypersonic Wind Tunnel."
Einger, D. W., "Telemetering Projectiles for High Velocity Guns."
Dyke, W. P., F. J. Grundhauser, F. M. Collins and N. W. Stunkard, "Recent Developments in Flash Radiography at Hypervelocities."
Clemens, F. L. and R. E. Hendrix, "Development of Instrumentation for the VKF 1000-Ft Hypervelocity Range."

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Pennelegion, L., "Microwave Interferometry Studies in Free-Piston Gun Tunnels,"
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Burke, A. F. and K. D. Bird, "The Use of Conical and Contoured Expansion Nozzles in Hypervelocity Facilities."
Trimpi, R. L., "A Preliminary Study of a New Device for Producing High Enthalpy Short Duration Gas Flows."
Henshall, B. D., R. N. Teng and A. D. Wood, "A Drive-Sphere Technique for Increasing the Steady State Test Time of Hypersonic Shock Tunnels."
Baldwin, K., R. Buck, T. Fessenden and L. McGuire, "Transient Plasma Diagnostics for Wake Studies."
Winkler, E. L. and R. N. Griffin, Jr., "Measurements in a Frozen, Partially Dissociated High-Speed Gas Stream."
Glowacki, W. J., "Effect of Finite Oxygen Recombination Rate on the Flow Conditions in Hypersonic Nozzles."
Howell, W. G., W. R. Orr and A. M. Krill, "Electrical Augmentation of a Light Gas Hypervelocity Projector."
Winter, D. F. T. and C. R. Wall, "The Performance of the A.R.D.E. Hypervelocity Launchers."
Anderson, D. E. and M. D. Prince, "Design of Light-Gas Model Launchers for Hypervelocity Research."
Van Kuren, J. T., "The Mechanical Design of a High Temperature Mach Number 4 Axisymmetric Wind Tunnel Nozzle."
Ledford, R. L., "A Device for Measuring Heat Transfer Rates in Hypervelocity Wind Tunnels."
Danberg, J. E., "The Equilibrium Temperature Probe, a Device for Measuring Temperatures in Hypersonic Boundary Layers."
Hickman, R. S., H. Tong and W. H. Giedt, "Heat Transfer Models for High Mach Number - Low Reynolds Number Research."
Lundell, J. H., W. Winovich and R. M. Wakefield, "Simulation of Convective and Radiative Entry Heating."
McDill, P. L., E. A. Brown, P. A. Ross and O. A. Huseby, "The Performance of a Buffered Shock Tube With Area Reduction."
Letarte, M. and L. E. Moir, "High G Telemetry: Application to Hypervelocity Ranges."

274. Krinov, E. L.
DEVYATAYA METEORITNAYA KONFERENTSIYA, (THE NINTH CONFERENCE ON METEORITES), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 5-8, (in Russian).

The ninth conference on meteorites was held in Kiev on 2-4 June, 1960. The progress of meteoritics in the past 2-3 years in the U.S.S.R. and abroad was reviewed. Subjects such as the surfaces of meteoritic bodies in interplanetary space, their composition, structure, and age, were discussed. The Tunguska fall was the main topic on the agenda. After a detailed discussion, the conference passed a resolution that a combined expedition should be sent in 1961 to the affected area in order to obtain additional data.

275. Krinov, E. L.
DIE METEORITEN - KONFERENZEN IN DER Ud.S.S.R. IM JAHRE 1960, THE 1960 U.S.S.R. METEORITE CONFERENCE), Chem. Erde, v. 21, no. 2, 1961/62, pp. 195-202, (in German).

A description of the papers presented at the 9th Conference of Meteorites of the Academy of Sciences of the U.S.S.R., held at Kiev, 2 to 4 June 1960.

276. Krinov, E. L.
KRATKII KATALOG METEORITOV S.S.S.R. NA 1 YANVARYA 1962 G, (SHORT CATALOGUE OF RUSSIAN METEORITES, CURRENT AS OF 1 JANUARY, 1962), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 114-126, (in Russian).

A new, revised catalogue of 128 meteorites (known to have fallen on the present territory of the U.S.S.R. before 1 January, 1962) which replaces the previous catalogue (1 January, 1949) and covers the period from 1749 to the last known fall, on 24 November, 1959. Doubtful and pseudometeoritic falls are excluded. In some cases, more accurate coordinates are given. The catalogue is arranged chronologically; an alphabetical list is included. The following data are given for each meteorite: the name by which commonly known and its English transliteration; synonyms, each cross referenced; locality (according to the present administrative division of the U.S.S.R.); coordinates of the locality; date of fall and/or find; class and subclass; number of specimens recovered and their total weight (metric); the present location of the main mass of the meteorite. Of the 128 meteorites, 14 are not represented in Soviet collections at all. Their specimens are in the following cities: London (4); Vienna (4); Budapest (2); Chicago (2); Berlin (1); and Tübingen (1).

277. Krinov, E. L.
METEORITNYE KRATERY NA POVERKHNOSTI ZEMLI, (METEORITIC CRATERS ON THE EARTH'S SURFACE), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 3-30, 23 figs., tbl., 50 refs., (in Russian).

The following meteoritic craters are described in detail: Meteor Crater; Odessa; Henbury; Wabar; Haviland; Campo del Cielo; Kaalijärv; Boxhole; Dalgaranga; Sikhote-Alin; Wolf Creek; Aouelloul; and Ungava. It is believed that ten other known craters are also of meteoritic origin, but this has not been conclusively proved. To this group belong the following: Ashanti; Talemzane; Mount Darwin; Murgab; Ilumetsa; Chinge; Brent; Holleford; Hebron; and Deep Bay. In addition, there are a number of circular depressions which may be of meteoritic origin. The suggestion of C. S. Beals that aerial photography be applied to the study and detection of meteoritic craters is strongly supported.

278. Krummenacher, D.
METEORITIC KRYPTON AND BARIUM VERSUS THE GENERAL ISOTOPIC ANOMALIES IN METEORITIC XENON, by D. Krummenacher, C. M. Merrihue, R. O. Pepin, and J. H. Reynolds, Geochim. et Cosmochim. Acta, v. 26, Feb 62, pp. 231-249, 6 figs., 6 tbls., 26 refs.

The general isotopic anomalies in meteoritic xenon are described in detail. Where superior isotopic analyses exist, the xenon anomalies appear to be the same for all meteorites. In other cases there is fair evidence that the xenon examined is a mixture of "meteoritic" and contaminating atmospheric xenon. Two superior krypton analyses for carbonaceous chondrites show no anomalies which are significant in comparison with those for xenon. Barium from the Richardton chondrite is of normal isotopic composition. Cyclotron deuterons produce no Xe^{124} in a tellurium target, although the other xenon isotopes, which are in excess in meteorites, are produced.

A number of possible mechanisms for producing the general anomalies are discussed and found wanting. One of them calls for excess terrestrial fission xenon and for transfer of solar xenon to the atmosphere. It thus involves reasonable processes, but, as is shown, required unreasonable yields for spontaneous fission. A mechanism is produced which calls for excess meteoritic fission xenon and for gross mass fractionation of terrestrial xenon. It thus produces the observed anomalies accurately, but by somewhat unlikely processes.

279. Kuroda, P. K.
ON THE CHRONOLOGY OF THE FORMATION OF THE SOLAR SYSTEM, I. RADIOGENIC XENON 129 IN THE EARTH'S ATMOSPHERE, by P. K. Kuroda and O. K. Manuel, J. Geophys. Research, v. 67, no. 12, Nov 62, pp. 4859-4862, fig., tbl., 16 refs.

A method for the calculation of the total number of atoms of radiogenic Xe^{129} in the earth's atmosphere is proposed. The atmosphere contains approximately 2.06×10^{35} atoms of radiogenic Xe^{129}. This corresponds to 9.6 percent of the total atmospheric Xe^{129} and leads to a maximum value of 240 million years for the time interval (H) between the nucleosynthesis and the formation of the earth.

280. Kuroda, P. K.
ON THE CHRONOLOGY OF THE FORMATION OF THE SOLAR SYSTEM, 2. IODINE IN TERRESTRIAL ROCKS AND THE XENON 129/136 FORMATION INTERVAL OF THE EARTH, by P. K. Kuroda and W. H. Crouch, Jr., J. Geophys. Research, v. 67, no. 12, Nov 62, pp. 4863-4866, tbl., 10 refs.

The iodine content of nine crustal rocks was determined by a spectrophotometric method. The iodine content ranged between

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0.04 and 0.33 ppm, the average value being 0.16 ppm. A method for calculating the time interval (H) between the nucleosynthesis and the formation of the earth from the ratio of radiogenic Xe^{129} versus fissiongenic Xe^{136} in the earth's atmosphere is proposed. The Xe^{129}/Xe^{136} formation interval (H) of the earth is calculated to be 102 million years.

281. Kvasha, L. G.
KATALOG METEORITOV KOLLEKTSII KOMITETA PO METEORITAM AKADEMII NAUK S.S.S.R., (CATALOGUE OF THE METEORITE COLLECTION OF THE COMMITTEE ON METEORITES OF THE RUSSIAN ACADEMY OF SCIENCES), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 127-156, 20 figs., 21 refs., (in Russian).

A new catalogue of 272 authenticated meteorites in the collection of the Academy of Sciences of the U.S.S.R. The catalogue reflects the state of the collection, as of 1 July, 1961, as well as the degree to which studies have been made of the individual meteorites. The need for a new catalogue is due to a considerable increase in the collection itself and to the proposed systematic and coordinated international cooperation in the field of meteoritics. The catalogue is arranged alphabetically and contains the following data: the meteorite name, in Russian and English (according to the Prior-Hey catalogue of 1953); synonyms (if justified by their frequent use); class and subclass; locality and date of fall and/or find (according to Leonard's classification of 1956); brief physical description of the specimen (nine conventional abbreviated descriptors are used to indicate whether the specimen is a meteorite in its entirety, a fragment, a sawed portion of a fragment, etc.); weight (metric); and studies which have been made of the meteorite (chemical and isotopic composition, rare gas content, age determinations, etc.). Several photographs of more recently discovered meteorites are included. Alphabetical indices of Soviet and foreign meteorites are also given. Separate lists of tektites and impact glasses are included as well. A special catalogue of polished meteorite thin sections is to be published in the future.

282. Kvasha, L. G.
NEKTORYE NOVYE DANNYE O STROENII KHONDRITOV, (SOME NEW DATA ON CHONDRITE STRUCTURE), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 124-137, 34 figs., 12 refs., (in Russian).

The results of microscopic analyses of 60 chondrites indicate that the majority of metallic grains are represented similar in form, composition, and structure to the pallasites (framework structure) and also similar to the metallic portion of the Hainholz mesosiderite. The amount of FeO in the silicate portions of the chondrites, the approximate amount of

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nickeliferous iron were determined. A diagram showing the relationship between the refractive index of silicates in chondrites and the abundance of nickeliferous iron is presented.

283. Kvasha, L. G.
VEKTORNAYA DIAGRAMMA KHIMICHESKIKH SOSTAVOV TEKTITOV I ZEMNYKH LAV, (VECTOR DIAGRAM OF THE CHEMICAL COMPOSITION OF TEKTITES AND TERRESTRIAL LAVAS), by L. G. Kvasha and G. S. Gorshkov, Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 193-203, fig., tbl., 44 refs., (in Russian).

A comparative vector diagram is constructed on the basis of 53 chemical analyses of tektites and of a large number of analyses of glassy lavas. An analysis of the diagram shows that tektites are related to meteorites and not to terrestrial lavas. Tektites are considered to be products of differentiation of feldspathic achondrites (in the same way as obsidians and andesites are products of the differentiation of magma) and originated in some extraterrestrial body in which volcanic processes similar to terrestrial volcanic processes were prevalent.

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284. LATEST PICTURES OF COMET SEKI-LINES BY ALAN MCCLURE, Sky and Telescope, v. 23, no. 5, May 62, pp. 242a-242b, 3 figs.

Three photographs of comet Seki-Lines (1962c) are reproduced and discussed.

285. LEONID METEORS GIVE UNEXPECTED DISPLAY, Sky and Telescope, v. 23, no. 2, Feb 62, pp. 64-66, 5 figs.

Descriptions are given of observations made by several observers of the Leonid meteor shower of 16 and 17 November, 1961. In addition to the unusually numerous meteors, very bright fireballs were reported which left long enduring trains.

286. Levin, B. Yu.
FRAGMENTATION OF METEOR BODIES, Nature (London), v. 196, no. 4854, 10 Nov 62, pp. 527-529, 3 figs., 3 refs.

The dependence of fragmentation on the mass of meteor bodies influences the magnitude distribution of meteors. Even for shower meteors one cannot suppose that the magnitude distribution of meteors depends only on the mass distribution of meteor bodies. All previous determinations of the mass distribution based on this supposition must be revised. The results based on radio-echo observations also need revision.

287. Levin, B. Yu.
THE ORIGIN OF THE SOLAR SYSTEM, New Scientist, v. 13, no. 273, 8 Feb 62, pp. 323-325, fig., tbl.

A survey of recent theories; most of them agree that the planets were formed cold from a cloud of dust and gas. There is still, however, disagreement about the details - in particular about the moon's origin and the nature of the earth's core.

288. Levin, B. Yu.
PHYSIKALISCHE THEORIE DER METEORE UND DIE METEORITISCHE SUBSTANZ IM SONNENSYSTEM, (PHYSICAL THEORY OF METEORS AND METEORITIC MATTER OF THE SOLAR SYSTEM), Ed. by N. Richter, Berlin, Akademie-Verlag, 1961, 330 pp., 30 figs., (in German).

A translation, from Russian, of the book which presents a review of the development of the theory of meteors and an investigation of meteoritic matter in the solar system (particularly in the vicinity of the terrestrial orbit). An extensive bibliography of the literature up to 1955 is included.

289. Levskii, L. K.
OB IZOTOPNOM SOSTAVE KSENONA V METEORITAKH, (ON THE ISOTOPIC COMPOSITION OF XENON IN METEORITES), Geokhimiya, no. 9, 1962, pp. 837-838, tbl., 7 refs., (in Russian).

In order to investigate xenon anomalies, the isotopic composition of xenon separated from uranium irradiated with high energy (680 mev) protons was determined. The results obtained, together with data pertaining to atmospheric xenon and xenon separated from the Richardton meteorite are presented, and the significance thereof are discussed.

290. Library of Congress, Aerospace Information Div., Washington, D.C.
PHOTOELECTRIC OBSERVATIONS OF METEORS, by D. L. Astavin-Razumin, AID rept. no. 62-15, 30 Jan 62, ASTIA AD 279 428, 2 pp.; trans. of Biul. Vsesoyuz, Astron.-Geod. Obshchestvo, no. 28(35), 1960, pp. 6-10.

Primary external and internal interference encountered in photoelectric observations of meteors are briefly surveyed, and certain measures for controlling or attenuating it are presented. Emphasis is given to three principal types of external interference: night-sky luminescence, stellar scintillation, and scintillation of terrestrial light sources.

291. Library of Congress, Aerospace Information Div., Washington, D.C.
THE TUNGUSKA METEORITE, by K. P. Florenskii, AID rept. no. 62-45, 4 Apr 62, ASTIA AD 280 575, 3 pp., fig.; trans. of Geokhimiya, no. 2, 1962, pp. 187-189.

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In 1961, an expedition under the auspices of the Soviet Academy of Sciences was organized to continue the exploration of the area of fall. While the data collected by the expedition do not contain direct evidence supporting Fesenkov's thesis that the Tunguska meteorite was the head of a comet, they in no way contradict it.

292. LIKE NOTHING ON EARTH, Lamp (Standard Oil Co., N.J.), v. 44, no. 2, Summer 1962, pp. 16-21, 7 figs.

In 1961, scientists at Esso Research and Engineering Company and at Fordham and New York universities, working in collaboration, found within a tiny fragment of the Orgueil meteorite chemical indications of the existence of life. They also found fragments which they believe are fossilized remnants of living things in fragments of this and three other carbonaceous meteorites that had fallen at different times and places. This is strong evidence that elsewhere in our solar system life exists, or has existed.

293. Lin, S.-C.
RADIO ECHOES FROM A MANNED SATELLITE DURING RE-ENTRY, J. Geophys. Research, v. 67, no. 10, Sep 62, pp. 3851-3870, 10 figs., tbl., 34 refs.

Radio-echo measurements of the ionized trails produced during re-entry of the MA-6 Mercury capsule are described and analyzed. From the results, it is possible to infer some conclusions concerning the origin of instantaneous meteoric head echo.

294. Lindblad, B.-A.
THE RADIANT AND ORBIT OF A BRIGHT FIREBALL, Arkiv. Astron. (Stockholm), v. 2, no. 46, 3 Oct 61, pp. 495-516, 6 figs., 2 pls., 7 tbls., 6 refs.

The atmospheric path of a bright fireball which appeared over Scandinavia on January 9, 1954, is calculated from: (1) visual data; and (2) early photographs of the persistent train. The results are compared and conclusions are drawn regarding the orbit in space.

295. Lipschutz, M. E.
DIAMONDS IN THE DYALPUR METEORITE, Science, v. 138, no. 3546, 14 Dec 62, pp. 1266-1267, fig., 9 refs.

Diamond was found by x-ray diffraction techniques in the Dyalpur ureilite; this is the fourth meteorite in which this mineral has been discovered (others: Canyon Diablo, Goalpara, and Novo-Urei). The diamond crystallites resemble those of Novo-Urei more than those of Goalpara.

296. Little (Arthur D.), Inc., Cambridge, Mass.
DEVELOPMENT OF AN EXPLOSIVE SYSTEM FOR ACCELERATING A METAL PELLET, by W. G. Sykes, Contr. AF 19(604)-5740, AFCRL-633, ASTIA AD 263 532, (OTS $4.60), 37 pp., 13 figs., 7 refs., appen.

An explosive system was produced capable of accelerating a metal pellet to hypervelocities, with a known in-flight pellet mass and velocity. The development of this system was part of a program to produce an accurate means for measuring the mass, density, and velocity distribution of particulate matter in space. A facility was designed and constructed for the vacuum pressing of an RDX-based, plastic-bonded explosive of a high and uniform density. The pellets were fired from a barricade, through Mylar screens electrically connected to a counter chronograph to measure their velocity, decelerated in foam, and recovered from Celotex boards.

297. Little (Arthur D.), Inc., Cambridge, Mass.
"Meteoroids in Space," by N. Weiderhorn, Sect. VII, pp. 26-41, 5 figs., tbl., 84 refs.; in THE SPACE ENVIRONMENT AND ITS INTERACTIONS WITH LIQUID PROPELLANTS AND THEIR STORAGE SYSTEMS, Contr. NAS 5-664, Rept. no. C-63270-02-1, Sep 61, ASTIA AD 266 034, (OTS $9.10), 102 pp.

A description of the meteoroid environment and a discussion of interactions of meteoroids with space vehicles. While a meteoroid protection problem clearly exists, it will not be possible to formulate optimum or even feasible solutions until the input parameters are known with greater precision. These parameters include the expected flux of meteoroids larger than about 10^{-6} grams as a function of size, velocity, and distance from the sun and the penetration of such particles.

298. Little (Arthur D.), Inc., Cambridge, Mass.
ON THE IMPACT OF PELLETS WITH THIN PLATES-THEORETICAL CONSIDERATIONS. PART 1, by G. V. Bull, Contr. NAS 5-664, Rept. no. 63270-03-01, Jan 62, ASTIA AD 273 236, (OTS $3.60), 33 pp., 13 figs., 11 refs.

The impact of pellets with thin plates at very high velocities was investigated. To render the problem tractable to analysis, a model has been assumed which allows use of essentially one-dimensional theory to predict both the impact shock-induced conditions and the subsequent expansion flow, although the latter state has been treated subsequently as a general axisymmetric three dimensional flow. The problem is considered in three phases. The first phase is the shock-induced impact states. Based on the concept of the strong shock wave, it is seen that the initial impact-induced states may be expressed readily in terms of impact velocities, initial density ratios, and the polytropic gas exponent in the shocked states. The

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second phase results from the high temperatures generated on impact. The resultant radiative loss mechanisms result in considerable reduction in the thermodynamic states from which expansion occurs. The third phase, the break up of the pellet into an expanding particle cloud, was approached from the restricted point of view of one-dimensional shock and rarefaction. This nonstationary wave system tends to accelerate the outer-material, essentially redistributing the initial kinetic energy of the pellet.

299. Lockheed Aircraft Corp., Sunnyvale, Calif.
EFFECTS OF MICROMETEORITES ON SPACE VEHICLES. AN ANNOTATED BIBLIOGRAPHY, (Addendum to the Space Materials Handbook), by J. B. Goldman and W. L. Hollister, Contr. AF 04(647)-673, Rept. no. 3-34-61-5, Special biblio. no. SB-61-37, Jul 61, ASTIA AD 263 821, (OTS $4.60), 46 pp., 116 refs.

The references included in this publication were gathered to present information on the effects of cosmic dust, micrometeorites, and meteorites on space vehicles. The erosive effects of micrometeorites and cosmic dust are included. Also included are the penetration effects of meteorites. Information on the effects of erosion and penetration on thermal contract surfaces, effects on structures and effects on optical devices were included. Theoretical and experimental research on erosion and penetration were also included. References are arranged alphabetically by author.

300. Loeffler, I. J.
METEOROID PROTECTION FOR SPACE RADIATORS, by I. J. Loeffler, S. Lieblein, and N. Clough, Paper presented at A.R.S. Space Power Systems Conf., Santa Monica, Calif., 25-28 Sep 62, A.R.S. Paper no. 2543-62, 54 pp., 20 figs., 23 refs.

A brief review of the present concepts of the nature of the meteoroid masses and their impact effects is presented. Large degrees of uncertainty exist in both the characteristics of the meteoroids and the resulting damage phenomena. Relations for predicting required thickness of armor protection are given for isotropic incident flux, and a uniform calculation procedure for design studies is proposed. The advantages of controlled radiator orientation to take advantage of the directional properties of meteoroids are also analyzed. It is believed that a vigorous pursuit of the problem areas revealed in the discussion will lead to an early resolution of the general meteoroid problem for space radiators.

301. Lovering, J. F.
THERMOMAGNETIC ANALYSIS OF CO-EXISTING NICKEL-IRON METAL PHASES IN IRON METEORITES AND THE THERMAL HISTORIES OF THE METEORITES, by J. F. Lovering and L. G. Parry, Geochim. et Cosmochim. Acta, v. 26, Mar 62, pp. 361-382, 9 figs., 3 tbls., 29 refs.

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The nickel contents of co-existing kamacite, taenite and plessite in all major structure classes of iron meteorites have been determined by thermomagnetic analysis. The results are in substantial agreement with preliminary data available on the electron probe microanalysis of octahedrites and are consistent with the view that the metal phases in iron meteorites have formed during cooling to temperatures of 300 to 370°C while the meteorites were subject to pressures up to about 25,000 atmospheres. There is some evidence that iron meteorites with relatively low nickel contents (i.e., hexahedrites and coarse octahedrites) formed at pressures slightly higher than those with higher nickel contents (i.e., fine octahedrites and nickel-rich ataxites). It is also suggested that iron meteorites with nickel contents greater than about 30 percent (e.g. Santa Catherina) may have been composed of two γ-phase alloys while they still formed part of the core within a parent meteorite body.

302. Lowman, P. D., Jr.
THE RELATION OF TEKTITES TO LUNAR IGNEOUS ACTIVITY, (Abstract), J. Geophys. Research, v. 67, no. 4, Apr 62, p. 1646.

The theory that tektites are of lunar origin has frequently been criticized on the grounds that rocks of this chemical composition could not have been formed on the moon. The purpose of this paper is to show that lunar igneous processes may have produced rocks from which tektites are derived and to suggest specific features as source areas. The igneous nature of tektites is suggested by their chemical compositions and systematic variation in major oxide contents. Most of the differences between tektites and common igneous rocks such as granite can be explained as being the result of a short period of fusion at temperatures around 2000°C. Examples of igneous rocks essentially similar to tektites in having relatively high iron and magnesium contents are presented. The probability that potential conditions for lunar igneous activity have existed is supported by thermal studies by MacDonald and by Urey. Comparison of estimated lunar thermal gradients with the probable melting curve of chondrites indicates that partial melting should have occurred at depths of a few hundred kilometers. This process should produce some variety of basaltic magma. The theory is proposed that the maria are extrusive lopoliths similar to the Bushveld, Wichita, and Duluth lopoliths studied by Hamilton. It is further proposed that tektites have been derived from the silicic differentiates overlying the maria basalts, such as rhyolites, granophyres, and tuffs. Comparisons to support this theory are made between these rocks and tektites, and between the structure of lopoliths and the maria. It is suggested that the silicic rocks of lopoliths be investigated as possible lunar mare-forming material.

303. Lowman, P. D., Jr.
TEKTITES VS. TERRESTRIAL ROCKS: A COMPARISON OF VARIANCE IN COMPOSITIONS, Geochim. et Cosmochim. Acta, v. 26, May 62, pp. 561-579, 7 figs., 6 tbls., 42 refs.

Tektites are much more similar chemically to certain terrestrial rocks than to known meteorites; this fact supports the possibility that tektites have been formed by the melting and quenching of terrestrial rocks by impact of comets or meteorites or by lightning. This paper presents the results of an attempt to estimate the probability of such occurrences by analysis of the variation in chemical compositions in tektites and igneous and sedimentary rocks. Sixty chemical analyses each of igneous and sedimentary rocks with a range of SiO_2 content equal to that of analysed tektites were picked at random from the literature, subject to restrictions on quality and area. The variance, for each major oxide, of the rock compositions was compared to the corresponding variances for sixty-six analysed tektites by the variance ratio test, and was found to be significantly greater for both rock classes than the tektite variance. All basic assumptions, including variance, and compositional changes due to fusion were justified.

This study suggests that tektite formation by random occurrences such as cometary impact must do two things to account for tektite compositions: terrestrial rocks of fairly restricted composition must be selected for fusion, and the variance in composition within this selected sample must be suppressed. The probability that random processes will do both is shown to be considerably less than 0.001.

The following conclusions were reached:

(1) Tektites are a distinct geochemical class characterized by restricted chemical composition and functional variation of major oxides with silica content.

(2) Tektites have not been formed from terrestrial materials by any natural process thus far suggested.

(3) Tektite formation involved some sort of systematic chemical differentiation. These conclusions point to an extraterrestrial origin for tektites.

304. Lüst, R.
DIE BEWEGUNG UND FORM VON STRUKTUREN IM SCHWEIF DES KOMETEN MRKOS 1957d, (MOTION AND TAIL STRUCTURES OF COMET MRKOS 1957d), Z. Astrophys., v. 54, no. 2, 1962, pp. 67-97, 9 figs., 5 tbls., 20 refs., (in German).

In a series of pictures of Comet Mrkos 1957d, taken with the 48-inch Schmidt telescope of the Mt. Palomar Observatory during the days from August 18 to August 28, 1957, velocities of streamers and condensations in the ionized tail of this comet as well as the dimensions of fine filaments have been measured. The investigation was carried out partly by means of a stereoscopic method, partly by direct measurement. The following results were obtained:

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1. The velocities of condensations in the middle part of the tail were from 10 to 100 km/sec, increasing with increasing distance from the comet's nucleus. An acceleration of about 50 cm/sec^2 can be derived with small variations from day to day (IVa). -- In the cometary matter forming the streamers on both sides of the tails, larger velocities up to 160 km/sec seemed to be present. The resulting accelerations reached values up to 300 cm/sec^2 (IVb).-- Further, more or less irregular motions of smaller structures in a direction perpendicular to the tail's axis could be measured. These motions were almost always directed towards the axis (IVc).

2. A very striking feature of the tail, namely a sharp nearly-right-angle bend was investigated in detail. During 48 hours it moved from about 3 X 10^6 km distance from the nucleus to about 13 X 10^6 km distance. The measurements lead to a velocity increasing from 35 to 70 km/sec, the mean acceleration is 15 cm/sec^2. An initial velocity of $\sim$20 km/sec seems probable. Besides this propagation is a direction parallel to the tail's axis, the structure has carried out some kind of rotation around the axis, thus spiraling from one side of the axis to the opposite side (V).

3. The extreme narrowness of the finest filamentary structures and side streamers gives strong evidence for the presence of magnetic fields which would be able to inhibit a diffusion perpendicular to the magnetic lines of force. A magnetic field of 3 X 10^{-6} Gauss would be sufficient to explain the observed widths of the structures. This value is even less than that for the interplanetary field which follows from theoretical considerations and which seems to be affirmed by recent direct measurements ($\sim 10^{-5}$ Gauss). In this connection, the very long-lived right-angle bend mentioned before is of interest, because here also the presence of magnetic fields may give an explanation for its very sharp boundaries which showed no considerable diffusion over more than 2 days (VI).

4. Finally, the correlation of the evolution of tail structures with geomagnetic events has been investigated. Though the difference in heliographic latitude and longitude between comet and earth were considerable ($\Delta b \sim 40°$, $\Delta \ell \sim 90°$), a correlation with a geomagnetic storm could be found (II).

305. Lyttleton, R. A.
THE EFFECT ON THE LUNAR ORBIT OF METEORITIC ACCRETION, Icarus, v. 1, no. 2, Sep 62, pp. 137-143, fig., tbl., 2 refs.

The assumption that the range of the lunar orbit has been influenced only by tidal dissipative effects may not be valid, for there is the further possibility that considerable change in mass of both the moon and earth has resulted through meteoritic accretion during the past 4-5 aeons, and this would operate to make the orbit contract. The effect of such addition of mass is greater for the moon at greater distance, whereas

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the tidal couple on the moon decreases very rapidly with distance. Examination of the hypothesis opens the possibility that the moon may have been captured at substantially greater distance than the present one and thereafter drawn in towards the earth.

306. Lyttleton, R. A.
"On the Statistical Loss of Long-Period Comets from the Solar System, I," pp. 229-244, 3 figs., 2 tbls.; in PROCEEDINGS OF THE FOURTH BERKELEY SYMPOSIUM ON MATHEMATICAL STATISTICS AND PROBABILITY, VOLUME III: ASTRONOMY, METEOROLOGY, AND PHYSICS, (held at Berkeley, Calif., 20 Jun-30 Jul 60), Berkeley, Univ. California Press, 1961, 335 pp.

It is shown that the distribution of the orbits of comets of the solar system must be changing with time, and a study is made of the main causes of these changes in order to obtain an estimate of the decay period associated with a defined group of comets.

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307. Mac Donald, G. J. F.
THE MOON AND ITS INTERIOR, Astronautics, v. 7, no. 7, Jul 62, pp. 14-18, 9 figs., 5 refs.

Theories of the internal constitution of the moon are discussed. There is no reliable estimate of the internal density distribution of the moon and it is thus impossible to determine whether the moon is chemically homogeneous. The composition of the moon and the associated internal temperature distribution and internal structure poses a problem whose solution will be aided by the determination of: (1) the moon's mean moment of inertia; (2) lunar surface heat flow; and (3) lunar seismicity. These observations may also permit a definitive theory to be developed concerning the genetic relationship of the moon to the earth.

308. Mac Donald, G. J. F.
ON THE INTERNAL CONSTITUTION OF THE INNER PLANETS, J. Geophys. Research, v. 67, no. 7, Jul 62, pp. 2945-2974, 23 figs., 15 tbls., 80 refs.

The internal structures of the moon, Mars, Venus, and Mercury are examined in the light of what is known about the constitution of the earth. A review of the seismic determination of the elastic constitution of the earth's mantle, using new results on the stability of silicates at high pressures, leads to the following interpretation: The rapid increase of

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velocity beginning at 200 km depends on the olivine-spinel transition and the breakdown of silicates to oxides. Preliminary calculations of the stability field of periclase (MgO) and stishovite (high-density SiO_2) relative to olivine ($MgSiO_4$) indicate that the oxides are stable at pressures greater than 1.0 - 1.5 X 10^5 bars. The oxide transition produces a change in volume of about 20 percent. The gravitational figure of the earth, as obtained from satellite orbits, is used to estimate the possible deviations from hydrostatic equilibrium on other planets. The near coincidence of the present rate of heat production of a chondritic earth and the present surface heat flow is discussed as a limiting condition of the internal thermal structure of the earth. Observations of the orbital and rotational motion of the moon give its gravitational figure. Calculations of its thermal structure show that a model moon with uniform radioactivity and chondritic composition is inconsistent with the present figure. The inferred strength of the moon requires either that the radioactivity is substantially less than that of chondrites or that the heat sources are concentrated in the outer layers. The problem of differentiation without melting is noted. The average lunar material has a radioactivity perhaps one-half, or less, that of chondritic materials. The astronomical data on the mean density and gravitational figure of Mars receive critical examination. If the mean radius of Mars is taken to be 3310 km, the planet must have a surface density of about 3.8 - 3.9 and must be nearly homogeneous. If Mars were homogeneous and had a radioactivity equal to that of chondrites, the interior would be molten and large-scale gravitational differentiation would be expected. Since this differentiation is not apparent in the gravitational data, it is concluded that the radioactive composition of Mars differs from that of chondrites. The internal structures of Mercury and Venus are examined briefly in terms of their inferred rotational history. In conclusion, the inner planets differ both in the abundances of the heavy elements and in the abundances of potassium, uranium, and thorium. Chondrites may provide a satisfactory chemical model for the earth but not for the other inner planets; Venus is a possible exception, only on the grounds of our ignorance of its internal constitution.

309. McGillem, C. D.
LUNAR CRATER ROUGHNESS FROM CRATER STATISTICS, by C. D. McGillem and B. P. Miller, J. Geophys. Research, v. 67, no. 12, Nov 62, pp. 4787-4794, fig., 4 tbls., 9 refs.

Statistical data have been compiled on the size distribution of craters in the range of sizes visible on lunar maps and photographs. These data are extrapolated to the smaller sizes to make an estimate of the relative frequency of smaller craters. It is found that cumulative crater size distribution in the

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visible range of sizes may be approximated by the law $N = AD^{-B}$ where N is the number of craters having diameter greater than D, and A and B are constants. The coefficient A depends upon the total number of craters per unit area, varying from about 1400 for the maria to 30,000 for the highland regions when D is measured in kilometers and N is in craters per 10^6 km^2. However, it is found that the exponent B is reasonably independent of location on the lunar surface, having a value of about 1.6. Extrapolation using this expression shows that not more than 0.2 percent of the surface of the maria is covered by craters in the diameter range 1 to 100 meters, and that even in the highlands, this size range covers less than 6.4 percent of the area. Thus it would appear that mobility of vehicles is not likely to be jeopardized by these craters.

310. McIntosh, B. A.
THE METEORIC HEAD ECHO, J. Atmospheric and Terrest. Phys., v. 24, Apr 62, pp. 311-315, fig., 12 refs.

It has recently been suggested that many of the "head" echoes from meteor trails can be explained on the basis that the ionized columns behave as round reflectors. This explanation is a result of confusion in terminology as to what constitutes a "head" echo. The characteristics of the echo type which is called a head echo by research workers at Ottawa are clarified and examples are given to distinguish this type of echo from others which resemble it.

311. McIntyre, D. B.
IMPACT METAMORPHISM AT CLEARWATER LAKE, QUEBEC, (Abstract), J. Geophys. Research, v. 67, no. 4, Apr 62, p. 1647.

In 1958 the Dominion Observatory made an extensive gravity survey east of Hudson Bay. Unusual metamorphic rocks were collected at stations on islands in Clearwater Lake (74°30'W, 56°10'N). The lake consists of two circular bodies of water, 30 km and 20 km in diameter. The smaller is more than 150 meters deep and is probably floored by arkose and Paleozoic limestone. The larger contains a ring of islands having topographic indication of gentle dip toward the center where recrystallized diorite is exposed. The crudely layered rocks are probably megabreccias and are interpreted as resulting from meteorite impact. Locally there are abundant boulders of fossiliferous Paleozoic limestone. No evidence of volcanic activity was observed. The predominant rock is hematite-stained breccia, and it has a glassy vesicular matrix, containing fragments of altered granite. Feldspars are recrystallized in sheaflike aggregates, amphibole and biotite are converted to pyroxene, and quartz is granular. Quartz paramorphs after tridymite are conspicuous. Shattered granite passes into microbreccias having numerous deformation lamellas in the quartz.

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Veins of vesicular glass and feathery feldspars traverse the breccia. Recrystallization of the feldspar which separates the quartz crystals may have prevented the formation of coesite.

312. McNarry, L. R.
FORWARD SCATTER OF RADIO SIGNALS VIA METEOR TRAILS AND SHORT-LIVED SOLAR RADIO BURSTS, Nature (London), v. 193, no. 4822, 31 Mar 62, pp. 1271-1272, 2 figs., 8 refs.

Many of the characteristics of the short-lived solar bursts or pips as reported in the literature bear a striking resemblance to the forward scatter signals from meteor trails as seen on the N.R.C. spectrum radiometer. Although the recorded characteristics of forward scatter signals will be a function of the observing equipment and may be easily recognized as individual events, it is possible that scatter signals reflected from a meteor trail in the antenna beam of a solar radiometer may occur during the lifetime of a solar radio burst. Thus it may be that the explanation of unusual events observed during studies of short-lived radio bursts may not always have a solar origin.

313. Marsden, B. G.
THE ORIGINAL ORBIT OF COMET BESTER-HOFFMEISTER, J. Brit. Astron. Assoc., v. 72, no. 3, 1962, pp. 139-140, 2 refs.

The elements of comet Bester-Hoffmeister (1959d) are calculated and it is concluded that the original orbit of this comet was most probably an ellipse.

314. Marshall, R. R.
THE COMPOSITE ORIGIN OF HEAVY ELEMENTS AND IRON METEORITES, Icarus, v. 1, no. 2, Sep 62, pp. 95-111, 3 figs., 2 tbls., appen.

A model based on three nucleosynthesising events preceding the formation of the solar system accounts for the origin of the r-process nuclides. The first such production occurred 13.4×10^9 years ago. It may represent an average of more than one such nuclear synthesizing event (but probably not many such events). The second event occurred 7.5×10^9 years ago, and the third occurred at the beginning of the solar system. The last two events contributed only 6 and 7%, respectivly, of the r-process elements to the meteorites and planets. (These values do not necessarily include those elements, such as lead and bismuth, which are quite volatile and easily fractionated by physical and chemical means.)

The range in the lead-lead ages of the stone meteorites seems to be about 0.3×10^9 years. This interval essentially coincides with that of 0.25×10^9 years between the last

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nucleosynthesis and the time at which the chondrite Richardton began to retain rare gases such as xenon. According to the abundance of Xe^{136} in the atmosphere, the earth may have formed as recently as 4.2×10^9 years ago.

The three-nucleosynthesizing-event model was suggested by the presence of two kinds of lead which must have been incorporated into iron meteorites at or before the beginning of the solar system. Three iron meteorites (Toluca, Bishtyube, and Henbury) contain both types, a fact which implies that there were at least two stages in the formation of these meteorites. First, iron must have been segregated from two sources which differed at least in the isotopic composition of their leads; then these masses of iron must have combined, with more or less complete sintering.

315. Marvin, U. B.
CRISTOBALITE IN THE CARBO IRON METEORITE, Nature (London), v. 196, no. 4855, 17 Nov 62, pp. 634-636, 2 figs., 9 refs.

Cristobalite, SiO_2, has been identified by optical and X-ray determinations as an accessory mineral in a troilite nodule of the Carbo iron meteorite. Cristobalite has been reported in only two other meteorites: Abee, an enstatite chondrite, and Nuevo Laredo, a brecciated eucrite. In both stones cristobalite and quartz occur together in very small traces.

In Carbo the cristobalite forms dendritic, microcrystalline aggregates within a droplet of green glass embedded in troilite. The droplet is irregular in shape with a maximum length of about 0.5 mm. The cristobalite is clearly a devitrification product of the glass. The glass must be a relatively late product formed by some selective process of sudden reheating or shock which melted one mineral grain to a droplet of silicate slag, but did not destroy the Widmanstätten patterns of the metal on the margin of the troilite nodule, or melt the neighbouring troilite, schreibersite, or spinels.

Carbo shows only slight evidence of reheating on one small area of its outer surface. Neumann-lines and the distribution of helium-3 indicate that the meteorite probably sustained shock, which caused the melting of the glass droplet as well as the modification of its shape and the Neumann-lines, by collision with another body in space, or on impact with the earth. Of the two possibilities, the former seems more likely because Carbo is small enough to have landed on the earth under conditions of free fall.

316. Maryland. Univ., Dept. Physics, College Park
ELECTROSTATIC SCREENING OF BODIES IN SPACE, by S. F. Singer and E. H. Walker, Grant AF-AFOSR 61-57, Tech. rept. no. 226, Sep 61, AFOSR-1399, ASTIA AD 263 806, (OTS $1.60), 19 pp., 6 figs.; also published as PHOTOELECTRIC SCREENING OF BODIES IN INTERPLANETARY SPACE, Icarus, v. 1, no. 1, May 62, pp. 7-12, 6 figs., 7 refs.

Continued

Bodies in space which are subject to the solar ultraviolet flux will emit photoelectrons. A certain number of these escape and are balanced by the accretion of thermal electrons from the surrounding plasma. However, for a positively charged body, a much larger number of photoelectrons will be released from the surface but will not escape because their energy is insufficient to do so. Their effect will be to produce an inner screening of the body's electric charge. This screening is calculated for spherical bodies as a function of size. For large bodies the space charge density of photoelectrons becomes quite large; in the case of the moon it reaches a value of the order of 10^3 to 10^4 electrons/cm^3 just above the lunar surface. For small dust particles, however, the photoelectric cloud becomes negligible.

317. Mason, B.
THE CLASSIFICATION OF CHONDRITIC METEORITES, Am. Museum Novitates, no. 2085, 24 May 62, 20 pp., 3 figs., 7 tbls., 23 refs.

It is proposed to modify Prior's classification by the addition of two groups, the olivine-pigeonite chondrites and the carbonaceous chondrites. Chondrites belonging to these two groups were included by Prior in the olivine-hypersthene chondrites. However, in the olivine-pigeonite chondrites pigeonite is the dominant pyroxene, and the carbonaceous chondrites contain little or no pyroxene. These two groups also show additional mineralogical and chemical differences which clearly differentiate them from the other groups of chondrites. The two groups are few in number; 11 divine-pigeonite and 14 carbonaceous chondrites have been recognized, whereas the olivine-bronzite and olivine-hypersthene chondrites number many hundreds and are by far the commonest of all meteorites.

318. Mason, B.
DESCRIPTIONS OF TWO METEORITES: KAROONDA AND ERAKOT, by B. Mason and H. B. Wiik, Am. Museum Novitates, no. 2115, 14 Dec 62, 10 pp., fig., 2 tbls., 9 refs.

The Karoonda meteorite fell on November 25, 1930, in South Australia; some 92 pounds of fragments were collected, the largest weighing 7 pounds. The meteorite contains a notable amount of magnetite, a mineral normally absent from fresh, unweathered chondrites. All in all, while the elemental composition is closely similar to other H-group (high-iron) chondrites, the Karoonda meteorite represents a highly oxidized condition for such meteorites, with no free metal, with nickel as a sulphide phase, and with virtually all the iron as ferrous iron, with some ferric iron.

The Erakot carbonaceous chondrite fell at Erakot, India, on June 22, 1940. One stone weighing 113 grams was recovered.

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Erakot is closely comparable in elemental composition to the other carbonaceous chondrites, and to the chondrites of the H-group. The meteorite belongs to the Type II carbonaceous chondrites as defined by Wiik, and is essentially identical with Cold Bokkeveld, Mighei, and other meteorites of this group.

319. Mason, B.
THE MACQUARIE RIVER "METEORITE," Mineral Mag., v. 33, no. 256, Mar 62, p. 68, 3 refs.

A note in which the Macquarie River meteorite is shown to be nonmeteoritic, presumably a smelter product.

320. Mason, B.
METEORITES, New York, John Wiley, 1962, 274 pp., 67 figs., 22 tbls., 362 refs., 2 appens.

The purpose of this book is to provide a comprehensive account of our present knowledge of meteorites, with special reference to their material nature--their mineralogical and chemical composition and structure. The emphasis throughout is on the data and their interpretation. Hypotheses and theories are presented but are not exhaustively discussed--the great upsurge in meteorite research along many new lines in recent years has provided a mass of new information yet to be integrated into a consistent and comprehensive theoretical framework. Tektites are described and discussed in a separate chapter. Although tektites have not been seen to fall and their identification as extraterrestrial matter is disputed, they retain a position in the overall field of meteoritics unless and until they are proved to be of terrestrial origin. The text is well illustrated.

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Introduction.
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321. Mason, B.
THE RENAZZO METEORITE, by B. Mason and H. B. Wiik, Am. Museum Novitates, no. 2106, 10 Oct 62, 11 pp., 4 figs., tbl., 11 refs.

The Renazzo meteorite fell near Ferra, Italy, on January 15, 1824. A number of stones fell, the largest weighing about 5 kilograms. Unfortunately, the location of the major mass of the meteorite is now unknown.

The Renazzo meteorite appears to be intermediate between a carbonaceous chondrite and an enstatite chondrite. Some of its remarkable features are: (a) the occurrence of chondrules of essentially iron-free anhydrous magnesium silicates in an iron-rich groundmass of hydrated silicate; (b) the mantling of many chondrules by a sheath of nickel-iron granules, whereas the interior of the chondrules are free from nickel-iron; and (c) the constant association of nickel-iron with the chondrules and its absence from the groundmass.

Several hypotheses can be formulated to explain the genesis of the Renazzo meteorite. The most likely possibilities seem to be:

1. The chondrules were formed in one environment, the groundmass in a different environment, and the meteorite is a chance accumulation of these two materials, with different genetic histories.
2. The meteorite is the product of a single process, the chondrules and the groundmass being genetically related, in which case there are the following alternatives: (a) the groundmass has been formed from the materials of the chondrules; (b) the chondrules have been formed from the materials of the groundmass.

It is concluded that the Renazzo meteorite represents an arrested stage in the conversion of a carbonaceous chondrite into an enstatite chondrite. The chondrules of iron-free olivine and pyroxene with the associated nickel-iron appear to have formed at the expense of the carbonaceous serpentine groundmass, which is presumably the result of a thermal metamorphism that failed to proceed to completion.

322. Massachusetts Inst. of Tech., Cambridge
CHEMICAL AND PHYSICAL STUDIES OF TEKTITES, by W. H. Pinson, Jr., Contr. AF 19(604)-6135, Proj. 7698 (Continuation of Contr. AF 19(604)-5497), Final rept., 15 Feb 62, AFCRL 62-221, ASTIA AD 273 076, NASA N62-10320, (OTS $13.00), 169 pp., 9 figs., 24 tbls., 125 refs.

Reanalyses of tektites revealed that they contain measurable quantities of radiogenic Sr. The Rb, Sr and Sr isotopic compositions were determined in tektites from Indochina, the Philippine Islands, Australia, Java, North America, and Czechoslovakia. The average Sr-87/Sr-86 ratio in 16 tektites is 0.7183 ± 0.0004 from the above localities, exclusive of

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Czechoslovakia (moldavites). The Rb and Sr contents from a given locality were similar, but differences existed between localities. Analyses revealed what appeared to be a sympathetic variability between Sr-87/Sr-86 ratios and Rb/Sr ratios among several groups of tektites which could be explained by a common age (approximately 175 million years). A separate study of the major element compositions of tektites was made; 34 new major element analyses for southeast Pacific areas are presented; chemical similarities are noteworthy. The Rb-Sr data and major element data indicate an extraterrestrial origin for tektites. The possibility of their having come from the moon is neither demonstrated nor excluded. Hypotheses of random processes of fusion of terrestrial materials are, however, excluded by the data.

323. Massalskaya, K. P.
BIBLIOGRAFICHESKII UKAZATEL LITERATURY PO METEORITIKE, (BIBLIOGRAPHIC INDEX OF LITERATURE ON METEORITES), Meteoritika, Akad. Nauk S.S.S.R., no. 21, 1961, pp. 81-129, 681 refs., (in Russian).

A bibliography of 681 references, most of which are briefly annotated, that includes the literature published in 25 languages in 1956, 1957, and 1958. Most of the literature listed is in English (45%) and Russian (28%). The references are listed alphabetically by author and are presented under the following headings: general information, theory and history of meteorites, meteorites in interplanetary space, meteorites in the earth's atmosphere, meteorites on the earth's surface, descriptions of single meteorites, and meteoritics and related problems (such as tektites and noctilucent clouds). Previous meteorite bibliographies in this journal appeared in 1951, 1952, 1955, 1956, and 1958.

324. Massalski, T. B.
A QUANTITATIVE METALLOGRAPHIC STUDY OF FIVE OCTAHEDRITE METEORITES, by T. B. Massalski and F. R. Park, J. Geophys. Research, v. 67, no. 7, Jul 62, pp. 2925-2934, 2 figs., 2 tbls., 24 refs.

The proportions by volume of kamacite, taenite, and nonmetallic phases have been determined by quantitative metallography in five octahedrite meteorites: Grant, Bristol, Toluca, Odessa, and Canyon Diablo. Using the ratio of the kamacite/taenite phases and the Fe-Ni phase diagram, the lowest temperature (T_o) at which these phases existed in equilibrium has been estimated, and its value employed in a calculation of the possible time intervals necessary for the formation of the Widmanstätten pattern in asteroidal bodies 100-200 km in radius and consisting either of an Fe-Ni alloy or of olivine with an iron core. It is concluded that the time intervals available for the

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formation of the Widmanstätten pattern need not have exceeded 10^8 years but could be longer if segregation occurred under pressure. The estimated T_0 temperatures fall into two groups with mean values of approximately 460° and 525°C. The difference between these two values may be due to the different origin of the meteorites or to the different content of the nonmetallic phases.

325. Mayer-Böricke, C.
γ-SPEKTROSKOPISCHE UNTERSUCHUNGEN AN STEINMETEORITEN, (γ-SPECTROSCOPIC ANALYSIS OF STONE METEORITES), by C. Mayer-Böricke, M. M. Biswas, and W. Gentner, Z. Naturforsch., v. 17a, no. 10, Oct 62, pp. 921-924, 4 figs., tbl., 12 refs., (in German).

Cosmic ray produced Al^{26} and Na^{22} activities in chondrites have been studied by nondestructive γ(511 keV)-γ coincidence spectroscopy. The values of the Al^{26} specific activities of the four measured hypersthene chondrite samples are nearly equal, and have a mean value of 0.061 Al^{26} e^+-decays/min g.

The Na^{22} specific activity of the Bruderheim chondrite was found to be 0.094 Na^{22} disint/min g in agreement with the results obtained by other authors using different methods. From the Na^{22} activity and the Ne^{22} content of our sample we have calculated a cosmic ray exposure age of 26 X 10^6 y for Bruderheim. Exposure ages of other chondrites are discussed.

Single crystal γ-spectroscopy of Bruderheim shows in addition to Al^{26} and Na^{22} the presence of Mn^{54} and K^{40}.

326. Meeus, J.
TABLES OF THE SATELLITES OF JUPITER, J. Brit. Astron. Assoc., v. 72, no. 2, 1962, pp. 80-88, 2 figs., 8 tbls.

The tables presented enable the configuration of the four great satellites of Jupiter to be computed easily at any given moment.

327. Meffroy, J.
SUR L'INTÉGRATION DES ÉQUATIONS DIFFÉRENTIELLES D'UN ASTÉROÏDE DE MASSE NEGLIGEABLE RECTILIGNE, (ON THE INTEGRATION OF DIFFERENTIAL EQUATIONS OF AN ASTEROID OF NEGLIGIBLE MASS MOVING WITH OBVIOUSLY PLANE RECTILINEAR MOTION), Compt. Rend., v. 255, no. 19, 5 Nov 62, pp. 2370-2372, ref., (in French).

In a previous note, rigorous differential equations were determined for the plane motion of an asteroid of negligible mass attracted by the sun and by a large planet which described a circular orbit around the sun. In the present note, a method of integration of these equations is given when the motion is nearly rectilinear. In the case of strictly rectilinear motion, one finds the fifth degree equation obtained by Euler.

328. Meffroy, J.
SUR LA RECHERCHE SYSTÉMATIQUE DES ÉQUATIONS DIFFÉRENTIELLES RIGOUREUSES DU MOUVEMENT PLAN D'UN ASTÉROÏDE DE MASSE NEGLIGEABLE EN COORDONÉES POLAIRES, (SYSTEMATIC RESEARCH ON RIGOROUS DIFFERENTIAL EQUATIONS OF THE PLANE MOTION IN POLAR COORDINATES OF AN ASTEROID OF NEGLIGIBLE MASS), Compt. Rend., v. 255, no. 4, 23 Jul 62, pp. 644-646, ref., (in French).

In the plane three-body problem one has to determine the rigorous differential equations of motion of an asteroid of negligible mass attracted by the sun and by a large planet which describes a circular orbit around the sun. It is shown that these equations allow a nonuniform transcendental integral.

329. Mellon Inst. Pittsburgh, Pa.
FOSSIL GLASSES PRODUCED BY IMPACT OF METEORITES, ASTEROIDS AND POSSIBLY COMETS WITH PLANET EARTH, by A. J. Cohen, NASA Grant NsG-57-60, Suppl. 1-62, Paper presented at Sixth Intern. Congress on Glass, Washington, D.C., 1962, NASA N62-15578, (OTS $3.60), 32 pp., 7 figs., 7 tbls., 30 refs.

Recent research indicates that those glasses known as tektites are the result of meteorite, asteroid, or possibly comet impact. Impact glasses, in general, differ from volcanic glasses in that they are lower in water content, have low gallium and germanium contents, and are not necessarily in magmatically unstable continental areas. These impactites may be divided as follows: (1) Glasses found in or near terrestrial meteorite craters. These glasses usually contain numerous spherules of nickel-iron, coesite, chunks of partially melted meteoritic matter and even stishovite. Shattered or fractured unmelted minerals such as quartz are commonly present. Aerodynamic-shaping may or may not be present in this type. Examples are Canyon Diablo and Wabar Crater glasses. (2) Impact-glasses associated with craters with no evidence of meteoritic material in the glass or surrounding the explosion site. The only known example is glass associated with Aouelloul Crater in the Western Sahara Desert. (3) Impact-glasses containing little or no aerodynamic-shaping and not associated with any known crater. These glasses usually contain some unmelted fractured quartz, coesite and high-melting detrital minerals. In one case crystobalite is present. The two known examples are Darwin glass from Tasmania and Libyan Desert glass. (4) Aerodynamically-shaped green to brown glasses containing only silica-glass and Ni-Fe spherules as inclusions. These glasses are not associated with nearby craters. They occur in strewn fields and are known as tektites. Two of these strewn fields are associated with known asteroid or comet craters, and from studies of the glass compositions in other strewn fields the locations of two additional asteroid craters are predicted.

330. Merrihue, C. M.
RARE GASES IN THE CHONDRITE PANTAR, by C. M. Merrihue, R. O. Pepin, and J. H. Reynolds, J. Geophys. Research, v. 67, no. 5, May 62, pp. 2017-2021, 2 figs., 3 tbls., 12 refs.

Ne and He studies by König and co-workers for the chondrite Pantar have been confirmed, and the measurements have been extended to include Ar and Xe. The light phase of this meteorite is typical of most chondrites in its content of radiogenic He^4 and Ar^{40} and cosmogenic He^3, neon, and argon. The dark phase, in which opaque minerals outline the chondrules, is rich in "primordial" rare gases. Primordial xenon, exhibiting "general" isotopic anomalies identical to those found in carbonaceous chondrites, occurs in both phases but is 12 times more abundant in the dark phase. Radiogenic Xe^{129} from I^{129} decay occurs in both phases but is 53 times more abundant in the dark phase. The primordial gas spectrum resembles other meteorites in its He/Ne and Xe/Ar ratios. In its Ar/Ne and Ne^{20}/Ne^{22} ratios it resembles Pesyanoe and belongs to what can be loosely described as a "cosmic" group of gas-rich stones.

331. Merz, E.
THE DETERMINATION OF HAFNIUM AND ZIRCONIUM IN METEORITES BY NEUTRON ACTIVATION ANALYSIS, Geochim. et Cosmochim. Acta, v. 26, Feb 62, pp. 347-349, tbl., 6 refs.

The great chemical similarity of hafnium and zirconium makes the chemical separation and accurate determination of both elements, when present in small amounts, extremely difficult. A procedure is described for determining these two elements together, without chemical separation, by means of neutron activation, measuring the induced activities of the nuclides Hf^{181} and Zr^{95} by pulse height analysis. The results of the measurements are given for seven meteorites.

332. METEORITE DATA STILL LACKING, Nucleonics, v. 20, no. 9, Sep 62, p. 66.

A note pointing out that a factor-of-1000 uncertainty still exists in estimates of the rate at which micrometeorites would penetrate thin structures such as radiator shells in space.

333. METEORITE NETWORK, Sky and Telescope, v. 23, no. 6, Jun 62, p. 303; additional data are given in Smithsonian Astrophysical Observatory, News Release, no. 62-40, 23 Dec 62, 2 pp.

A note describing a new project established by the Smithsonian Astrophysical Observatory in an attempt to locate meteorites quickly after they fall. At each of 16 locations in seven midwestern states, the SAO is setting up camera stations. Each day the cameras will operate automatically from sunset to

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sunrise; about twice a month workers from field headquarters (Lincoln, Nebraska) will visit the sites to pick up the film for processing, scanning, and transmitting to Cambridge. Quick recovery search trips will be made whenever a meteor fall is indicated.

334. METEORITE RESEARCH, Eng. and Sci. (Calif. Inst. of Tech.), v. 25, no. 7, Apr 62, pp. 15-16, fig.

Analyses of the chondrites Bruderheim and Murray suggests that both meteorites represent an excellent environment for the growth of microorganisms. Apparently the peculiar chemistry of meteorites, in terms of sulphur content, high iron concentration, or the various oxidation states of heavy metals, stimulates the activity of certain terrestrial microbes, and even accelerates the production and accumulation of terrestrial biogenic organic matter. The organic spectrum of chondrites strikingly resembles the one of oxidizing recent marine sediments, but differs considerably from any other spectrum obtained from any ancient or recent rocks. The present facts indicate simple terrestrial contamination of these chondrites - not biogenic indications of extraterrestrial life.

335. Miller, F. D.
THE TYPE I TAIL OF COMET 1955e, Publs. Astron. Soc. Pacific, v. 74, no. 436, Feb 62, pp. 60-65, 4 figs., tbl., 10 refs.

Comet 1955e was observed in June 1955, at which time it reached maximum heliographic latitude +80°. On three objective-prism spectrograms of the type I tail, two previously unobserved features appear, the (0.2) band of CO^+ at λλ6189, 6239, and an unidentified emission feature near λ6600. On direct photographs, the photored image of the type I tail is conspecuous, in contrast to the near-invisibility on similar plates of the type I tail of comet 1957d. The presence of a well developed type I tail in a comet at high heliocentric latitude in a period of solar calm is noteworthy.

336. Millman, P. M.
METEOR NEWS, J. Roy. Astron. Soc. Can., v. 56, no. 5, Oct 62, pp. 226-228, 2 tbls.

All the meteors visually observed during the calendar year 1961 are reported in tabular form.

337. Millman, P. M.
THE METEOR RADAR ECHO-AN OBSERVATIONAL SURVEY, Astron. J., v. 67, no. 5, Jun 62, pp. 235-240, 6 figs., 3 tbls., 9 refs.

The ionization left by a meteor along its path acts as a radar target, and since 1946 radar methods of meteor observation

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have been regularly employed by astronomers. Observationally, all radar echoes can be divided into three main categories which may appear singly or in combination for any given meteor. These categories may be listed as (a) the underdense echo, characterized by aspect sensitivity and a relatively short duration with an exponential decay in amplitude; (b) the overdense echo, with little or no aspect sensitivity and relatively long duration and complex structure; (c) the head echo, a feature which appears to be confined to the immediate neighborhood of the moving meteoroid.

The general observational statistics of meteor echoes are here examined, particularly in relation to the parameters of the visual meteors. During the last 15 years at Ottawa over 27,000 visual meteors have been recorded concurrently with the operation of high-powered meteor radar equipment on 32 Mc/sec, with peak powers ranging from 200 to 4000 kw. These observational data have been used to determine various statistical correlations between the brightness, position, and velocity of the visual meteors, and the range, amplitude, and duration characteristics of the meteor radar echoes.

It seems evident that both the physical properties of the meteoroid and the existing conditions in the ionosphere combine to determine the nature of the meteor echo.

338. Millman, P. M.
AN OBSERVATIONAL SURVEY OF METEOR TRAILS, Paper presented at A.R.S. 17th Ann. Meet. and Space Flight Exposition, Los Angeles, Calif., 13-18 Nov 62, A.R.S. paper 2659-62, 7 pp., 7 figs., 7 refs.

A general survey of present knowledge of meteor trails and the observational techniques pertaining thereto. There is now a considerable amount of qualitative information from meteor observations, but quantitive data of high accuracy are lacking when an attempt is made to determine the distribution of luminosity and ionization around an ablating meteoroid.

339. Millman, P. M.
PHOTOGRAPHIC METEOR SPECTRA (APPENDIX 8), J. Roy. Astron. Soc. Can., v. 56, no. 6, Dec 62, pp. 263-267, tbl.

A total of 177 additional photographic meteor spectra are listed in tabular form. As in previous lists, each meteor photographed is listed only once even though a number of spectrograms of the same meteor have been secured with different cameras.

340. Mitler, H. E.
He^3 IN PLANETESIMALS, (Abstract), Bull. Am. Phys. Soc., ser. II, v. 7, no. 7, 27 Aug 62, p. 464, ref.

Continued

Recently, a theory was proposed by Fowler, Greenstein, and Hoyle (Geophys. J., v. 6, no. 2, Feb 62, pp. 148-220) to account for the anomalously high abundance of D, Li, Be, and B in the earth, meteorites, and cosmic rays. In their theory, a great deal of He^3 is produced in the preplanetary planetesimals by spallation. If retained, it would throttle the necessary neutron reactions because of its large cross section for thermal neutrons. A calculation is made of the probable amount of He^3 actually retained in an ice and silicate planetesimal. It is found that He^3 will indeed diffuse away rapidly enough, as long as the planetesimal is less than 2 m in radius. A minimum radius of 10 cm is needed for thermalization of the neutrons. An incidental result is that the energy spectrum for heavy particles in a solar flare is $n(E) = kE^{-4.86\pm0.14}$.

341. Mokhnach, D. O.
DETERMINATION OF THE PHYSICAL PROPERTIES OF THE CYANOGEN ENVELOPES OF HALLEY'S COMET, 1910-II, Soviet Physics, (Doklady), v. 7, no. 1, Jul 62, pp. 1-3, 6 refs.; trans. of Doklady Akad. Nauk S.S.S.R., v. 142, no. 2, Jan 62, pp. 304-307.

The values of the initial velocity v_o (1.55×10^5 cm sec^{-1}) and the acceleration due to radiation pressure g (4×10^{-2} cm sec^{-2}) found from the observation of the cyanogen envelopes of Halley's comet can be considered to be close to their true values, although the values of the mass (10^9 g if $\Delta T = 2100$ sec, 10^8 g if $\Delta T = 21$ sec) and the emission coefficients n_c (3×10^{26} molecules sec^{-1} $sterad^{-1}$) of the envelopes cannot be so considered. In the latter case, the calculations were based on the assumption that the cyanogen heads of Halley's comet and comet 1942g are similar which, of course, puts the reliability of the results under suspicion.

342. Mokhnach, D. O.
THE SIMPLEST MODEL OF HALOS, Soviet Physics, (Doklady), v. 6, no. 11, May 62, pp. 961-963, 2 figs., 2 refs.; trans. of Doklady Akad. Nauk S.S.S.R., v. 141, no. 3, Nov 61, pp. 578-581.

Halos are luminous rings in a comet's head whose centers are practically coincident with the "nucleus" (photometric center). The radius of a halo increases proportionately to time, while the surface brightness of a ring is a decreasing function of time. Because of this, halos as objects open to observation exist for only a comparatively short period - in all, a few days.

A model is proposed which describes the apparent density distribution and the time variation in brightness of halos, based on the assumption that cometary halos are formed by isotopic ejection from a point (the "emission center").

343. Montana. State Coll., Electronics Research Lab., Bozeman
METEOR SCATTER COMMUNICATIONS TECHNIQUES, Contr. AF 30(602)-2110, Final rept., 31 Oct 61, RADC TR 61-240, ASTIA AD 271 773, (OTS $8.60), 85 pp., 30 figs., 6 refs.

Certain characteristics of 73 mc signals reflected from ionized meteor trails were measured. The duration and frequency of occurrence of these intermittent propagation paths are presented for the hours of minimum meteor activity, based on data obtained from a special test circuit installed between Bozeman, Montana, and Palo Alto, California. Parameters are determined for a system consisting of a remote station and a fixed station, with daily bit rate and maximum allowable error specified. A demonstration system was assembled and operated to verify the design and validate its feasibility.

344. Moore, C. B.
THE DISTRIBUTION OF MANGANESE AND TITANIUM IN STONY METEORITES, by C. B. Moore and H. Brown, Geochim. et Cosmochim. Acta, v. 26, Apr 62, pp. 495-502, fig., 6 tbls., 11 refs.

The concentrations of manganese and titanium have been determined spectrographically in a group of forty-three chondrite falls, forty-five chondrite finds, two carbonaceous chondrites and five achondrites. Significant differences in the concentrations of Mn and Ti are found between chondrites which are seen to fall as distinct from those which are found. Also, differences in the Mn and Ti concentrations are indicated between "high" iron group and "low" iron-group chondritic falls. The ratios Mn/Ti are, with few exceptions, quite constant between all groups. The chondrite falls investigated appear to constitute an unbiased sample with average concentrations by weight of Mn 0.26 ± 0.03 per cent and Ti 0.064 ± 0.008 percent. The best value of the weight ratio Mn/Ti in these chondrites is 4.07 ± 0.36. The differences between various groups and the cosmic abundances of Mn and Ti are discussed. Atomic cosmic abundances of Mn 7470 ± 800 and Ti 2120 ± 260 based on Si 10^6 are calculated.

345. Moore, C. B., Ed.
RESEARCHES ON METEORITES, (Proc. of a Sym. on Meteorites held at Arizona State Univ., 10 Mar 61), New York, John Wiley, 1962, 227 pp.

The theme of the symposium was a review and discussion of the current problems in meteoritics and those which will probably be answered by future research on meteorites. Each chapter provides a review of present knowledge in a specific area of inquiry, a description of the author's recent work, and a pertinent bibliography.

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Lovering, J. F., "The Evolution of Meteorites - Evidence for the Co-existence of Chondritic, Achondritic and Iron Meteorites in a Typical Parent Meteorite Body."
Ringwood, A. E., "Present Status of the Condritic Earth Model."
Nininger, H. H., "Recovery of Material for Meteoritic Research."

346. Morrisby, A. G. F.
DAYLIGHT METEOR OF 4TH JANUARY 1962, Monthly Notes Astron. Soc. Southern Africa, v. 21, nos. 1/2, 28 Feb 62, p. 3.

A note describing an extremely bright meteor observed at Salisbury, Southern Rhodesia.

347. Morrison, P.
CARBONACEOUS "SNOWFLAKES" AND THE ORIGIN OF LIFE, Science, v. 135, no. 3504, 23 Feb 62, p. 663.

The possibility that the intricate "organized elements" found in some carbonaceous chondrites are to be interpreted, not as microfossils of once-living cells, but as organic-chemical analogues of similarly intricate snow crystals is raised; tests and implications are discussed.

348. Mueller, G.
INTERPRETATION OF MICRO-STRUCTURES IN CARBONACEOUS METEORITES, Nature (London), v. 196, no. 4858, 8 Dec 62, pp. 929-932, 12 figs., 7 refs.

The considerable number and variety of microscopic objects within the Orgueil and several other carbonaceous stones were interpreted by some authors as of likely organic orgin. These conclusions have been contested and critically discussed. An attempt is made to cast more light on this controversy through additional evidence furnished from observations under the

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polarizing microscope of fifteen previously recognized and five new stones with carbonaceous phase. It was found that the majority of the structures claimed as of organic orgin could be readily and quite unequivocally identified as mineral grains.

349. Murthy, V. R.
ISOTOPIC ANOMALIES OF MOLYBDENUM IN SOME IRON METEORITES, J. Geophys. Research, v. 67, no. 2, Feb 62, pp. 905-907, tbl., 10 refs.

The anomalous molybdenum found in some iron meteorites (Aroos, Santa Luzia, Odessa and Deep Springs) cannot be attributed either to any contamination effects or to fractionation in the mass spectrometer. The anomaly for the 92/100 ratio in Aroos is as large as 6 to 7 percent relative to terrestrial molybdenum. It is believed tentatively that these isotopic anomalies are real; they are all the more puzzling because they seem to be restricted only to some meteorites.

350. Murthy, V. R.
THE ISOTOPIC COMPOSITION OF SILVER IN IRON METEORITES, Geochim. et Cosmochim. Acta, v. 26, Apr 62, pp. 481-488, 3 tbls., 25 refs.

Microgram quantities of silver were extracted from the troilite of Toluca iron meteorite and the metal phases of Sikhote Alin and Canyon Diablo meteorites using anion-exchange techniques. Isotopic analysis of silver in iron meteorites indicates a 2-3 percent higher Ag^{107}/Ag^{109} ratio relative to the terrestrial silver. If this excess Ag^{107} is attributed to the decay of the extinct radioactive nuclide Pd^{107}, an unreasonably short interval of time between the end of nucleosynthesis and the formation of iron meteorites is indicated. The silver isotopic anomaly in iron meteorites appears too large to be attributed entirely to Pd^{107} produced in the galactic synthesis of elements, and may have to be interpreted in terms of a last-minute contribution of some amounts of short-lived radioactivities to the solar nebula, or by postulating that some Pd^{107} was produced in the solar system in its early stages, after its separation from the galactic nucleosynthesis. In either case, other short-lived radioactive nuclides would be extant in the early history of the solar nebula, and extinct radioactivity as the heat source in the early history of meteorite parent bodies becomes a definite possibility.

351. Murthy, V. R.
PRIMARY ISOCHRON OF ZERO AGE FOR METEORITES AND THE EARTH, by V. R. Murthy and C. C. Patterson, J. Geophys. Research, v. 67, no. 3, Mar 62, pp. 1161-1167, 4 figs., 3 tbls., 27 refs.

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The present values for the isotopic composition of primordial lead in iron meteorites are $Pb^{206}/Pb^{204} = 9.56$, $Pb^{207}/Pb^{204} = 10.42$, and $Pb^{208}/Pb^{204} = 29.71$. Each of these ratios has an apparent uncertainty of ±1.5 percent of the ratio. The primary isochron of zero age (geochron) for meteorites, calculated by using the above estimate of the isotopic composition of primordial lead and the isotopic compositions of leads in some stone meteorites, has a slope of 0.59 ± 0.01. The isotopic composition of primordial lead in the earth appears to be identical to that in meteorites within the error limits given above. From a consideration of quaternary marine lead data and ore lead data, the terrestrial geochron is shown to have the same location as the meteorite geochron. The ratio of Th^{232}/U^{238} in stone meteorites is 3.8.

352. Murthy, V. R.
THE TIME OF FORMATION OF THE SOLAR SYSTEM RELATIVE TO NUCLEOSYNTHESIS, by V. R. Murthy and H. C. Urey, Astrophys. J., v. 135, no. 2, Mar 62, pp. 626-631, tbl., 22 refs.

The chronology of events in the early history of the solar system determined by extinct radioactive-decay intervals results in an unreasonable time scale, if the commonly used "sudden synthesis" models of element formation are employed. An alternative model, in which additions of short-lived radioactivities were made to the material of the solar system by a supernova, is suggested here, based on some recent astronomical observations on expanding stellar associations in the Galaxy. Estimates for the end of melting processes in this model range from 9 to 15 million years: the calculated cooling times range from 156 to 190 million years. If Al^{26} was the effective heat source for melting processes, solid bodies must have formed in the solar system during the first 2 million years after the supernova explosion. If the moon is a primary object and was formed about 6 million years after this event.

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353. Nagy, B.
ORGANIC PARTICLES EMBEDDED IN MINERALS IN THE ORGUEIL AND IVUNA CARBONACEOUS CHONDRITES, by B. Nagy, G. Claus, and D. J. Hennessy, Nature (London), v. 193, no. 4821, 24 Mar 62, pp. 1129-1133, 5 figs., tbl., 11 refs.

Four types of experiments are described which offer additional data regarding the nature and formation of the organized elements, although, undoubtedly, additional experiments must yet be performed. The experiments seem to indicate that these microscopic particles are fossilized, organic, organized

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structures, which are not likely to be minerals, organic artifacts or terrestrial, microbiological contaminations. It is believed that the organized elements are microfossils apparently indigenous to the meteorite parent body.

354. National Aeronautics and Space Administration, Washington, D.C. AERODYNAMIC ANALYSIS OF TEKTITES AND THEIR PARENT BODIES, by E. W. Adams and R. M. Huffaker, Paper presented at Third Intern. Space Sci. Sym. and Fifth COSPAR Plenary Meet., Washington, D.C., 30 Apr-9 May 62, NASA N62-15238, (OTS $4.60), 41 pp., 24 figs., 2 tbls., 24 refs.; also published as NASA Tech. rept. TR R-149, 1962, 43 pp.

Experiment and analysis indicate that the button-type australites were derived from glassy spheres which entered or re-entered the atmosphere as cold solid bodies; in case of average-size specimens, the entry direction was nearly horizontal and the entry speed between 6.5 and 11.2 km/sec. Terrestrial origin of such spheres is impossible because of extremely high deceleration rates at low altitudes. The limited extension of the strewn fields rules out extraterrestrial origin of clusters of such spheres because of stability considerations for clusters in space. However, tektites may have been released as liquid droplets from glassy parent bodies ablating in the atmosphere of the earth. The australites then have skipped together with the parent body to re-enter as cold spheres. Terrestrial origin of the parent body would require an extremely violent natural event. Ablation analysis shows that fusion of opaque siliceous stone into glass by aerodynamic heating is impossible.

355. National Aeronautics and Space Administration, Washington, D.C. AERODYNAMIC EVIDENCE PERTAINING TO THE ENTRY OF TEKTITES INTO THE EARTH'S ATMOSPHERE, by D. R. Chapman, H. K. Larson, and L. A. Anderson, Tech. rept. TR R-134, 1962, ASTIA AD 271 893, 24 pp., 17 figs., tbl., 33 refs., 2 appens.

Evidence is presented which shows that Australian and Java tektites entered the earth's atmosphere and experienced ablation by severe aerodynamic heating in hypervelocity flight. The laboratory experiments on hypervelocity ablation have reproduced ring-wave flow ridges and coiled circumferential flanges like those found on certain of these tektites. Systematic striae distortions exhibited in a thin layer beneath the front surface of australites also are reproduced in the laboratory ablation measurements, and are shown to correspond to the calculated distortions for aerodynamic ablation of a blass. About 98 percent of Australian tektites represent aerodynamically stable configurations during the ablative portion of an entry trajectory. Certain meteorites exhibit surface features similar to those on tektites.

356. National Aeronautics and Space Administration, Washington, D.C. CALCULATION OF EPHEMERIDES FROM INITIAL VALUES, by K. Stumpff, Tech. note TN D-1415, Dec 62, NASA N63-10796, (OTS $0.75), 25 pp.

A short report is presented on a method for calculating undisturbed ephemerides (coordinates of location and velocity) of a planet or a comet when its initial time values are given. Thus far this method has been available only in German language publications. The orbital elements need not be known for this method, which is applicable without formal variations for all types of orbits. In particular, the singularity of classical methods is avoided by the transfer from elliptical to hyperbolic orbits. In place of Kepler's equation, a transcendent main equation appears which is valid for all types of orbits and becomes rational for circular and parabolic orbits. The formulas for the calculation of location and velocity coordinates are simple and especially well suited for electronic computers. The optimal area for application (small and medium intermediate times) coincides with the requirements for orbit determination, orbit correction, and the calculation of special perturbations.

357. National Aeronautics and Space Administration, Washington, D.C. THE COMPOSITION OF GASES IN A TEKTITE BUBBLE, by J. A. O'Keefe, K. L. Dunning and P. D. Lowman, Jr., Tech. note TN D-1342, Jul 62, NASA N62-14086, (OTS $0.50), 8 pp., 2 figs., tbl., 7 refs.; a condensed version is published in Science, v. 137, no. 2535, 20 Jul 62, p. 228, fig., 8 refs.

Spectroscopic analysis of light produced by electrodeless discharge in a tektite (bediasite) bubble showed the main gases in the bubble to be neon, helium, and oxygen. The neon and helium have probably diffused in from the atmosphere, while the oxygen may be atmospheric gas incorporated in the tektite during its formation.

358. National Aeronautics and Space Administration, Washington, D.C. THE DISTRIBUTION OF SMALL INTERPLANETARY DUST PARTICLES IN THE VICINITY OF THE EARTH, by C. W. McCracken and W. M. Alexander, Tech. note TN D-1349, Jul 62, NASA N62-14090, (OTS $0.50), 18 pp., 3 figs., 5 tbls., 21 refs.

Existing direct measurements of small interplanetary dust particles in the vicinity of the earth are analyzed on the basis of new data obtained with the satellite Explorer VIII (1960ξ). All but one of the direct measurements made with microphone systems on other spacecraft fit remarkably well on the distribution curve derived from Explorer VIII data. This agreement permits the construction of an average distribution curve for small interplanetary dust particles in the vicinity of the earth.

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The equation of a straight line segment that approximately fits this new distribution curve for particle masses between 10^{-10} and 10^{-6} gm is

$$\log I = -17.0 - 1.70 \log m$$

where I is the influx rate in particles/m^2-sec and m is the mass in grams. One of the more important consequences of the new distribution curve is the evidence that the accretion of particulate matter by the earth is dominated by particles with characteristic dimensions of a few microns.

359. National Aeronautics and Space Administration, Washington, D.C. THE EARLY CHRONOLOGY OF THE SOLAR SYSTEM, by A. G. W. Cameron, Tech. note TN D-1465, Aug 62, NASA N62-14784, (OTS $0.50), 11 pp., 5 figs., 6 refs.

The solar system's early history can be deduced from a study of anomalies in the isotopic composition of certain elements extracted from meteorites. In stone meteorites, xenon is sometimes enriched in Xe^{129}; and in iron meteorites, silver is sometimes enriched in Ag^{107}. If these anomalies are attributed to the decay of the extinct radioactivities of I^{129} and Pd^{107}, then it is possible to deduce the approximate time intervals between the cessation of nucleosynthesis in the interstellar gas, and the formation and cooling of the meteorite parent bodies to the point where further fractionation of the elements involved ceases. This time interval is about 1.5 X 10^8 years for the xenon anomaly and about 2 to 4 X 10^7 years for the silver anomaly. The earth's atmosphere contains xenon that has been subjected to additional enrichment processes; the earth apparently did not start retaining any xenon until about 10^8 years following the retention of xenon by the meteorites.

360. National Aeronautics and Space Administration, Washington, D.C. AN EXPERIMENTAL INVESTIGATION OF THE IMPACT RESISTANCE OF DOUBLE-SHEET STRUCTURES AT VELOCITIES TO 24,000 FEET PER SECOND, by C. R. Nysmith and J. L. Summers, Tech. note TN D-1431, Oct 62, NASA N62-16839, (OTS $0.50), 24 pp., 12 figs., tbl., 5 refs.

Small glass spheres, representative of stony meteoroids, were fired into double-sheet structures. The effects of combined sheet thickness and of sheet spacing on the impact resistance to the structures were determined. Also determined was the performance of meteor bumpers of different materials as well as the variation with velocity and bumper thickness of the hole produced by impact for bumpers of 2024-T3 aluminum alloy. The difference between low- and high-speed impact is described and the importance of testing at high speeds is discussed.

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It was concluded that structures having front sheets with equal mass per unit area and identical rear sheets have the same penetration resistance for several front-sheet materials. Also, for maximum penetration resistance per unit weight, the available structural weight should be concentrated in the rear sheet with the front sheet only thick enough to shatter the projectile completely.

A discussion and illustrations of oblique impact on double-sheet structures are also presented.

361. National Aeronautics and Space Administration, Washington, D.C. INSTRUMENTATION OF THE IONOSPHERE DIRECT MEASUREMENTS SATELLITE (EXPLORER VIII), by R. E. Bordeau, J. L. Donley, and E. C. Whipple, Tech. note TN D-414, Apr 62, ASTIA AD 274 563, NASA N62-11147, (OTS $1.00), 34 pp., 23 figs., 4 tbls., 2 refs.

A description of the ionosphere direct measurements satellite Explorer VIII, with emphasis on the physics of the experiments designed to measure electron density (RF impedance probe), electron temperature (electron temperature probe), positive ion concentration (ion current monitor), and ion mass (retarding potential probe). Experiments were also performed which measured the momentum, energy, and spatial distribution of dust particles. Experimental data presented are typical of that processed to date. Methods used by systems engineers to fulfill the special requirements imposed by the scientific experiments upon the overall satellite design are described; and data such as the satellite's thermal and spin-decay history are reported. Of interest to spacecraft technologists concerned with the influence of the earth's magnetic field are measurements on effects of potential differences at various points on the satellite surface. A method for determining satellite aspect is also introduced.

362. National Aeronautics and Space Administration, Washington, D.C. MEASUREMENTS OF MOMENTUM TRANSFER FROM PLASTIC PROJECTILES TO MASSIVE ALUMINUM TARGETS AT SPEEDS UP TO 25,600 FEET PER SECOND, by B. P. Denardo, Tech. note TN D-1210, Mar 62, NASA N62-10636, (OTS $0.75), 30 pp., 11 figs., tbl., 8 refs.

Momentum transfer during impact at speeds essentially 0 to 25,600 feet per second was measured by a simple ballistic pendulum. The change in mass of the target was also obtained, as were penetration data for this combination of materials. During the course of this experiment some interesting features of impact were observed; namely, crater formation and ejected spray patterns.

363. National Aeronautics and Space Administration, Washington, D.C. THE METEORITIC HAZARD OF THE ENVIRONMENT OF A SATELLITE, by J. E. Duberg, Tech. note TN D-1248, May 62, NASA N62-11647, (OTS $1.00), 34 pp., 13 figs., 4 tbls., 23 refs.

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A brief description is presented on meteorites, their composition, and frequency of occurrence. A meteoroid flux as a function of mass that has been proposed by F. L. Whipple is compared with the direct measurements obtained to date by rockets, satellites, and space probes. On the assumption of a Poisson distribution for the probability of impacts and a penetration law which represents a mean of those proposed for high-velocity impact, the probability of penetration of earth satellite surfaces is obtained.

364. National Aeronautics and Space Administration, Washington, D.C. MICROMETEOROID SATELLITE LAUNCH SET BY NASA, News Release, no. 62-259, 10 Dec 62, 13 pp.

The satellite (launched from Wallops Island on 16 Dec 62 and designated Explorer 16 -- Ed.) is a joint effort by three NASA centers under direction of the Office of Advanced Research and Technology (OART), with project management by the Langley Research Center. The cylindrical satellite is 24 inches in diameter and 76 inches long. It is built around the Altair motor case which is Scout's fourth stage and which will go into orbit as an integral part of the assembly. Total weight in orbit will be 222 lbs. A thin heat shield protecting the satellite during launch will be jettisoned in space, exposing five types of sensitive detecting instruments to impacts by high velocity particles of matter.

The elliptical near-earth orbit is planned to have an initial perigee of 453 statute miles and an apogee of 661 statute miles. Initial orbital period is planned for 102 minutes. The satellite is programmed to be traveling 16,955 miles per hour at injection and at perigee. Its speed at apogee will be approximately 16, 191 miles per hour. Experiments hope to achieve for the S-55B (Explorer 16) an orbit lifetime of up to three years with useful data to be gathered for about one year.

The five micrometeoroid detectors in the satellite will include pressurized cells, foil gages, and wire grids, providing a total of 24.5 square feet of area exposed to the penetration hazard, and cadmium-sulfide cells, and impact sensors, which will have a combined total of 4 square feet exposed for impact detection. Five test groups of window-like silicon solar cells on the nose of the satellite will determine what protection solar cells in future space experiments will require. Descriptions of the five micrometeorite detectors are given.

Three primary objectives have been established for the flight: (1) direct measurement of the micrometeoroid puncture hazard to structural skin samples; (2) measurements of particles possessing different amounts of momentum; and (3) comparing the performance of protected and unprotected solar cells in space.

365. National Aeronautics and Space Administration, Washington, D.C. SCIENTIFIC SATELLITES AND THE SPACE ENVIRONMENT, by J. C. New, Tech. note TN D-1340, Jun 62, NASA N62-12345, (OTS $0.75), 22 pp., 18 figs., tbl., 14 refs.

An outline of the need for space science information in the next 10 years and the general objectives of the NASA space programs. The scientific satellite is defined and contrasted to military and application satellites and a graphical summary of the satellites launched to date is presented. A typical space vehicle mission profile is also given. The general characteristics of the space environment, such as atmospheric structures, particles, and fields are discussed. Major findings from satellites, such as the discovery of the Van Allen belts, the pear shape of the earth, micrometeorites, and effects of solar pressure, are briefly surveyed.

366. National Aeronautics and Space Administration, Washington, D.C. SPUTTERING OF A VEHICLE'S SURFACE IN A SPACE ENVIRONMENT, by J. R. Redus, Tech. note TN D-1113, Jun 62, NASA N62-12347, (OTS $1.00), 35 pp., 3 figs., 5 tbls., 33 refs., appen.

A brief survey of current investigations of physical sputtering is given, from which estimates are made of the sputtering yields by constituents found in a vehicle's environment. The rates at which a vehicle's surface is sputtered by the earth's atmosphere, by radiation belts, and by solar corpuscular radiation are calculated. It is shown that the atmospheric sputtering constitutes a serious problem at low orbital altitudes and that the damage at 1 A.U. by solar corpuscular radiation is within an order of magnitude of that caused by micrometeorites. Recommendations are made regarding areas of investigation which are needed.

367. National Aeronautics and Space Administration, Washington, D.C. VELOCITY AND ENERGY OF THE TUNGUSK METEORITE, (O SKOROSTI I ENERGII TUNGUSSKOGO METEORITA), by K. P. Stanyukovich and V. A. Bronshten, Tech. trans. TT F-89, Dec 62, (OTS $0.50), 7 pp., fig., tbl., 13 refs.; trans. of Doklady Akad. Nauk S.S.S.R., v. 140, no. 3, 21 Sep 61, pp. 583-586.

On the basis of physical phenomena observed following the fall of the Tunguska meteorite, estimates are made of its energy and velocity. Possible explanations of the explosion that occurred during the fall of the meteorite are included.

368. National Aeronautics and Space Administration, Office of Scientific and Technical Information, Washington, D.C. "Interplanetary Space Physics," by C. Snyder, H. R. Anderson, M. Neugebauer, and E. J. Smith, pp. 163-195, 31 figs., 68 refs.; in PROCEEDINGS OF THE NASA-UNIVERSITY CONFERENCE ON THE SCIENCE AND TECHNOLOGY OF SPACE EXPLORATION, (held at Chicago, Ill., 1-3 Nov 62), v. 1, SP-11, Dec 62, 429 pp., (G.P.O. $2.50).

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A few, mostly interrelated topics in space physics are discussed: interplanetary fields, interplanetary matter, solar disturbances and their effects, and cosmic radiation. The section on interplanetary matter includes discussion of: (1) the cosmological problems to be solved; (2) dust; (3) meteors and meteorites; (4) comets; and (5) interplanetary charged particles.

369. National Aeronautics and Space Administration, Office of Scientific and Technical Information, Washington, D.C. "Space Environment and Its Effects on Materials," by D. D. Davis, Jr., pp. 439-449, 12 figs., 25 refs.; in PROCEEDINGS OF THE NASA-UNIVERSITY CONFERENCE ON THE SCIENCE AND TECHNOLOGY OF SPACE EXPLORATION, (held at Chicago, Ill., 1-3 Nov 62), v. 2, SP-11, Dec 62, 532 pp., (G.P.O. $3.00).

Three aspects of the space environment that influence the selection of materials for use in the space environment are considered: namely, vacuum, particle radiation, and meteoroids. To the best of our knowledge, vacuum effects have not so far been a serious problem for spacecraft. On the other hand, several spacecraft failures have been attributed to radiation, and confirmation of the suspected effects has been obtained in the laboratory. The extent of the hazard from meteoroids is uncertain. The most urgent need here for reliable and accurate measurements of damage.

370. Naval Research Lab., Washington, D.C. PROCEEDINGS OF THE FIFTH SYMPOSIUM ON HYPERVELOCITY IMPACT, VOLUME 1, PART 1, (held at Denver, Colo., 30 Oct-1 Nov 61, Sponsored by U.S. Army, Navy, Air Force), Grant no. Nonr-G-0020-62(x), Apr 62, ASTIA AD 284 282, NASA N62-16548, (OTS $19.75), 330 pp.

Contents:
Session I: Techniques.

Swift, H. F., "Hypervelocity Ballistic Accelerators."
Porter, C. D., H. F. Swift, and R. H. Fuller, "Summary of NRL Hypervelocity Accelerator Development."
Baer, P. G. and H. C. Smith, "Interior Ballistics of Hypervelocity Projectors, Instrumented Light Gas Gun and Traveling Charge Gun."
Friichtenicht, J. F., "Experiments With a Two Million Volt Electrostatic Accelerator."
Swift, H. F., "Concluding Remarks."

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Hopkins, H. G., "Mathematical Methods in Theoretical Mechanics of Hypervelocity Impact of Metals."
Davids, N., Y. K. Huang, and W. Jaunzemis, "Some Theoretical Models of Hypervelocity Impact."

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Riney, T. D. and P. R. Chernoff, "Inertial, Viscous, and Plastic Effects in High Speed Impact."
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Olshaker, A. E. and R. L. Bjork, "Hydrodynamics Applied to Hypervelocity Impact, I. Scaling Laws for Dissimilar Metals."
Olshaker, A. E. and R. L. Bjork, "Hydrodynamics Applied to Hypervelocity Impact, II. The Role of Melting and Vaporization in Hypervelocity Impact."
Zaid, M., "Penetration by Hypervelocity Particles."
Schipper, J. F., "A Model of Non-Explosive Impact."
Fyfe, I. M., "Application of 'Hydrodynamic' Theory to the Low Stress Range of Hypervelocity Impact Problems."
Chou, P. C., "Visco-Plastic Flow Theory in Hypervelocity Perforation of Plates."
Allison, F. E., "Summary for Theory Sessions."

371. Naval Research Lab., Washington, D.C.
PROCEEDINGS OF THE FIFTH SYMPOSIUM ON HYPERVELOCITY IMPACT, VOLUME 1, PART 2, (held at Denver, Colo., 30 Oct-1 Nov 61, Sponsored by U.S. Army, Navy, Air Force), Grant no. Nonr-G-0020-62(x), Apr 62, ASTIA AD 284 280, NASA N62-16564, (OTS $19.75), 338 pp.

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Sessions IV and V: Experiments.

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Kineke, J. H., Jr., "Observations of Crater Formation in Ductile Materials."
Frasier, J. T. and B. G. Karpov, "Hypervelocity Impact Studies in Wax."
Herrmann, W. and A. H. Jones, "Correlation of Hypervelocity Impact Data."
Bruce, E. P., "Review and Analysis of High Velocity Impact Data."
Smith, F., W. A. Clayden, C. R. Wall, and D. F. T. Winter, "Hypervelocity Launchers and Hypervelocity Impact Experiments at ARDE, Fort Halstead."
Halperson, S. M. and W. W. Atkins, "Observations of Hypervelocity Impact."
Bryan, G. M., "Oblique Impact of High Velocity Steel Pellets on Lead Targets."
Rockowitz, M., C. A. Carey and J. F. Dignam, "Hypervelocity Impact of Heated Copper."
Lee, T., W. Clark, and E. Cannon, "Spray Particle Technique for Studying Hypervelocity Impact."
Humes, D., R. N. Hopko, and W. H. Kinard, "An Experimental Investigation of Single Aluminum 'Meteor Bumpers'."
Watson, R. W., "The Perforation of Thin Plates by High Velocity Fragments."

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Vitali, R. and R. W. Watson, "Perforation of Finite Targets by High Velocity Projectiles."
Kreyenhagen, K. N. and L. Zernow, "Penetration of Thin Plates."
Moore, H. J., R. V. Lugn, and D. E. Gault, "Experimental Hypervelocity Impact Craters in Rock."
Alexander, W. M. and O. E. Berg, "Microparticle Hypervelocity Impact From Ranger I."
Eichelberger, R. J., "Summary-Experimental Studies."

372. Netherlands. SHAPE Air Defense Technical Center, The Hague
THE FINE STRUCTURE OF METEOR-BURST SIGNALS, by P. J. Bartholomé, Tech. memo. no. TM-36, Apr 62, ASTIA AD 276 512, 43 pp., 19 figs., 8 refs.

This effort is part of a study to determine the suitability of meteor-burst communication systems for military use. The fine structure of meteor-burst signals was studied using magnetic-tape recordings made at high speed. The experimental results can be summarized as follows: (1) Most reflections from meteor trails have a saw-tooth shape but the main contribution to the duty cycle (proportion of time available for communication) is made by signal bursts of irregular shape; (2) The rate of decay at the end of the bursts ranges between one and several hundred decibels per second; (3) The principles of operation in communication systems of the JANET-B type, particularly the gating principle, are not well matched to the characteristics of the medium; and (4) A pronounced space-diversity effect is present on longer reflections when the signal received fluctuates as a result of trail deformation.

373. Ney, E. P.
ECLIPSE OBSERVATIONS OF THE ZODIACAL LIGHT, Sky and Telescope, v. 23, no. 5, May 62, pp. 267-271, 10 figs.

A description is given of an expedition to Mexico for studying the zodiacal light during the February 4th solar eclipse with cameras carried 115,000 feet aloft by balloons. This is believed to be the first time that a solar eclipse below the horizon has been successfully used to facilitate measurements of the zodiacal light.

374. Nichiporuk, W.
PLATINUM AND IRIDIUM ABUNDANCES IN METEORITES, by W. Nichiporuk and H. Brown, Phys. Rev. Letters, v. 9, no. 6, 15 Sep 62, pp. 245-246, 2 tbls., 5 refs.

A determination of the abundances of platinum and iridium in meteorites is reported. The ratios of platinum to iridium are the same (3.0), within the limits of error, for both the iron meteorites and the chondrites. This suggests that apparently no major fractionation has occurred between Pt and Ir in the evolution of meteorites. The ratios are therefore particularly important abundance ratios.

375. Nicholls, R. W.
FRANCK-CONDON FACTORS AND r-CENTROIDS TO HIGH VIBRATIONAL QUANTUM NUMBERS FOR THREE BAND SYSTEMS OF CO^+ AND ABSOLUTE BAND STRENGTHS FOR THE COMET-TAIL SYSTEM, Can. J. Phys., v. 40, no. 12, Dec 62, pp. 1772-1783, 5 tbls., 19 refs.

Franck-Condon factor and r-centroid arrays computed to high vibrational quantum numbers for Morse potentials are displayed for the CO^+ comet-tail ($A^2\Pi_i$ - $X^2\Sigma^+$), first negative ($B^2\Sigma^+$ - $X^2\Sigma^+$), and Baldet-Johnson ($B^2\Sigma^+$ - $A^2\Pi_i$) band systems. Estimates of band strengths are made for CO^+ comet-tail bands.

376. Nikolov, N. S.
METEORITY BOLGARII, (BULGARIAN METEORITES), Meteoritika, Akad. Nauk S.S.S.R., no. 21, 1961, pp. 71-76, 5 figs., 14 refs., (in Russian).

An account of studies conducted by the Department of Meteorites of the Bulgarian Academy of Sciences and, in particular, of the investigations of meteorites which have fallen in Bulgaria. The circumstances surrounding the fall or discovery of the meteorites Rasgrad, Virba, Gumoshnik, and Konovo are presented. It was determined that the Bulgarian meteorite Tyrnovo never actually existed; it was identified with the Aleppo meteorite, which fell in Syria about 1873. The chemical composition of Gumoshnik is given.

377. Nilsson, C. S.
RADIO-ECHO OBSERVATIONS OF METEORS IN THE ANTARCTIC, by C. S. Nilsson and A. A. Weiss, Australian J. Phys., v. 15, no. 1, Mar 62, pp. 1-19, 14 figs., 2 tbls., 11 refs., appen.

Radio observations of meteors have been made at Mawson on the Antarctic continent since 1957, with a coherent pulse radar equipment operated at a frequency of 34 Mc/s. Heights and directions of reflection points are available for about 10% of the echoes, and temporal variations in these characteristics, together with the diurnal variations in the total echo rate, are analysed and discussed. All the variations observed in these characteristics agree with predictions based on a three-source model for the distribution of the radiants of sporadic meteors. This model distribution, which is symmetrical about the ecliptic, consists of a broad apex source and more concentrated sources near the sun and antisun. The integrated intensities of the three sources are found to be approximately equal. There is evidence that the meteor echo rate is depressed at times of radio black-out, and it is suggested that periods of exceptionally high meteor activity observed during the summer months could be caused by abnormal ionospheric conditions.

378. Nordyke, M. D.
AN ANALYSIS OF CRATERING DATA FROM DESERT ALLUVIUM, J. Geophys. Research, v. 67, no. 5, May 62, pp. 1965-1974, 7 figs., 2 tbls., 8 refs., appen.

From the large amount of data available for explosion craters in the desert alluvium at the Nevada test site it has been possible to establish very reliable relationships among charge size, depth of burst, crater radii, and crater depths. A scaling law for crater dimensions of $W^{1/3.4}$ is derived, together with an efficiency factor for nuclear explosives relative to high explosives. In addition, a curve for the dependence of crater radii and depth on the depth of burst of the explosive is given.

379. NOTES ON THREE COMETS, Sky and Telescope, v. 24, no. 2, Aug 62, p. 96, fig.

Brief descriptions are given of three comets: Honda (1962d), Humason (1961e), and Seki-Lines (1962c).

380. Notni, P.
LICHTELEKTRISCHE HELLIGKEITSMESSUNGEN AM KOMETEN 1956h AREND-ROLAND, (PHOTOELECTRIC BRIGHTNESS MEASUREMENTS OF COMET 1956h AREND-ROLAND), Astron. Nach., v. 286, no. 4, Mar 62, pp. 169-178, 8 figs., 4 tbls., 15 refs., (in German).

Brightness and colorimetric measurements of comet Arend-Roland are given (4 ranges). The results are discussed in conjunction with results obtained by Thiessen and Wehlan in the series of measurements they conducted. The B-V color index remains practically constant in the observation area. Brightness variations are related to radiation fluctuations of the mass of the comet. A correlation with solar corpuscular radiation is assumed (increased brightness corresponds to greater relative sunspot number).

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381. Obashev, S. O.
O GEOMAGNITOM EFFEKTE TUNGUSSKOGO METEORITA, (ON THE GEOMAGNETIC EFFECT OF THE TUNGUSKA METEORITE), Meteoritika, Akad. Nauk S.S.S.R., no. 21, 1961, pp. 49-51, 5 refs., (in Russian).

After the explosion of the meteorite, a dense plasma was generated. It expanded across the magnetic field until the kinetic and magnetic pressures became equal. The expansion time is determined by the explosion energy and by the mass of the medium. It is equal to 3.9 minutes, which is close to the magnetic disturbance delay time. Subsequently the moving ions formed a dipole which generated, at the distance of Irkutsk, a variation H equal approximately to 4×10^{-5} gauss.

382. O'Dell, C. R.
EMISSION-BAND AND CONTINUUM PHOTOMETRY OF COMET SEKI (1961f), by C. R. O'Dell and D. E. Osterbrock, Astrophys. J., v. 136, no. 2, Sep 62, pp. 559-566, 2 figs., 3 tbls., 17 refs.

Measurements of Comet Seki were made through interference filters centered on the C_2 λ4737 sequence and on the continuum near λ4470, through diaphragms of various diameters. The measurements were calibrated in energy units by means of a spectral scan made of the same region of the comet at the same time as the filter measurements and by measurements of stars with known energy distributions. The C_2 luminosities measured in this way are fitted to a model density distribution due to Haser, the numerical parameters of which were derived from the mean C_2 surface-brightness curve for comets published by Miller. The resulting C_2 densities in comet Seki are listed, as well as the densities in comet Burnham (1959k) derived in the same way from earlier measurements of this comet.

383. O'Keefe, J. A.
EVIDENCE FROM THE MOON'S SURFACE FEATURES FOR THE PRODUCTION OF LUNAR GRANITES, by J. A. O'Keefe and W. S. Cameron, Icarus, v. 1, no. 3, Oct 62, pp. 271-285, fig., tbl., 38 refs.

If tektites come from the moon, they indicate a granitic constitution for a considerable portion of the outer crust, especially if allowance is made for the chemical effects of volatilization (loss of alkalies). The evidence for granitic rocks from the morphology of the moon's surface does not contradict the notion that large amounts of acid rock are present on its surface.

384. Oklahoma State Univ., Research Foundation, Stillwater
ANALYTICAL AND EXPERIMENTAL STUDY OF THE MECHANISMS OF PENETRATION AND LIGHT EMISSION FOR MICROMETEOROID IMPACT ON AN ALUMINUM-COATED PHOTOMULTIPLIER, by F. C. Todd, B. A. Sodek, J. G. Ables, R. R. Slater, and L. Wong, Contr. NASr-7, Quart. prog. rept. no. 7 (1 Apr-30 Jun 62), 1962, NASA N62-15714, (OTS $2.60), 19 pp., 2 figs., 11 refs.

The analytical and experimental phases of this project are to be directed toward ascertaining the mechanisms which occur during a micrometeoroid impact on an aluminum plate and the evaluation of their relative importance. The overall objective is to measure the momentum, energy and possibly the density of the incident micrometeoroid. This study is primarily concerned with the earlier phases of the impact. This report summarizes the interconnection between one completed problem, several active problems and some proposed problems for the future. These problems are separated into three groups for discussion under the broad titles: (1) analytical studies on shock propagation; (2) analytical studies on plasma; and (3) experimental problems.

385. Oklahoma State Univ., Research Foundation, Stillwater
DEVELOPMENT OF APPARATUS FOR MICROMETEORITE MEASUREMENTS, by R. F. Buck, Contr. AF 19(604)-7202, Proj. P7667, Final rept., 14 Dec 61, AFCRL 62-415, ASTIA AD 275 303, NASA N62-12135, (OTS $8.10), 83 pp., 27 figs., 2 tbls.

Technical details for a specific detection system making use of the acoustic technique are given. This system was tailored in design to the unique requirements of a specific satellite vehicle. Information is also presented concerning the instrumentation of the payload for a Nike-Cajun rocket (AA6.104C) prepared for an experimental investigation of the influx of micrometeoritic material. The available techniques for calibration and testing of acoustic detection systems are discussed, and the electrical and mechanical features of a special electronic simulator which facilitates calibration in terms of effective momentum transfer are discussed in detail. Some practical implications of the investigation with regard to the design of similar equipment for future experiments are discussed, and a proposal for improvement of the uniformity of response for the acoustic sensor assembly is offered. Finally, a number of miscellaneous support activities concerned with the prime investigation are covered in some detail.

386. Olivier, C. P.
THE NEW JERSEY FIREBALL OF APRIL 23, 1962, Sky and Telescope, v. 24, no. 1, Jul 62, p. 19, fig.

The path of an exceptionally brilliant fireball (magnitude about -10) is calculated from reports by numerous observers.

387. Olivier, C. P.
NOTES ON OBSERVING METEORS AND FIREBALLS, Sky and Telescope, v. 24, no. 5, Nov 62, p. 285.

A note composed of extracts from the 1961 annual report to the American Meteor Society.

388. Öpik, E. J.
REINTERPRETATION OF THE URANIUM-HELIUM AGES OF IRON METEORITES, by E. J. Öpik and S. F. Singer, Trans. Am. Geophys. Union, v. 38, no. 4, Aug 57, pp. 566-568, 19 refs.

Measurements of uranium and helium content of iron meteorites have been carried out by Paneth and his collaborators over the last 25 years, but the interpretation of their measurements has varied widely. A reinterpretation is suggested in the light of: (1) our recent knowledge of the cosmic ray effects on meteorites; and (2) the physical mechanism of meteorite creation.

385. Oklahoma State Univ., Research Foundation, Stillwater
DEVELOPMENT OF APPARATUS FOR MICROMETEORITE MEASUREMENTS, by R. F. Buck, Contr. AF 19(604)-7202, Proj. P7667, Final rept., 14 Dec 61, AFCRL 62-415, ASTIA AD 275 303, NASA N62-12135, (OTS $8.10), 83 pp., 27 figs., 2 tbls.

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386. Olivier, C. P.
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388. Öpik, E. J.
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389. Öpik, E. J.
"Surface Properties of the Moon," Chapt. 5, pp. 215-260, 6 figs., 4 pls., 5 tbls., 56 refs.; in PROGRESS IN THE ASTRONAUTICAL SCIENCES, VOLUME I, Ed. by S. F. Singer, Amsterdam, North-Holland Pub. Co., 1962, 416 pp.

A critical study of the following is presented: (1) interpretation of surface markings; (2) lunar photometry; (3) figure of the moon; (4) the atmosphere of the moon; (5) the lunar surface; (6) some recent Soviet lunar observations; and (7) origin and structure of the moon.

The origin of the lunar craters in meteoritic impact is beyond doubt; only a few minor formations are apparently of volcanic origin. The craters on the lunar continents belong to the final stages of accretion of the moon. The primeval craters have been obliterated in the maria which only carry the imprints of the less numerous later collisions with the stray bodies of the solar system.

390. O RABOTE KOMPLEKSNOI EXPEDITSII 1961 G. V RAIONE PADENIYA TUNGUSSKOGO METEORITA, (WORK OF THE 1961 TUNGUSKA METEORITE EXPEDITION), Vestnik Akad. Nauk S.S.S.R., no. 5, May 62, p. 111, (in Russian).

A note describing the investigations made by the 1961 expedition to the area of fall of the Tunguska "meteorite." It was established that the explosion responsible for the destruction of the forest in the area occurred in the air. Soil samples were taken from which magnetic and silicate spherules, of extraterrestrial origin, were extracted. Inasmuch as the quantity of spherules was insufficient for detailed laboratory analysis, it was decided to send another expedition in the summer of 1962 in order to further collect and study the spherules.

391. Ordway, F. I., III
"Interplanetary Matter," Sec. 4.2, pp. 128-133, 4 figs.; in BASIC ASTRONAUTICS, by F. I. Ordway, III, J. P. Gardner, and M. R. Sharpe, Jr., Englewood Cliffs, N.J., Prentice-Hall, 1962, 587 pp.

Considerable quantities of data have been gathered on micrometeorites, the easiest (and for deep space travel probably the most significant) component of interplanetary matter to measure. Brief descriptions of several micrometeorite experiments and the results therefrom are given.

392. Orsini, P. G.
METALLOGRAFIA ELETTRONICA DI ALCUNE OTTADRITI, (ELECTRON METALLOGRAPHY OF SOME OCTAHEDRITES), by P. G. Orsini and B. Marchese, Rendi. Soc. Mineral. Ital., v. 17, 1961, pp. 393-406, 12 figs., 14 refs., (in Italian).

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Twelve microscopic examinations are presented. Nine of the examinations were made using an electron microscope. The photographs obtained show the structure of octahedrites in detail. All the varieties of plessite investigated consist of mixtures of kamacite and taenite; direct evidence of this phenomenon is obtained for the first time. In addition, microscopic examination has revealed an arrangement, which would, on a macroscopic scale, precede formation of Widmanstätten figures.

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393. Palm, A.
POSSIBLE ELEMENTAL ABUNDANCES OF THE LUNAR CRUST, by A. Palm and R. G. Strom, Publs. Astron. Soc. Pacific, v. 74, no. 439, Aug 62, pp. 316-322, 2 tbls., 10 refs.

The thermal history of the moon and the mechanisms by which the surface features were formed determine the nature and composition of the lunar crust. A hot origin (lunar melting) would have caused chemical and mineralogical differentiation resembling that which produced terrestrial igneous rocks. A cold origin (non-melting) would have resulted in a body composed of primitive, accreted cosmic material subjected to phase transitions.

Possible rock types consonant with some of the recent hypotheses concerned with the origin of the moon's surface structures have been derived. These materials were compared with common terrestrial rocks, meteorites, and tektites of known chemical compositions, and a most probable set of elemental abundances of the lunar crust deduced for each hypothesis. Oxygen, Si, Al, Fe, Mg, Ca, Na, K, and Ni are the principal elements that distinguish the rock types. Therefore, the abundance ratios of these elements constitute one of the important criteria for deciding whether volcanic or impact mechanisms predominated in the shaping of the surfaces features.

394. Parkin, D. W.
METALLIC COSMIC DUST WITH AMORPHOUS ATTACHMENTS, by D. W. Parkin, W. Hunter, and A. E. Brownlow, Nature (London), v. 193, no. 4816, 17 Feb 62, pp. 639-642, fig., 4 refs.

A discussion of the attachments which have sometimes been found adhering to metallic particles of possible extraterrestrial origin. It is possible that the amorphous attachments are partly organic and that, on impinging on the upper atmosphere at high speed, this material is reduced by complete or partial charring to give the red staining visible on some of the metal particles. The grouping of these particles with respect to date indicates a possible relationship with meteor streams. There

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is not yet sufficient evidence to be certain whether meteor streams can be distinguished from each other by chemical means; the Perseids to seem to give rise to more bare-iron flakes than the daylight streams.

395. Parkin, D. W.
"Meteorites and Cosmic Dust," by D. W. Parkin and W. Hunter, pp. 105-163, 17 figs., 3 tbls., 45 refs.; in ADVANCES IN ASTRONOMY AND ASTROPHYSICS, v. 1, Ed. by Z. Kopal, New York, Academic Press, 1962, 366 pp.

A review is made of some of the salient facts about meteorites, their structure and possible origin. The relation of cosmic dust to meteorites is investigated in detail and methods of cosmic dust collection and analysis techniques therefore are described. Reliable facts concerning the dust are so meager that it is impossible, at this stage, to know whether they are meteoritic or meteoric, i.e., whether they originate in a planet or in a comet. In presenting this review arguments in favor of the planetary hypothesis are advanced.

396. Peebles, P. J.
COSMOLOGY AND THE RADIOACTIVE DECAY AGES OF TERRESTRIAL ROCKS AND METEORITES, by P. J. Peebles and R. H. Dicke, Phys. Rev., v. 128, no. 5, 1 Dec 62, pp. 2006-2011, 2 tbls., 34 refs.

Several different cosmologies have been proposed in which the strength of the gravitational interaction is variable. Also, it has been suggested that the gravitational interaction may play a significant role in determining the structure of elementary particles, and in particular that the value of the fine structure constant may depend on the strength of the gravitational interaction. It is shown that these two effects taken together would lead to observable discrepancies in the ages of terrestrial rocks and meteorites as determined by different radioactive decay schemes. Analysis of the geophysical data leads to an upper limit of about 3 parts in 10^{13} per year on the rate of change of the fine structure constant. If the assumed relation between gravitation and particle structure were valid, this would correspond to a limit on variations in the strength of the gravitational interaction of 2 parts in 10^{11} per year. This upper limit is one-fifth of the size of the variations expected according to Dirac's cosmology, and roughly as big as the variation to be expected according to the Brans-Dicke cosmology. It is concluded that either the assumed connection between gravitation and elementary particles does not exist, or, if the connection does exist, that the geophysical data provide a significant limit on possible variations in the strength of the gravitational interaction.

397. Peebles, P. J.
THE TEMPERATURE OF METEORITES AND DIRAC'S COSMOLOGY AND MACH'S PRINCIPLE, J. Geophys. Research, v. 67, no. 10, Sep 62, pp. 4063-4070, 2 figs., tbl., 22 refs.

Arguments based on Mach's principle and on numerical coincidences in the astrophysical data lead to the idea that the strength of the gravitational interaction may be decreasing with time. This would imply that the radiation rate of the sun was larger in the past and that asteroids and meteorite bodies were warmer, possibly leading to loss of argon from the material of the meteorites. It is shown from the observed potassium-argon ages of meteorites that the strength of the gravitational interaction has not been decreasing by more than about 1 part in 10^{10} per year. This limit does not seem to rule out any of the cosmologies in which the strength of the gravitational interaction is variable.

398. Peltier, L.
COMET HUNTING FOR AMATEURS, Sky and Telescope, v. 23, no. 1, Jan 62, pp. 10-13, 7 figs.

A discussion of the instruments and techniques used in amateur comet searches.

399. Perelman, T. L.
DENSITY DISTRIBUTION OF CHARGED PARTICLES IN METEOR WAKES, by T. L. Perelman and S. I. Anisimov, Doklady Acad. Sci. U.S.S.R., Earth Sci. Sect., v. 136, nos. 1-6, Sep 62, pp. 167-168, 3 refs.; trans. of Doklady Akad. Nauk S.S.S.R., v. 136, no. 4, 1961, pp. 810-812.

In order to investigate the reflection of radio waves from meteoric wakes it is necessary to know the density distribution of charged particles therein. Formulae are derived to aid in interpreting the density distribution.

400. THE PERSEID METEOR SHOWER-1962, Sky and Telescope, v. 24, no. 4, Oct 62, p. 220, 2 figs.

A description is given of observations made during the 1962 Perseid shower.

401. Peterson, N. D.
JANUARY'S QUADRANTID METEOR SHOWER OBSERVED, Sky and Telescope, v. 23, no. 4, Apr 62, p. 215, fig.

A brief description is given of observations made in California during the fairly rich display of the 1962 Quadrantid meteors.

402. Petersen, N. D.
MORE PERSEID OBSERVATIONS, Sky and Telescope, v. 24, no. 5, Nov 62, pp. 284-285, 2 figs.

A note describing Perseid observations made during the night of August 10-11 by the American Meteor Society.

403. Pinson, W. H., Jr.
RUBIDIUM-STRONTIUM CORRELATION OF THREE TEKTITES AND THEIR SUPPOSED SEDIMENTARY MATRICES, by W. H. Pinson, Jr., and C. C. Schnetzler, Nature (London), v. 193, no. 4812, 20 Jan 62, pp. 233-234, 2 tbls., 11 refs.

Results are presented of analyses of seven tektites and associated sediments in an attempt to determine enrichment of strontium relative to rubidium to obtain evidence in support of the local fusion hypothesis of the origin of tektites. Because of the obtruse sampling problem, and the negative indication of the present results, this subject will not be pursued further. However, the rubidium-strontium correlation method will be used in testing of the more promising hypothesis that tektites may be the fusion products of large meteoritic splashes of continental dimensions.

404. Pitakpaivan, K.
ORIGIN OF TEKTITES OF MUONG NONG TYPE, (Abstract), by K. Pitakpaivan and V. E. Barnes, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3587.

As part of a project supported by the National Science Foundation, tektites of Nuong Nong-type were collected in situ in five places in southeast Asia. Such tektites were also found on the surface, associated with normal tektites in Cambodia, Viet Nam, and Thailand, and were identified with tektites in collections from the Philippines and Texas. A petrographic study of this material and of type specimens from Laos reveals (1) a broad internal stratification, with variation from layer to layer in color and in content of bubbles, lechatelierite, and froth; (2) a very closely spaced, in part closely folded, shimmery structure within (1); and (3) lack of overall internal tensional strain. The in situ occurrence, in areas a yard or two across, of as much as 50 pounds of chunky tektite glass also differs from the manner in which normal tektites occur. Both types of tektites were probably formed by the same event: the impact of an asteroid or comet. The impact would have produced an explosion strong enough to form and distribute normal tektites. The accompanying heat and shock wave may have produced the Muong Nong-type tektites.

405. Plavcová, Z.
RADIO-ECHO OBSERVATIONS OF THE GEMINID METEOR STREAM IN 1959, Bull. Astron. Insts. Czech., v. 13, no. 5, 1962, pp. 176-177, 3 figs., tbl., 5 refs.

Continued

The echo rates from December 8th to December 19th, 1959, were measured. The peak activity of the echoes with duration $\tau \geq 1$ sec occurred at a longitude of the sun $\lambda = 260.8°$ in agreement with other observations. The maximum echo rate of smaller particles occurred 1.5 days earlier.

406. Plyashkevich, L. N.
NEKTORYE DANNYE O SOSTAVE I STRUKTURE ZHELEZNOGO METEORITA ELGA, (SOME DATA ON THE COMPOSITION AND STRUCTURE OF THE IRON METEORITE ELGA), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 51-60, 10 figs., tbl., 4 refs., (in Russian).

The chemical composition and the structural characteristics of the 28.8-kg Elga meteorite classify it as a fine octahedrite. The metallic portion of the meteorite consists of kamacite, taenite, plessite, schreibersite, and troilite. The silicate inclusions amount to 10-15 percent of the total mass of the meteorite, which is rather unusual, inasmuch as they consist mainly of potash-soda feldspar (anorthoclase?), clinopyroxene of diopside type (pigeonite?), and maskelynite. The presence of these minerals in meteorites is extremely rare. The absence of olivine is unusual as well. The structure of the meteorite, particularly that of its silicate inclusions, is most complex and varied. Of particular interest are traces of what appears to be a secondary fusion crust. Spectral and chemical analyses of metallic and silicate portions of the meteorite are presented.

407. Pokorný, F.
DIFFRACTION EFFECTS IN METEORIC FORWARD SCATTER, Bull. Astron. Insts. Czech., v. 13, no. 5, 1962, pp. 167-174, 10 figs., 3 tbls., 15 refs.

This paper derives the generalized Fresnel integral, which describes the diffraction effect in forward scattering of electromagnetic waves by ionized meteoric trails. The generalized Fresnel integral respects the different scattering properties along the trail, diffusion and displacement of the trail caused by winds. The integral is modified to the form of tabulated functions. A method of determining certain physical quantities from the diffraction effect is described.

408. Pokrovskii, G. I.
O VOZMOZHNYKH MEKHANICHESKIKH YAVLENIYAKH PRI DVIZHENII METEORNYKH TEL, (MECHANICAL PHENOMENA WHICH MAY OCCUR DURING MOTION OF METEORIC BODIES), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 95-102, 6 figs., (in Russian).

The reactive force produced by ablating molecules of meteoric bodies can produce their deceleration as well as their acceleration. Acceleration may occur as a result of self-rotation of the body and also as a result of its nonhomogeneous structure. In addition, particles of the surrounding medium

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may penetrate small rotating meteoric bodies causing ejection of fragments from the rear of these bodies. In the study of the ballistic shock wave formed during the motion and fragmentation of the body it is necessary to consider that its heated trail acts as a waveguide. A shock wave propagates through this waveguide faster than through the unperturbed air. As a result, the wave front stretches along the trajectory of the body. In order to verify this phenomenon model studies were conducted. During the experiment an explosive charge generated a ballistic wave which propagated along a radial flame jet. The experiment proved that heated air having a cylindrical form significantly deforms the spherical front of the wave.

409. Pokrzywnicki, J.
CEIZARY WLASCIWE METEORYTOW, (SPECIFIC GRAVITIES OF METEORITES), Acta Geophys. Polon., v. 10, no. 2, 1962, pp. 191-194, tbl., 16 refs., (in Polish).

The specific gravities of 53 meteorites (42 aerolites, 2 mesosiderites, and 9 siderites) were determined. Several specimens of each of the meteorites were analyzed in order to determine the mean specific gravity of each meteorite. This method made it possible to reduce the influence of such factors as differential composition, weathering, and measurment inaccuracies.

410. Pokrzywnicki, J.
O TZW. BOLIDZIE CZECHOSLOWACKIM, (THE SO-CALLED CZECHOSLOVAK BOLIDE), Acta Geophys. Polon., v. 10, no. 1, 1962, pp. 67-74, fig., (in Polish).

The accounts of eighteen eyewitnesses who observed a very bright bolide moving northeast to southwest across portions of Poland and Czechoslovakia on the night of 9 January, 1957, are presented and commented upon. The bolide was observed for a 5-6 second interval over a trajectory of 200 km; its height was determined to be 7.3 ± 1.8 km. The bolide disintegrated and a loud explosion was heard. No fragments were recovered.

411. Porter, J. G.
REPORTS ON THE PROGRESS OF ASTRONOMY, COMETS (1961), Quart. J. Roy. Astron. Soc., v. 3, no. 3, Sep 62, pp. 167-178, tbl., 43 refs.

Two of the comets of 1961 reached naked eye brightness, and encouraged a good number of observations. Twenty comets were under observation during the year, three of these being new discoveries. Besides the two annual comets, ten others were recovered on the basis of satisfactory predictions. Comet observations made during 1961 are summarized and additional data concerning important 1961 comet papers are presented. Orbital elements of 14 comets are also given.

412. Portnov, A. M.
KRATER NA PATOMSKOM NAGORE, (A CRATER ON THE PATOM PLATEAU), Priroda, no. 11, Nov 62, pp. 102-103, 3 figs., 2 refs., (in Russian).

A description is given of a crater located on the Patom plateau, 50 km west of the village of Perevoz, Irkutsk Oblast, Russia. The crater was first described in 1951 but opinions differed regarding its origin (meteoritic or volcanic). The crater is elliptical: its major axis is 160 m (southwest) and its minor axis is 140 m (southeast). The crater rim is 2-4 m wide at the top and 4-40 m high on the outer slopes. The mean height of the rim and diameter of the crater are 20 m and 140 m, respectively. The general appearance of the crater, the presence of a raised rim and of a central hillock (composed of fragmented but otherwise unaffected bedrock) indicate the explosive origin of the crater. The absence of limestone metamorphism, of hydrothermal or fumarolic activity, and of faults, refute the volcanic hypothesis of origin. It is postulated the crater was formed 150-200 years ago by meteoritic impact. If so, it is probably the largest meteoritic crater in Russia. The name Patomskii is proposed for the crater.

413. Princeton Univ., Dept. of Chem., N.J.
COSMOGENIC Mn^{53}, Al^{26}, AND Be^{10} IN IRON METEORITES AND A SEARCH FOR TERRESTRIAL Mn^{53}, by J. P. Shedlovsky, Ph.D. dissertation, 1961, University Microfilms Mic 61-4831, 127 pp., 15 figs., 28 tbls., 90 refs.

Cosmogenic Mn^{53}, Al^{26}, and Be^{10} have been found in the iron meteorites Odessa, Grant, and Williamstown. The identity of these nuclides has been confirmed by radiochemical recycling to constant specific activity. The preatmospheric sizes of these meteorites have been estimated and the cosmic ray exposure ages have also been calculated. It is suggested that meteoritic Mn^{53}, which is shown to be free of Mn^{54} contamination, may be used to determine the half life of the former.

414. Pskovskii, Yu. P.
PYLEVAYA MATERIYA V OKRESTNOSTYAKH ZEMLI, (DUSTY MATERIAL IN THE VICINITY OF THE EARTH), Priroda, no. 12, Dec 62, pp. 68-73, fig., 2 refs., (in Russian).

A description is given of the composition of interplanetary matter (asteroids, comets, meteorites, micrometeorites and nonterrestrial dust). In addition, the zodiacal light, night airglow, and the gaseous tail of the earth are discussed. Various hypotheses concerning the gegenschein, zodiacal light, dust concentrations about the earth, Kordylewski's clouds, and the Trojans, are reviewed.

415. Pyavchenko, N. I.
KRATERA NE BYLO, (THERE WAS NO CRATER), Priroda, no. 8, Aug 62, pp. 39-42, 3 figs., (in Russian).

Studies by a group of marsh specialists made in the area of fall of the Tunguska "meteorite" are described. A detailed investigation of the area indicates that the numerous conical depressions in the ground were caused by lengthy thermokarst processes and are in no way related to the Tunguska phenomenon. Similar depressions are characteristic of the entire permafrost region of Siberia. Disarrangements attributable to meteoritic impact were not found.

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416. Radio Corp. of America, Flight Control Lab., Camden, N.J.
"High Speed Particles," Sect. H, pp. 53-57, tbl., 2 refs.; in STUDY OF INSTRUMENTATION AND TECHNIQUES FOR MONITORING VEHICLE AND EQUIPMENT ENVIRONMENTS AT HIGH ALTITUDE, VOLUME I. VEHICLES AND ENVIRONMENTS, by B. V. Wacholder and E. Fayer, Contr. AF 33(616)-6407, Proj. 8223, Rept. on Crew and Environmental Data Sensing and Instrumentation, 1961, WADC TN 59-307, v. 1, ASTIA AD 266 288, (OTS $14.50), 163 pp.

A general discussion is presented on the micrometeorite flux and on interplanetary dust. An individual meteoritic particle will react with the atmosphere over a range of 18.3 to 38 km of altitude, so that most, which begin to react at 122 km, will still be in existence at 92 km. Thus, it is concluded that above 92 km altitude the total incident particles will be present and they will still have significant velocities. Between 61 and 92 km, probably one-half of all incident particles will still have significant velocities. Particles in this range of altitude will have lesser velocities than those interacting above 92 km. Below 61 km, there will be few high-energy particles.

417. Ramdohr, P.
ORE MICROSCOPE STUDIES OF STONY METEORITES, (Abstract), by P. Ramdohr and G. Kellerud, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3589.

Specimens from about one hundred falls were examined carefully in high-quality polished sections. The resulting new information bears especially on mineralogy, textures, and weathering. Mineralogy: ten new minerals were discovered. Seven minerals previously known only from ores and/or synthesis were observed in meteorites: chalcopyrrhotite, valleriite, chalcopyrite, pyrite, bravoite, sphalerite, and Fe-Mn bearing oldhamite.

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Native copper, pentlandite, and ilmenite, which in the literature are considered rare or questionalbe, are common. Much new information has been obtained on "trivial" components: plessite, graphite, troilite, daubreelite, magnetic, and especially chromite. Textures: fine textures and intergrowths, examinable in much greater detail in reflected than in transmitted light, indicate that many schemes concerning origin of meteorites are wrong or "oversimplified." A completely new observation is that involving "spontaneous melting," in which iron, troilite, and silicates on a local scale and not connected with breaks or collisions often show melting textures. Melting connected with faults or fissures is trivial. Weathering: terrestrial weathering attacks first α iron, then γ iron, and later troilite. Iron weathers chiefly to magnetite, which almost invariably is secondary except in hydrocarbon containing meteorites. Nickel freed during weathering of iron (to magnetite and limonite) produces secondary pentlandite and bravoite by surface reactions with troilite.

418. RAND Corp., Santa Monica, Calif.
CONCERNING A CERTAIN EFFECT IN THE FIELD OF METEOR AERODYNAMICS, (OB ODNOM EFFEKTE V OBLASTI AERODINAMIKI METEROV), by K. P. Stanyukovich, trans. by J. B. Grazley, Contr. AF 49(638)-700, Memo no. RM-2932-PR, Jan 62, ASTIA AD 270 232, (OTS $1.60), 13 pp., 4 refs.; trans. of Izvest. Akad. Nauk S.S.S.R., Otdel. Tekn. Nauk, Mekhan. i Mashin., no. 5, 1960, pp. 3-8.

An investigation of the process of ablation experienced by a meteoric body as it passes through the earth's atmosphere.

419. RAND Corp., Santa Monica, Calif.
EFFECT OF MICROMETEORITE COLLISIONS ON SPHERICAL WIRE-MESH PASSIVE REFLECTORS, by E. Bedrosian, Contr. NASr-21(02), Memo no. RM-3274-NASA, Aug 62, NASA N62-15090, (OTS $1.60), 12 pp., 2 figs., 6 refs.

An investigation of the possible effects of micrometeorites in reducing the useful lifetime of a spherical wire-mesh passive-reflector communications satellite. Theoretical conditions are postulated under which a wire composing part of the mesh might be severed by a hypervelocity collision with a micrometeorite. This criterion, taken with the known flux of micrometeorites, is used to compute the probability that such collisions will degrade the electrical performance of such a reflector. It is concluded that they will not significantly affect its useful lifetime.

420. RAND Corp., Santa Monica, Calif.
THE GRAVITATIONAL CONCENTRATION OF PARTICULATE MATTER IN SPACE NEAR THE EARTH, by S. H. Dole, Contr. AF 49(638)-700, Memo no. RM-2879-PR, Apr 62, 48 pp., 12 figs., 8 tbls., 21 refs., 2 appens.; an abridged version is published in Planet. Space. Sci., v. 9, Sep 62, pp. 541-553, 9 figs., 3 tbls., 15 refs.

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The concentration of particles (meteoroids) in the space near the earth recently observed through data telemetered from satellites can be attributed entirely to the earth's gravitational attraction.

It is pointed out that low-velocity particles are preferentially attracted to the earth and that such particles (coming from direct near-circular heliocentric orbits of low inclination) are abundant in the solar system at earth's distance from the sun.

Experimental runs on the IBM 7090 computer (studying families of trajectories of particles initially moving around the sun on direct orbits in the plane of the ecliptic with zero eccentricity, and thus having low velocities relative to the earth) have shown that these particles have a steady-state concentration (number per cm^3) near the earth that varies inversely with the 1.14 power of the distance from the earth's center. The particle flux (number per cm^2-sec) was found to vary inversely with the 1.66 power of the distance. These particles fell into two general classes: those destined to impact on the earth, and those moving in loops around the earth, making one, two, three, or four approaches before returning to purely heliocentric orbits. Of those particles that came within 100 earth radii from the earth, about 18 percent impacted, the remainder escaped. Residence times in earth's vicinity ranged from 5 to 400 days, the median residence time being about 12 days.

421. Reid, A. M.
COESITE IN DARWIN GLASS, (Abstract), by A. M. Reid and A. J. Cohen, J. Geophys. Research, v. 67, no. 4, Apr 62, p. 1654, 2 refs.

The occurrence of Darwin glass in western Tasmania, remote from any contemporaneous acid volcanism and resting directly upon diverse types of bedrock, precludes any hypotheses of volcanic or fulguritic origin. Conder (Ind. and Mining Standard Australia, v. 89, 1934, p. 329) and others have advocated fusion of sediments by meteorite impact, but definite evidence is lacking and no crater has been recognized in the vicinity. An investigation of the crystalline constituents of Darwin glass by optical and X-ray diffraction methods has revealed the presence of coesite and tourmaline in addition to the quartz previously described by Campbell, Smith, and Hey (Bull. Inst. Francais d'Afrique Noir, v. 14, 1952, p. 762). The discovery of trace amounts of coesite indicates that Darwin glass is an impactite produced from terrestrial materials under the high pressures and temperatures generated by meteorite impact.

422. Remy-Battiau, L.
COMPORTEMENT DES RAIS INTERDITES DE L'OXYGÈNE DANS LES COMÈTES, II. RELATIONS AVEC L'ACTIVITÉ SOLAIRE ET MÉCHANISMES D'EXITATION, (BEHAVIOR OF FORBIDDEN OXYGEN LINES IN COMETS, II. RELATION BETWEEN SOLAR ACTIVITY AND EXCITATION MECHANISMS), Ann. Astrophys., v. 25, no. 3, May-Jun 62, pp. 171-183, 6 tbls., 18 refs., (in French).

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It has been found impossible to find any convincing correlation between solar phenomena (bright solar flares, relative sunspot number), terrestrial phenomena (geomagnetic indices, aurorae) and the occurrence or intensity variations of oxygen forbidden lines in cometary spectra. The relative intensities of nebular transitions (red doublet) or auroral transitions (green line) of oxygen have been calculated on the basis of two different mechanisms: fluorescence and electron collisions. In the case of pure resonance, the red lines are the only lines visible. The excitation by electron collisions implies that red lines are always found more intense in the range

$$10^3 {}^\circ K \leq T_e \leq 10^5 {}^\circ K; \; 10^3 \text{ el cm}^{-3} \leq n_e \leq 10^5 \text{ el cm}^{-3}.$$

The intensity ratio is a slowly varying function of the electron density n_e. It is smaller than 10 if T_e is higher than $5 \times 10^4 {}^\circ K$. Excitation by collisions with protons is less likely to be negligeable. The possible contribution of recombination processes like $O_2^+ + e \rightarrow O^* + O^{**}$ remains to be taken into account.

423. REPORTS ON COMET SEKI, Sky and Telescope, v. 23, no. 1, Jan 62, pp. 34-35, fig.

Reports from several observers concerning comet Seki (1961f) are given.

424. RESHENIE DEVYATOI METEORITNOI KONFERETSII PO VOPROSU IZUCHENIYA PADENIYA TUNGUSSKOGO METEORITA, (RESOLUTIONS OF THE NINTH CONFERENCE ON METEORITES CONCERNING THE PROBLEM OF THE FALL OF THE TUNGUSKA METEORITE), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 9-13, (in Russian).

Results of theoretical studies and of field work of the 1958 expedition to the area of fall of the Tunguska meteorite are discussed. The following were accomplished: (1) preparation of a map of the destroyed forest; (2) establishment of the lack of a crater; (3) detection of accelerated growth of trees in the area; (4) recovery of minute spherules from soil samples; (5) gathering of additional data pertaining to the unusual twilight phenomenon observed on the night of the fall; (6) study of the magnetic disturbance caused by the fall; and (7) simulation of several mechanisms of explosion of a meteoric body in the atmosphere. The following problems are considered worthy of further investigation: (1) development of a theory of large meteorites; (2) model studies of the motion and explosion of large meteorites; (3) investigation of the comet hypothesis; (4) preparation of a detailed map of the destroyed forest reflecting geometric and dynamic parameters of the explosion; (5) search for ablated material; and (6) study of the biological effects of the fall.

425. Richter, N. B.
THE PHOTOMETRIC PROPERTIES OF INTERPLANETARY MATTER, Quart. J. Roy. Astron. Soc., v. 3, no. 3, Sep 62, pp. 179-186, 15 refs.

The zodiacal light, and light from the nuclei and dust tails of comets, from asteroids, libration clouds, etc., is sunlight that has been reflected or scattered by small particles. For the interpretation of photometric observations of interplanetary matter a selection of phase laws is recommended, which depends on the diameter of the particles. These phase functions have been determined mostly by experimental investigations. Polarization curves are also recommended.

426. Riddell, F. R.
FROM ICBM RE-ENTRY TO METEORITE ENTRY, by F. R. Riddell and H. B. Winkler, Paper presented at Joint Nat. I.A.S.-A.R.S. Meet., Los Angeles, Calif., 13-16 Jun 61, A.R.S. paper no. 61-113-1807, 38 pp., 13 figs., tbl., 22 refs.; also published in revised form as METEORITES AND RE-ENTRY OF SPACE VEHICLES AT METEOR VELOCITIES, A.R.S. J., v. 32, no. 10, Oct 62, pp. 1523-1530.

In the exploration of the solar system, it will soon be of interest to recover instrumented probes, which, if they are not decelerated in some fashion in space, will approach earth at velocities as high as 140,000 fps. The possibility of decelerating such a recovery vehicle by atmospheric braking is examined. Since this velocity is well into the meteor range, data on meteorites are used to orient the analysis. Meteorites are known to cover a wide range of sizes from a few microns to hundreds of feet in diameter. There is evidence, furthermore, that, in the intermediate-size range from a few inches to a foot or two in diameter, only objects in the lower meteor velocity range survive. Rational designs of recoverable deep-space probes are of this intermediate size. Analysis is performed which shows that, whereas very small and very large objects may survive throughout the meteor velocity range, there may well be an upper limit to re-entry velocity of about 50,000 to 60,000 fps for objects of intermediate size. The reason for this upper limit appears to be that, at meteor velocities, the dominant mechanism of heat transmission is radiation. This provides a much more effective route for the transfer of energy than the convective heat transfer processes associated with lower entry velocities.

427. Ridley, H. B.
THE PHOENICID SHOWER OF 1956 DECEMBER 5, J. Brit. Astron. Assoc., v. 72, no. 6, 1962, pp. 266-272, 5 tbls., 9 refs.

On 5 December 1956, a hitherto unknown meteor shower was widely observed in the southern hemisphere, both visually and

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by radar. A discussion is presented on all available information on the shower from all known sources. The conditions for another encounter with the Phoenicids are rather sensitive to small changes in the perihelion distance of the stream, and since this distance appears to be increasing, it is quite possible that the shower may not subsequently observed except as a weak remnant as in the case of the Bielids, the Leonids, the Pons-Winneckeids and - it seems - the Giacobinids.

428. Rigollet, R.
UNE NOUVELLE MÉTHODE D'OBSERVATION PHOTOGRAPHIQUE DES MÉTÉORES D'ORIGINE COSMIQUE, (A NEW METHOD OF PHOTOGRAPHIC OBSERVATION OF METEORS OF COSMIC ORIGIN), J. Observateurs, v. 45, no. 8, 1962, pp. 181-223, 16 figs., 5 pls., (in French).

A description of a special method of observation of meteorites and artificial earth satellites used for the determination of their trajectories. The cameras are not driven, but remain in fixed positions, while an occulation screen measures velocities by rapidly sectioning the trajectories. Determination of trajectories is made using the points of intersection of the trajectories with the trails of star images. In addition, the so-called "revolving camera" connected with a fixed camera (rotation around an optical axis) yields the t_m recorded instants of objects being photographed. This method permits, by means of a single operation (i.e., combination of fixed and revolving cameras), access to all data necessary for computation of a meteoric orbit. Several experimental results are presented.

429. Ringwood, A. E.
COHENITE AS A PRESSURE INDICATOR IN IRON METEORITES - II, by A. E. Ringwood and M. Seabrook, Geochim. et Cosmochim. Acta, v. 26, Apr 62, pp. 507-509, 5 refs.

A direct investigation of the stability of cohenite is described. The previous conclusion by Ringwood (Geochim. et Cosmochim. Acta, v. 20, no. 2, Oct 60, pp. 155-157), that meteoritic cohenite was stabilized by high pressure still stands.

430. Ringwood, A. E.
THE INFLUENCE OF HIGH PRESSURE ON TRANSFORMATION EQUILIBRIA IN IRON METEORITES, by A. E. Ringwood and L. Kaufman, Geochim. et Cosmochim. Acta, v. 26, Oct 62, pp. 999-1009, 4 figs., 2 tbls., 25 refs.

Phase diagrams of the α-γ transformation equilibria in iron-nickel alloys at high pressures have previously been calculated by the authors. The phase compositions and structures of iron meteorites are discussed in terms of the high pressure diagrams, using arguments which were first advanced by

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H. H. Uhlig. It is concluded that the structures of iron meteorites were developed within the pressure range 30-60 kilobars. The new 50 kilobar diagram permits the time interval for formation of the Widmanstätten texture to be less than 10^8 years, thus resolving a current controversy between advocates of high pressure and low pressure crystallization for iron meteorites.

The influence of minor components, principally phosphorus, on the crystallization equilibria is also considered. The small amounts of phosphorus usually occurring in meteorites do not change the binary Fe-Ni equilibrium sufficiently to modify the principal conclusions. However, the stabilizing effect of phosphorus on the α phase may account for the fact that meteoritic kamacite is slightly richer in nickel than would be expected from either the high pressure or the low pressure binary Fe-Ni phase diagram.

431. Roberts, G.
COMET SEKI 1961f, Monthly Notes Astron. Soc. Southern Africa, v. 21, nos. 1/2, 28 Feb 62, pp. 6-7.

A note describing observations of comet Seki made on 13 November 1961.

432. Roberts, G.
OBSERVATIONS OF COMET SEKI-LINES 1962c, Monthly Notes Astron. Soc. Southern Africa, v. 21, no. 4, 30 Apr 62, pp. 54-55.

Positions and magnitudes of comet Seki-Lines (1962c) are given for several observations made during February and March, 1962.

433. Robertson, W. H.
PRECISE OBSERVATIONS OF MINOR PLANETS AT SIDNEY OBSERVATORY DURING 1959 AND 1960, J. Roy. Soc. New South Wales, v. 95, pt. 6, Mar 62, pp. 179-187, 2 tbls., 2 refs.

The results of a program of precise observations made during 1959 and 1960 are given in tabular form for the following asteroids: 1 Ceres; 4 Vesta; 18 Melpomene; 39 Laetitia; and 40 Harmonia.

434. Robey, D. H.
A NEW MODEL FOR COMETS - THE COLD, PARTIALLY CONDENSED MAGNETIZED PLASMA, J. Astronaut. Sci., v. 9, no. 2, Summer 1962, pp. 41-48, 5 figs., 5 tbls., 27 refs.

A study has been made of the general properties of comets. Some characteristics which suggest that a comet's nucleus may be surrounded by and attached to a magnetized plasma are presented. A theory, based on the assumption that the coma behaves

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as a magnetized plasma, is then used to derive a formula for coma contraction during approach to perihelion. The coma diameter of comet Encke was found to vary approximately as the cube of the solar distance out to distances of the order of 1.6AU's. The agent causing the contraction is believed to be the solar wind.

The theory has also been applied to comet outbursts. Outbursts are considered to be caused by sudden contractions of the coma brought about by transient increases (solar flares) in the solar wind. This could result in shock waves which then carry the required energy to the nuclei.

435. Rodionov, S. P.
O ZNACHENII METEORITIKI, (ON THE SIGNIFICANCE OF METEORITICS), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 14-15, (in Russian).

Meteoritics is of great importance in that the field is providing considerable data of value toward the solution of many problems in astrophysics, geophysics, and geology. It has recently acquired particular significance in connection with space exploration. The purpose of the ninth conference on meteorites was to review the progress of meteoritics within the past few years, exchange scientific information, coordinate research, and discuss the results of study of the Tunguska fall.

436. Roemer, E.
ACTIVITY IN COMETS AT LARGE HELIOCENTRIC DISTANCE, Publs. Astron. Soc. Pacific, v. 74, no. 440, Oct 62, pp. 351-365, 7 pls., tbl., 19 refs.

Although bright comets continue to be the source of most of our present knowledge, an increasing number of comets that remain at large heliocentric distances have been discovered in recent years. Some of the comets discovered with powerful photographic instruments have become bright enough for limited astrophysical investigations. Results already obtained suggest that the smaller objects observed in the region of the terrestrial planets may not be in all ways representative of comets in general.

To demonstrate the need for revised ideas about normal behavior of comets the characteristics and behavior of a "typical" comet are reviewed. Next, some statistics are given regarding the comets that remain at greater distance from the sun, and the importance of recent discoveries is discussed. Finally, the characteristics are given of several of the known comets of perihelion distance greater than 3.0 A.U., as well as some of the interesting observations that have been made within the last few years.

437. Roemer, E.
COMET NOTES, Publs. Astron. Soc. Pacific, v. 74, no. 438, Jun 62, pp. 254-256.

Notes concerning the following comets are presented; 1962c (Seki-Lines); 1962a (P/Harrington-Abell); 1961h (P/Perrine); 1961e (Humason); 1961b (P/Tempel 2); 1960j (P/Schwassmann-Wachmann 2); 1960f (P/Comas Solá); and 1925II (P/Schwassmann-Wachmann 1).

438. Rose, H. J., Jr.
X-RAY FLUORESCENCE ANALYSIS OF TEKTITES, (Abstract), by H. J. Rose, Jr., F. Cuttitta, M. K. Carron, and F. J. Flanagan, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3593.

To provide data on the composition of tektites, X-ray fluorescence analyses of 26 samples were made for Si, Al, Fe, Ca, K, Mn, and Ti. La_2O_3, a heavy absorber, is added to a mixture of sample and $Li_2B_4O_7$ to minimize absorption differences. The mixture is fused, crushed, pressed into a pellet, and analyzed. X-ray fluroescence determinations of these tektites compare favorably with the chemical analyses. The coefficient of variation for each element, expressed as the percent standard deviation of a single determination, is about 2 percent. The variation for SiO_2 determinations is less than 1 percent.

439. Rowe, M. W.
ON THE RADIOACTIVITY OF IRON METEORITES, (Abstract), by M. W. Rowe, M. A. Van Dilla, and E. C. Anderson, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3594.

A nondestructive technique employing a large sodium iodide γ-ray spectrometer has been used to examine the γ radioactivity of iron meteorites. Of seven studied, only Aroos and Ussuri (Sikhote-Alin) showed detectable γ radioactivity. In Aroos, measured 120 days after fall, 425 ± 40 dis kg^{-1} min^{-1} of 291-day Mn^{54} was the predominant radioactivity detected; Co^{60} concentration in three pieces of Ussuri ranged from 207 ± 31 to 382 ± 38 dis kg^{-1} min^{-1}. Of the five showing negative results (Pitts, Odessa, Canyon Diablo, Toluca, and Seattle), only Seattle (two pieces, totaling 232 grams, fell January 17, 1955, near Seattle, Washington) is young enough to show Co^{60} if its concentration were similar to Ussuri. The negative result on Seattle shows that the concentration at the time of fall $\leq$ 90 dis kg^{-1} min^{-1}.

440. Rushbrook, P. R.
IRIDIUM IN STONE METEORITES BY NEUTRON ACTIVATION ANALYSIS, by P. R. Rushbrook and W. D. Ehman, Geochim. et Cosmochim. Acta, v. 26, Jun 62, pp. 649-657, 3 tbls., 18 refs.

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Chemical and radiometric procedures for the determination of submicrogram amounts of iridium in silicate materials by use of neutron activation have been developed. These procedures were applied to the analyses of six chondrite meteorites, one achondrite meteorite, and standard rock G-1. A cosmic abundance value for iridium based on the chondrite analyses of this work was calculated to be 0.38 ($Si = 10^6$). This value is lower than the interpolated iridium abundances of both Suess and Urey and Cameron, but is closer to that of Cameron. Implications of these results are discussed.

441. Rushing, H. C.
SEARCH FOR EXTINCT Pd^{107} IN METEORITES, (Abstract), by H. C. Rushing, A. K. Chakraburtty, E. Anders, and C. M. Stevens, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3594.

To verify the isotopic anomalies in meteoritic silver that have been attributed to the decay of extinct Pd^{107} (Murthy, 1960, 1961), silver was isolated from a number of iron meteorites. The silver concentration was determined by isotope dilution, and the chemical yield by means of Ag^{110} tracer. Recoveries ranged from 20 to 90 percent. The isotopic composition was measured by surface ionization on the Argonne 100-inch mass spectrometer. The results and their significance are discussed.

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442. Safronov, V. S.
ON THE TEMPERATURE OF THE DUST COMPONENT OF THE PROTOPLANETARY CLOUD, Soviet Astronomy (AJ), v. 6, no. 2, Sep-Oct 62, pp. 217-225, 2 tbls., 11 refs.; trans. of Astron. Zhur., v. 39, no. 2, Mar-Apr 62, pp. 278-289.

The temperature of an optically thick protoplanetary dust layer heated by solar radiation propagating nearly parallel to its surface and scattered by the dust particles is estimated. It is assumed that the absorption coefficient does not depend on wavelength and that the reradiation of light by the particles is isotropic. The same result would be obtained in the case of pure scattering (conservative case). It is assumed that the equivalent thickness of a uniform layer is proportional to the distance from the sun ($h = \beta R$). The finite size of the sun in the z direction is taken into account. It is shown that the black-body temperature in the dust layer is only very slightly dependent on z. The values of T, computed for different values of β, are given. The temperature of the layer decreases with β. Therefore, most of the heating of the layer is due to light scattered in the gas component of the

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cloud. The black-body temperature in the layer at the distance of Jupiter is found to be 30-35°K and at the distance of Saturn 15-18°K. It is concluded that the condensation of hydrogen was not possible at the distances of Jupiter, Saturn and Uranus and very unlikely at the distance of Neptune.

443. Salisbury, J. W.
STATE OF THE LUNAR DUST, (Abstract), by J. W. Salisbury, R. A. Van Tassel, and C. F. Campen, J. Geophys. Research, v. 67, no. 4, Apr 62, pp. 1655-1656.

There are presently in existence two major hypotheses concerning the state of the dust on the lunar surface. One holds that the dust bears an electrostatic charge sufficient to separate the dust particles; the other maintains that sputtering and vacuum welding will cement the dust particles into a low-density, semiporous matrix. Deductions from the observed characteristics of the moon are strongly suggestive of a sintered dust layer but are necessarily based upon assumptions concerning the nature of observed lunar features. A characteristic of the lunar dust directly related to the property of "looseness" must be measured to prove its state conclusively. It appears that the value of $(K\rho c)^{-1/2}$ can be directly related to the number of point contacts between particles. It is proposed that, if the value of $(K\rho c)^{-1/2}$ changes during the lunar day, it will indicate that the electrostatic charge produced by solar radiation is sufficient to cause significant loosening of the dust. Laboratory experiments are planned to define more clearly the roles of conduction and radiation in heat transfer in a vacuum. A new radiometric technique is proposed in which an interferometer is used aboard a balloon-borne platform to determine more accurately the value of $(K\rho c)^{-1/2}$ throughout a lunation.

444. Savich-Zablotskii, K. N.
GEOCHEMICAL AND MINERALOGIC STUDY OF A STONY METEORITE FROM THE VICINITY OF THE VILLAGE OF SEVRYUKOVO, Intern. Geol. Rev., v. 4, no. 6, Jun 62, pp. 639-644, tbl., 14 refs.; trans. of Mineral. Sbornik, L'vov. Geol. Obs., no. 14, 1960, pp. 184-194.

In studying the conditions of formation of stony meteorites, it is assumed that (1) they are fragments of asteroids fallen to the surface of the earth. During their flight through the atmosphere, the meteorites develop a melted surface layer but their texture and mineralogic composition remain unchanged. (2) According to V. M. Goldschmidt, stone meteorites crystallize in a lesser gravity field than that of earth, which is the reason for their chondritic texture and high porosity (about 4%). (3) Meteorites were formed in a medium with a deficiency of free oxygen. As a result, part of their iron and nickel was segregated as native metal; in addition, lawrencite and oldhamite, sulfides typical of meteorites, were formed.

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Three stages of meteorite formation are identified: magmatic, pneumatolytic, and hydrothermal. The interval 1450-850°C corresponds to the magmatic stage at which a silicate phase and native iron with nickel were formed. As a result of thermal dissociation of water and because of the deficiency of oxygen required for a complete oxidation of metals and carbon, in the gaseous phase, free oxygen and H_2O were absent and the phase consisted probably of H_2, CH_4, CO_2, and CO.

The temperature interval 750-500°C corresponds to the pneumatolytic phase. Here, H_2S, CH_4, CO_2, and CO were the principal agents of the gaseous phase. CH_4 was formed in a high temperature region between hydrogen and elementary carbon. As the temperature dropped to 750°C, electrolytic dissociation of H_2O rendered possible the formation of sulfides, especially of troilite.

Mineralization at the hydrothermal stage with a temperature interval of 400° to 300°C has been observed only in carbon meteorites with a considerable graphitic carbon content. Here, a small portion of the ferrous iron is oxidized to the ferric, in the presence of CO_2 and at a temperature of 450° to 500°C; the iron sulfide so formed is represented by pyrrhotite. Simultaneously, colored silicates are chloritized, with a separation of $CaCO_3$.

445. Schmidt, R. A.
AUSTRALITES AND ANTARCTICA, Science, v. 138, no. 3538, 19 Oct 62, pp. 443-444, 2 figs., 9 refs.

A meteorite crater in the Wilkes Land region of Antarctica has been postulated as an explanation of the origin of australites. Geophysical data suggest that such a feature may have been located; striking gravity minima have been found almost exactly in the place predicted. Similar, pronounced gravity minima have been found for Canadian meteorite craters. The magnitude of anomaly was found to be related to the size of the crater and to the volume of pulverized rock which the crater contained. Data for the Wilkes Land feature fall on a smooth curve extrapolated from values for the Canadian craters.

446. Schmidt, T.
INTERPLANETARE ELEKTRONENDICHTE UND ZODIAKALLICHTSPEKTRUM, (INTERPLANETARY ELECTRON DENSITIES AND THE ZODIACAL LIGHT SPECTRUM), by T. Schmidt and H. Elsässer, Z. Astrophys., v. 56, no. 1, 1962, pp. 31-42, fig., 4 tbls., 7 refs., (in German).

There are two possibilities of deriving interplanetary electron densities from observations of the zodiacal light. The new discussion of polarization data by Giese and Siedentopf, using exact scattering functions for spherical particles, gives a minimum value of 300 electrons/cm^3 at 1 A.U. distance from the sun. On the contrary Blackwell and Ingham deduced from

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spectroscopic observations that the electron density at 1 A.U. is not greater than 120 particles/cm^3. Section 2 reviews the investigations based on the polarization- and brightness-distribution in the zodiacal light. In section 3 calculations are presented showing the influence of an electron component on the spectrum of the zodiacal light. A reduction of the line-depths should be observable if at 1 A.U. there are a few hundred electrons per cm^3. In section 4 it is demonstrated that the correct upper limit for the density at 1 A.U. according to the spectroscopic data of Blackwell and Ingham is at least 400 electrons/cm^3. In order to attain a more definite result spectroscopic observations of higher accuracy would be required.

447. Schnetzler, C. C.
A STUDY OF THE CHEMICAL COMPOSITION OF TEKTITES FROM THE SOUTHEAST PACIFIC, (Abstract), by C. C. Schnetzler and W. H. Pinson, Jr., J. Geophys. Research, v. 67, no. 9, Aug 62, pp. 3596-3597.

Thirty-four new major-element tektite analyses are given in the table, the numbers in parentheses representing numbers of samples from each locality. Small differences in Ti, Si, and Al and a large difference in Ca contents between indochinites and philippinites are established. However, the chemical similarities (confirmed also by trace-element and isotope studies) are more striking than the differences. For example, the K/Na, Fe/Mn, and Fe^{2+}/Fe^{3+} ratios are identical in three of the groups, and all four groups possess a unity of chemical character which to us excludes any random process of formation,

	Philippinites (15)	Indochinites (12)	Javanites (2)	Australites (5)
SiO_2	70.8	73.0	70.2	71.3
Al_2O_3	13.85	12.83	12.29	13.96
Fe_2O_3	0.70	0.64	0.71	0.65
FeO	4.30	4.37	5.86	3.95
MgO	2.60	2.48	4.47	2.11
CaO	3.09	1.91	2.47	3.50
K_2O	2.40	2.40	1.96	2.39
Na_2O	1.38	1.45	1.10	1.43
TiO_2	0.79	0.73	0.68	0.72
MnO	0.09	0.09	0.12	0.09

such as four separate meteorite impacts. However, difficulties (such as their peculiar geographical distributions) of fitting the compositional data to the hypothesis of one big meteorite splash cause us to favor an extraterrestrial origin.

448. Schrader, E. W.
HYPERVELOCITY IMPACT RANGES SIMULATE SPACE COLLISION DAMAGE, Design News, v. 17, no. 22, 31 Oct 62, pp. 10-11, 5 figs.

Continued

A brief description is presented on hypervelocity impact tests being conducted to provide data on the effects of puncture or crater formation upon ablative materials.

449. Schwarcz, H. P.
IMPLICATIONS OF MONOMINERALIC CHONDRULES TO THE ORIGIN OF CHONDRITES, (Abstract), J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3597.

Meteoritic chondrules appear to have formed by crystallization of spherical drops of glass. A significant fraction of the chondrules of most meteorites are monomineralic and contain no interstitial glass. These could have formed only from the melting of monomineralic crystal fragments. They cannot represent droplets of a magma in the usual terrestrial sense, since they would necessarily contain two or more crystalline phases. This is shown on the basis of the physical chemistry of silicate melts. Therefore, they (and presumably the polymineralic chondrules as well) formed by the disruption and grain-by-grain melting of a previously crystalline rock as suggested by Urey (THE PLANETS, 1952). The upper size limit to the grain size of monomineralic chondrules (1 to 2 mm) furnishes a lower limit to the grain size of the parent rock. Melting may be explained by adiabatic decompression of a parent planet following violent disruption.

450. Schwarcz, H. P.
A POSSIBLE ORIGIN OF TEKTITES BY SOIL FUSION AT IMPACT SITES, Nature (London), v. 194, no. 4823, 7 Apr 62, pp. 8-10, 2 figs., 2 tbls., 26 refs.

It is demonstrated that possible parent rock for tektites is terrestrial soil. Soil forms a discrete, geochemically well-defined family of rock types which, with some ad hoc modifications, match the family of tektite compositions. Unlike the various mixtures of sedimentary or igneous rock types which have been proposed, soil is truly ubiquitous, covering all land surface except high mountains and deserts. Comparisons have been drawn between tektites and fulgarites; these latter would be formed by fusion of soil, though by lightning rather than impact. It is believed that such a process is ruled out in the case of tektites by their distribution and the recently described occurrence of nickel-iron spherules in some tektites.

451. SCIENTISTS FIND RARE MINERAL IN METEORITE, L. A. Times, Mon., 10 Dec 62, pt. 1, p. 13.

A 19-lb iron meteorite fell near Bogu in Upper Volta, Africa, on August 14, 1962. The mineral wustite, an exceedingly rare form of iron oxide, has been found on the crust of the meteorite. It is believed that the wustite was formed

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when the meteorite was close to the earth's surface after having plunged through the atmosphere. Results of studies and analyses of the Bogu meteorite indicate that it travelled through space for 500 million years before impacting on earth. The number of isotopes in the meteorite is twice that in a fragment recovered from Sputnik IV, indicating that the meteorite came from a great distance in space and was not in an orbit near the earth. Numerous additional studies have been proposed.

452. Sclar, C. B.
SYNTHESIS AND OPTICAL CRYSTALLOGRAPHY OF STISHOVITE, A VERY HIGH PRESSURE POLYMORPH OF SiO_2, by C. B. Sclar, A. P. Young, L. C. Carrison, and C. M. Schwartz, J. Geophys. Research, v. 67, no. 10, Sep 62, pp. 4049-4054, 4 figs., 2 tbls., 19 refs.

Stishovite, a high-pressure high-density polymorph of SiO_2, isostructural with rutile, was synthesized at pressures between 75 and 125 kb and temperatures greater than 800°C. Significant conversion to the rutile form was obtained in a modified girdle apparatus at 125 kb; trace amounts were obtained in a belt-type apparatus between 75 and 100 kb. Stishovite is colorless, acicular in habit, and uniaxial positive with $\epsilon = 1.845 \pm .005$, $\omega = 1.800 \pm .005$. The optic axis is commonly highly inclined to the morphological axis. The transformation of coesite (4-fold coordination) to stishovite (6-fold coordination) exemplifies the decrease in molar refraction with increasing coordination predicted by Dachille and Roy.

453. Sekanina, Z.
COLLISIONS OF COMETS WITH DUST PARTICLES IN INTERPLANETARY SPACE, Bull. Astron. Insts. Czech., v. 13, no. 4, 1962, pp. 155-163, 5 figs., 2 tbls., 34 refs.

The problem of the physical consequences of a collision between the comet nucleus and a dust particle in interplanetary space is solved. On the basis of the physical theory worked out by Stanyukovich an expression is derived for the total loss of the comet mass caused by the pulverization process due to collisions with micrometeorites. It is indicated that the pulverization process itself is not sufficient for explaining the amount of dust in atmospheres of comets ascertained photometrically and spectroscopically. With short-period comets which are exposed to the effects of the process throughout their "life," it may be the initial stage in forming a thin dispersion dust layer. The process may also be responsible for a number of comet outbursts, and shapes the face of the surface of the comet nucleus.

454. Sekanina, Z.
ON THE ORLOV FORMULA, Bull. Astron. Insts. Czech., v. 13, no. 1, 1962, p. 34.

Continued

On the assumption that there existed a radiation-pressure force originating in the nucleus of a comet, Orlov derived the differential equation for the motion of a particle along the radius vector in the atmosphere of a comet. The correctness of the Orlov formula is investigated and found to be correct when only the infinitesimals higher than the third order are neglected.

455. Senftle, F.
MAGNETIC-SUSCEPTIBILITY STUDIES OF THE Fe^{+2} ION IN TEKTITES AND THE DETERMINATION OF THE AMOUNT OF Fe^{+2} AND Fe^{+3}, (Abstract), by F. Senftle, A. Thorpe, and F. Cuttitta, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3597.

Magnetic-susceptibility measurements have been made on about twenty chemically analyzed tektites. The validity of the "spin only" formula for calculating the magnetic susceptibility of tektites is shown. From it the amounts of ferrous and ferric iron can be determined, and the results compare closely with the chemical values. The data also show that the magnetic susceptibility of tektites is almost entirely due to the ferrous iron and that all the iron is completely dissolved in the glass.

456. Shaposhnikov, D. P.
K IZUCHENIYU METEORITA LIPOVSKII KHUTOR, (THE STUDY OF THE LIPOVSKII KHUTOR METEORITE), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, p. 170, (in Russian).

The Lipovskii Khutor meteorite was found in 1904 near the Lipovskii farm in Stalingrad Oblast, Russia. The initial dimensions of the meteorite were 10 X 10 X 12 cm, and its weight, 3832 g. The meteorite is an iron-stone pallasite consisting mainly of kamacite, plessite, and olivine. The chemical composition of various portions was determined.

457. Shedlovsky, J. P.
PROTON BOMBARDMENT OF A SIMULATED IRON METEORITE, (Abstract), by J. P. Shedlovsky and T. P. Kohman, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3598.

A multilayered iron target (1 X 1 X 3 feet) was bombarded at the Brookhaven cosmotron with 3-bev protons normal to and centered on the 1 X 1 foot face. Production rates of Be^7, Na^{22}, P^{32}, P^{33}, Ca^{45}, V^{48}, V^{49}, Cr^{51}, Mn^{52}, Mn^{54}, and Co^{56} are being measured at various positions, both on and off the beam axis. These (except Mn^{52}) plus C^{14}, Si^{32}, Sc^{46}, and Ti^{44} are being measured in thick sections along the axis. Along the axis, the activities rise by a factor of ~ 2 from the face to ~ 50 g cm^{-2} depth and then approach an exponential decrease with a mean path of ~ 120 g cm^{-2}. The integral yield at given

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depth rises by a factor of ~3 at ~125 g cm^{-2} and eventually decreases with a mean path of ~175 g cm^{-2}. The radial spread is greater for "low-energy" products, which can be produced readily by secondaries (e.g., Mn^{54}), than for "high-energy" products (e.g., P^{32}). The results are being integrated numerically over iron spheres of different sizes exposed to an isotropic 3-bev proton flux to give depth-dependence curves for comparison with results on cosmogenic radionuclides in iron meteorites.

458. Shima, M.
BORON IN METEORITES, J. Geophys. Research, v. 67, no. 11, Oct 62, pp. 4521-4523, 4 tbls., 14 refs.

It is very difficult to reach a conclusion regarding the variation of the content and isotope abundance of boron in nature, since a limited number of samples have been analyzed. However, the limited results for chondrites indicate that boron contents of approximately 0.4 to 0.5 ppm and a B^{11}/B^{10} atom ratio of approximately 3.8 to 3.9 can be expected. Hence it seems that the boron content of meteorites is 10 percent of the terrestrial content, and the B^{11}/B^{10} ratio of meteorites is 10 percent less than that of terrestrial boron. This observation suggests either that the meteoritic boron was enriched in B^{10} owing to synthesis by spallation or that some other effect altered the ratio. However, it should be stressed that no final conclusion can be drawn until a more complete survey of boron isotope abundances has been made.

459. Shoemaker, E. M.
EXPLORATION OF THE MOON'S SURFACE, Am. Scientist, v. 50, no. 1, Spring 1962, pp. 99-130, 8 figs., 41 refs.

A discussion of the motivations for exploring the surface of the moon, the scientific objectives of this immense undertaking, some problems of strategy in exploring the moon, and the probable sequence of events in the American program in the near future.

460. Shoemaker, E. M.
SAMPLING THE MOON THROUGH KORDYLEWSKI'S CLOUDS, (Abstract), J. Geophys. Research, v. 67, no. 4, Apr 62, pp. 1656-1657.

Particulate material tends to be concentrated in at least three regions of space in the vicinity of the earth: (1) in close orbits about the earth, (2) near the earth-sun collinear Lagrangian point opposite from the sun, and (3) near the earth-moon triangular Lagrangian points (L_4 and L_5). Discovery of two clouds near L_5 was announced by Kordylewski in 1961. At least four types of particles can be trapped in all three regions - zodiacal particles, asteroidal and cometary particles

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decelerated aerodynamically during passage through certain corridors in the earth's atmosphere, and particles ejected from the moon by impact of asteroidal and cometary particles. The proportions of these four types of particles in each of the three different regions should be different. Experimental investigation of hypervelocity impact in rock and particulate targets shows that particles derived from the moon should be a major component of Kordylewski's clouds. A mixed sample of material exposed on the moon's surface can probably be obtained with existing rockets and instrumentation by sending a probe through these clouds. The existence of discrete clouds suggests the material in them may have been ejected mainly by a few comparatively recent discrete events.

461. Shteins, K. A.
THE DIFFUSION OF COMETS, by K. A. Shteins and S. Ya. Sture, Soviet Astronomy (AJ), v. 6, no. 3, Nov-Dec 62, pp. 398-404, fig., 3 tbls., 5 refs.; trans. of Astron. Zhur., v. 39, no. 3, May-Jun 62, pp. 506-515.

In section 1 it is proven that there is an arbitrarily small difference between the solution of the differential equation in partial derivatives (1) with the boundary and initial conditions (2) and the solution of equation (3) with boundary conditions (4) if $t \to \infty$.

In section 2 solutions of the diffusion equations of the stationary state (3) with m = 1, 0, -1, -3/2 (5) are compared with observations. Oort investigated the case m = 0 and came to the conclusion that the disagreement between theory and observation should be explained by the existence of "new" comets, that is, comets with a large supply of gases which are very bright as they approach the sun for the first time. Computations show that in the case m = 1 the smallest number of new comets should be introduced. In this case it may be assumed that in (3) the dynamic instability of comets with large major semiaxes is taken into account. It is shown that Woerkom's hypothesis on the nonstationary character of the process also necessitate the introduction of "new" comets.

In section 3 a strict computation is made of the mean variation of the square of the cometary velocity due to stellar perturbations. The width of the zone $\Delta 1/a$, where the main influence is exercised by stellar perturbations, is estimated. The width of the zone is found to be so narrow that disagreement between theory and observation cannot be explained. Thus, the analysis shows that Oort's assumption on the existence of new comets can explain the disagreement between theory and observation, if we assume that different comets have different lifetimes.

In section 4 it is found that the stabilization of the diffusion process involves several million years.

462. Signer, P.
RARE-GAS CONCENTRATION IN THE PANTAR METEORITE, (Abstract), J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3599.

The detection of particularly interesting concentrations of He and Ne in the veined chondrite Pantar was recently reported (König, Keil, Hintenberger, Wlotzka, and Begemann). Our investigation of all the rare gases in Pantar confirmed these results and showed that Ar, Kr, and Xe are also distributed unevenly in the two phases. The concentration of Ar^{40} in the two phases indicates similar Ar^{40} retention ages of about 3.7×10^9 years (an average Kr concentration is assumed). From the total He^4 concentration of the light phase and an average U and Th concentration, a He^4 retention age of 3.4×10^9 years is found. The abundance of the Ne isotopes in this phase, however, indicates a contamination of the He in the light phase by primordial He. Therefore, the He^4 age above is an upper limit, and the two gas-retention ages appear to disagree, which could indicate a diffusive loss of the radiogenic component whereby the He^4 is affected predominantly. The comparatively low value of the cosmogenic He^3/Ar^{38} ratio seems to support this conclusion. The exposure age of Pantar, the significance of the excess Xe^{129}, the relative abundance of nuclides of primordial origin, and some conclusions about the conditions of formation of the two phases are discussed.

463. Sill, C. W.
THE BERYLLIUM CONTENT OF SOME METEORITES, by C. W. Sill and C. P. Willis, Geochim. et Cosmochim. Acta, v. 26, Nov 62, pp. 1209-1214, 2 tbls., 8 refs.

The beryllium concentration of 17 meteorites has been determined with excellent precision by a fluorometric procedure using morin as reagent. The average concentration found for 13 chondrites and 1 achondrite was 0.038 ppm or 0.64 atom per 10^6 atoms of silicon. Two other achondrites were excluded from the average because of their large deviations from the mean. The only iron meteorite analysed contained less than 1 ppb as expected. One sample each of a diabase, basalt, granite and shale showed an increasing quantity of beryllium in the order given compared to the meteorite average, ranging from about 16 times for the diabase to 160 times for the shale. Values of 2.74 ± 0.03 ppm and 0.623 ± 0.006 ppm were obtained for the standard rock samples G-1 and W-1, respectively.

464. Simmons, D. A. R.
AN EXPLODING FIREBALL, by D. A. R. Simmons and T. L. Evans, J. Brit. Astron. Assoc., v. 72, no. 3, 1962, pp. 136-138, fig., tbl.

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A description of a silver-colored fireball with a maximum magnitude of at least -10 and an apparent diameter of 0.5° which crossed Northern Scotland from west to east at 21^h38^m UT on 18 June, 1961, and was observed from the Orkneys in the north to the Midlands of England on the south.

465. Singer, S. F.
EFFECTS OF NONGRAVITATIONAL FORCES ON ZODIACAL DUST, (Abstract), J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3599.

The effects of two major nongravitational perturbation forces are investigated. Solar radiation pressure produces a force opposed to solar gravity which, in the case of small particles, leads to an appreciably lower circular orbital velocity. Effects begin to be noticeable for particles below 5 microns and lead to an anisotropy in their density distribution about the earth; an even more pronounced anisotropy in the flux distribution should be experimentally observable. We present calculations of the density and the flux along the line of the earth's orbit for particles between 3 and 0.3μ; both are higher at 6 P.M. than at 6 A.M. The effects of solar corpuscular drag are investigated. The radial force component is found to be negligible as compared with radiation pressure, but the tangential component is appreciable. For the case of interplanetary gas streaming radially outward from the sun the interaction between the charge of the dust particle and the plasma leads to a drag of the order of the Poynting-Robertson effect and a spiraling inward of small particles. In the case of a gas cloud rotating with the solar angular velocity, the effect is in the opposite direction. Within approximately 0.1 AU it cancels the Poynting-Robertson effect and causes a spiraling outward of the particles.

466. Singer, S. F.
ELECTROSTATIC DUST TRANSPORT ON THE LUNAR SURFACE, by S. F. Singer and E. H. Walker, Icarus, v. 1, no. 2, Sep 62, pp. 112-120, 4 figs., tbl., 12 refs.

Rapid erosion processes have sometimes been postulated to exist on the lunar surface. We show that the most favored process, electrostatic erosion, is not valid. Meteor impact produces a much smaller erosion due to mechanical crushing; its effectiveness is calculated. We also calculate the velocity distribution of the dust particles ejected from the impact.

By considering in detail the charging of these dust particles we can show that a fraction of them will be reflected elastically by the strong electric field in the lunar electronosphere. This process leads to a limited amount of fluidity of the dust.

We conclude that the mass of dust which is "floated" and eventually redistributed forms between 1% and 10% of the

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incident meteoric mass. Over 5 billion years the total amount transported is of the order of 0.4 to 2.0 gm/cm^2 and produces an average layer thickness of 20 to 100 cm in shadow areas.

The surface density of hopping dust particles is between 10-100/meter^2 on the sunlit hemisphere. Dust is deposited preferentially in shadow areas such as crevaces.

467. Skolnick, H.
ANCIENT METEORITIC DUST, Bull. Geol. Soc. Am., v. 72, no. 12, Dec 61, pp. 1837-1842, 2 pls., 2 tbls., 6 refs.

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 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 at least to the late Cretaceous.

468. Smith, C. S.
NOTE ON THE HISTORY OF THE WIDMANNSTÄTTEN STRUCTURE, Geochim. et Cosmochim. Acta, v. 26, Sep 62, pp. 971-972, pl., 8 refs.

A note which is intended to call attention to an additional article, not noticed heretofore, that was published in September, 1815, by F. P. N. Gillet de Laumont, chief editor of the Journal des Mines. De Laumont was not able to use the etched meteorite directly as a typographic surface to print his published sheets, but he prepared colored ink impressions of the Widmannstätten structure to serve as copy for the engraver. A description of de Laumont's observations is included.

469. Southworth, R. B.
DECELERATION OF RADIO METEORS, (Abstract), Astron. J., v. 67, no. 5, Jun 62, p. 283.

Meteors observed with the six-station system of the Harvard Radio Meteor Project show rates of deceleration from 5 to 30 or more km/sec^2. Among shower meteors, the first velocity observed for any one meteor is some one to three km/sec below the no-atmosphere velocity.

Decelerations of this size are predicted by the classical single-body theory, but are also consistent with fragmentation of the meteoroid. Somewhat less than half of the meteors show evidence of fragmentation; either the Fresnel oscillations damp out faster than they would under diffusion alone, or the ionization curve is irregular.

Plasma resonance in the ion column seriously disturbes velocity measures from the Fresnel patterns of meteors of about magnitude 6 or brighter. The average effect, predicted and observed, is a spurious acceleration. Possibly this effect has prevented earlier deceleration measures.

470. Space Technology Labs., Inc., Redondo Beach, Calif.
INTERPLANETARY MATTER: A Bibliography, by L. R. Magnolia, Research Biblio. no. 42, Rept. no. 9990-6058-KU-000, Jun 62, ASTIA AD 276 064, NASA N62-16764, 591 pp., 1650 refs., 5 indices.

This bibliography consists of 1650 references (mostly annotated) on asteroids, comets, cratering, meteorites, meteors, micrometeorites, noctilucent clouds, nonterrestrial dust, origin of the lunar craters, origin of the solar system, tektites, the zodiacal light, and related subjects. The majority of references are those published between January, 1950, and March, 1962. Author, subject, agency, periodical, and ASTIA indices are included.

471. Space Technology Labs., Inc., Redondo Beach, Calif.
INVESTIGATION OF HIGH SPEED IMPACT PHENOMENA, by J. F. Friichtenicht, Contr. NASw-269, Rept. no. 2, Quart. prog. rept. (31 Oct 61-31 Jan 62), Rept. no. 8628-6003-CU-000, 9 Feb 62, 12 pp., 5 figs., 2 refs.

Primary emphasis is placed on those aspects of high speed impact having properties useful in micrometeoroid detection systems. Experiments were conducted concerning impact ionization, gaseous target impacts, and penetration of thin films by high speed particles. Each of these areas of study is discussed in detail.

472. Space Technology Labs., Inc., Redondo Beach, Calif.
INVESTIGATION OF HIGH SPEED IMPACT PHENOMENA, by J. F. Friichtenicht, Contr. NASw-269, Rept. no. 3, Quart. prog. rept. (31 Jan 62-30 Apr 62), Rept. no. 8628-6004-SU-000, 15 May 62, 15 pp., 5 figs.

The major effort was concerned with the study of effects produced by the passage of high speed particles through gaseous targets. The investigation of the impact ionization effect was also continued. The latest measurements made use of an electron multiplier assembly as a diagnostic tool.

473. Space Technology Labs., Inc., Redondo Beach, Calif.
INVESTIGATION OF HIGH SPEED IMPACT PHENOMENA, by J. F. Friichtenicht, Contr. NASw-269, Final rept. (31 Jul 61-30 Sep 62), Rept. no. 8628-6005-RU-000, 28 Sep 62, 34 pp., 11 figs., 4 refs.

During the course of the present program the measurements were restricted to the impact ionization effect, impacts on thin foils, impacts into gaseous media, and tests of various micrometeorite detector components in conjunction with NASA personnel. A small effort was also directed toward the development of an improved particle injector for use with the 2 million volt electrostatic accelerator. Each of these topics is discussed in detail.

474. Space Technology Labs., Inc., Redondo Beach, Calif.
NEW EXPLORATIONS, NEW RESULTS, (NOVYE POISKI, NOVYE REZULTATY), (1961 Tunguska Expedition), by K. P. Florenskii and I. T. Zotkin, trans. by Z. Jakubski, Trans. no. 71, Rept. no. 9990-6346-KU-000, Dec 62, ASTIA AD 294 826, 15 pp., 3 figs., tbl., 10 refs.; trans. of Priroda, no. 8, Aug 62, pp. 31-39.

Details of studies made by the 1961 expedition to the area of fall of the Tunguska "meteorite" are given. The fall, in addition to the initial destruction of the forest, produced subsequent changes in the general ecological conditions of the forest, but these changes are of no importance for an understanding of the nature and composition of the Tunguska "meteorite." It can now be positively stated that a crater which would correspond to the total energy of the fall, does not exist and that the disintegration of the "meteorite" occurred in the air. On the basis of dubious data, there have been opinions expressed that the luminous impulse amounted to 30% of the total energy of the "meteorite," which would imply that its effect was similar to the effect of a nuclear explosion. However, an analysis of the characteristics of the shock wave and of the luminous impulse have not disclosed traces of high energy concentrations at a single point and have indicated that the phenomenon occurred in the presence of low energy densities. The available data indicate the destruction of the forest was caused by the explosion of a cometary body with a nucleus probably about 150 m in diameter, a mass of 10^6 tons (assuming a density of 1 g/cm^3), energy of the order of 10^{25} ergs, with a collision velocity of 45 km/sec. The 1962 expedition to the area of the fall is making further studies.

475. Space Technology Labs., Inc., Redondo Beach, Calif.
SPACE DATA, Ed. by J. B. Kendrick, 1962, 98 pp., 78 figs., 22 tbls., 16 refs.

In selecting material for this booklet, a balance has been sought between applications to current design problems, and other brief notes of interest on space technology. Included are general data on comets, asteroids, and micrometeorites.

476. Stanford Univ., Stanford Electronics Labs., Calif.
BIBLIOGRAPHY OF THE IONOSPHERE. AN ANNOTATED SURVEY THROUGH 1960, by L. A. Manning, Contr. AF 19(604)-6194, Proj. 4603, Rept. no. SEL-62-064, Final rept., May 62, AFCRL 62-188, ASTIA AD 277 749, 613 pp.; also published by Stanford Univ. Press, 1962, 613 pp.

The great majority of papers on the ionosphere published in recognized periodocal journals through 1960 are listed. The period covered goes back to the important pioneer studies of 1925, and in some cases to earlier work. Articles in symposium volumes, books, or technical reports are not included. Papers

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are included if they deal with ionospheric radio propagation, radio studies of the ionosphere, or physics of the ionosphere important to radio studies. Examples of such topics are radio studies of the aurora, rocket studies of the upper atmosphere, eclipse effects on radio propagation, recombination and diffusion processes in the F region, solar effects on the ionosphere, and the formation of ionized meteor trails. Examples of topics excluded are many studies of the geomagnetic field, of the aurora by visual and spectroscopic methods, of solar radio astronomy, and of the design of communications systems.

477. Stanford Univ., Stanford Electronics Labs., Calif.
ON THE VELOCITY DISTRIBUTION OF SPORADIC METEORS, by R. F. Mlodnosky, V. R. Eshleman, and L. A. Manning, Contr. AF 19(604)-7436, Proj. 5631, Rept. no. SEL-62-062, Scientific rept. no. 5, Apr 62, AFCRL-62-192, ASTIA AD 276 679, 17 pp., 4 figs., 9 refs.

The characteristic double-humped geocentric velocity distribution of sporadic meteors is attributed to the scarcity of meteor orbits passing close to the sun. A theory of meteor orbits has been given that includes the effect of the sun in removing low-perihelion particles. Velocity distributions based on the theory are compared with extensive measurements made by others, and it is concluded that the solar effect is the main cause of both the velocity and the marked radiant-distribution nulls for sporadic meteors. The present antiradiant interpretation is contrasted with previous discussions based on fitting radiants to the peaks of the distributions.

478. Stanford Univ., Stanford Electronics Labs., Calif.
THE PROBABILITY OF INTERCEPTING RADIO SIGNALS SCATTERED BY METEOR TRAILS, by U. R. Embry, Contr. AF 30(602)-2398, Proj. 4505, Rept. no. SEL-62-012, Tech. rept. no. 773-1, Mar 62, RADC-TDR-62-249, ASTIA AD 282 334, (OTS $5.60), 50 pp., 26 figs., tbl., 17 refs.

The possibility of detecting communication systems which use signals scattered by meteor trails, and intercepting information passed over such systems is discussed. To obtain the statistical data required on the fraction of meteor trails that scatter energy to an intercept location, and the fraction of transmitted messages that can be intercepted, a computation program is formulated. For a specific distribution of meteor sources, the fraction of meteor trails that will scatter a signal to any point in a large area about the transmitter, and the fraction of message fragments received that can be intercepted at any point in the region about a receiver location, can be readily found. The computed results for a uniform distribution of meteor sources across the sky are displayed graphically. An example is worked out showing that the data can be used to

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estimate the performance of a meteor-scatter communications link. Sample calculations on the probability of detecting the operation of a meteor-burst communications system are carried out. Finding the locations of transmitters using meteor-scatter signals, recognition of operating characteristics, and the interception of information passed over such links are also discussed.

479. Stanyukovich, K. P.
ELEMENTS OF IMPACT THEORY FOR SOLID BODIES HAVING HIGH (COSMIC) SPEEDS, A.R.S. J., v. 32, no. 9, Sep 62, pp. 1459-1471, 7 figs., 4 refs.; see also REVIEWERS COMMENT, by R. L. Bjork, pp. 1471-1473.

The problem of impact upon planetary surfaces of meteorites having cosmic velocities is examined. When impact phennomena with regard to large meteorites is examined, it is necessary to take the force of gravity into consideration when discussing the ejection of explosive products.

The explosion process for explosive charges of various power and caloric energy is investigated in order to determine the dependence of size and shape of the crater and the character of ejection of explosion products on the characteristics of the medium and the acceleration of gravity on the given planet. As a limiting case, the same problems are examined for micrometeorites, where it is possible to ignore gravitational force.

R. L. Bjork, in reviewing this paper, considers that the general approach of the author is subject to strong criticism and that enough sources of error are present to render any agreement with experiment fortuitous.

480. Stanyukovich, K. P.
O DVIZHENII METEORNYKH TEL V ATMOSFERE ZEMLI, (THE MOTION OF METEORIC BODIES THROUGH THE EARTH'S ATMOSPHERE), by K. P. Stanyukovich and V. P. Shalimov, Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 54-71, 3 figs., 3 tbls., 12 refs., (in Russian).

The motion of meteoric bodies through the earth's atmosphere is investigated by applying two different methods depending on the relation between the mean free path of atmospheric molecules, λ, and the dimensions of a body, r. The collision of single atmospheric molecules with the body at high altitudes, where $\lambda \gg r$, is discussed. If the velocity of the body is high (of the order of tens of km/sec), each collision leads to micro-explosion phenomena. Both ablated and fragmented mass are ejected from the surface of the body. The ejection velocity of shattered material is less than the thermal velocity; (i.e., less than the velocity which corresponds to the vaporization temperature); the reactive impulse of the shattered material is higher than that of ablated material. This leads to

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estimate the performance of a meteor-scatter communications link. Sample calculations on the probability of detecting the operation of a meteor-burst communications system are carried out. Finding the locations of transmitters using meteor-scatter signals, recognition of operating characteristics, and the interception of information passed over such links are also discussed.

479. Stanyukovich, K. P.
ELEMENTS OF IMPACT THEORY FOR SOLID BODIES HAVING HIGH (COSMIC) SPEEDS, A.R.S. J., v. 32, no. 9, Sep 62, pp. 1459-1471, 7 figs., 4 refs.; see also REVIEWERS COMMENT, by R. L. Bjork, pp. 1471-1473.

The problem of impact upon planetary surfaces of meteorites having cosmic velocities is examined. When impact phennomena with regard to large meteorites is examined, it is necessary to take the force of gravity into consideration when discussing the ejection of explosive products.

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480. Stanyukovich, K. P.
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The motion of meteoric bodies through the earth's atmosphere is investigated by applying two different methods depending on the relation between the mean free path of atmospheric molecules, λ, and the dimensions of a body, r. The collision of single atmospheric molecules with the body at high altitudes, where $\lambda \gg r$, is discussed. If the velocity of the body is high (of the order of tens of km/sec), each collision leads to micro-explosion phenomena. Both ablated and fragmented mass are ejected from the surface of the body. The ejection velocity of shattered material is less than the thermal velocity; (i.e., less than the velocity which corresponds to the vaporization temperature); the reactive impulse of the shattered material is higher than that of ablated material. This leads to

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a greater deceleration and to an increase of the resistance coefficient. Laws of decrease of mass and velocity are derived.

The motion of a body in a dense atmosphere, where processes are described by equations of gasdynamics is discussed. A shock wave is generated in front of the body; an approximate computation of the parameters of the shock wave is made. Deceleration, heating, and ablation of the body are discussed. Radiation of the air heated in the shock wave is of great significance. Results of computations of ablation and deceleration of meteorites with respect to altitude are given.

481. Stanyukovich, K. P.
"The Role of External Cosmic Factors in the Evolution of the Moon," by K. P. Stanyukovich and V. A. Bronshten, Chapt. VIII, pp. 304-337, 13 figs., 2 tbls., 22 refs.; in THE MOON: A RUSSIAN VIEW, Ed. by A. V. Markov, Univ. Chicago Press, 1962, 391 pp.

All the present-day theories of the origin of lunar craters which have scientific value and are seriously considered in the astronomical literature can be divided into two groups: (a) theories of the endogenetic origin of the craters, which explain the formation of the latter through the action of internal forces (in particular, volcanic forces); and (b) theories of the exogenetic origin of the craters, which connect the formation of craters as with the falling of meteorites on the moon. The meteoritic theory is investigated in detail. Discussed are: (1) structural features of the craters; (2) the distribution of craters on the surface of the moon; (3) the formation of maria and clefts; (4) the theory of explosive phenomena in the impact of meteorites on the moon; and (5) the formation of light-colored rays on lunar craters.

482. Staplin, F. L.
MICROFOSSILS FROM THE ORGUEIL METEORITE, Micropaleontology, v. 8, no. 3, Jul 62, pp. 343-346, 15 figs., 8 refs.

Paylnological treatment of a sample from the Orgueil meteorite, a black carbonaceous chondrite, yielded new acid-resistant microfossils. The assemblage does not compare with any of Cambrian to Recent age. Most of the fossils have some similarity to unicellular algae with acid-resistant pellicles. Caelestites sexangulatus n. gen., n. sp. and Clausisphaera fissa n. gen., n. sp. are described. Recent contaminants, and a very few Cretaceous ones, were noted in the residue.

483. Starik, I. E.
K VOPROSU O PROISKHOZHDENII TEKTITOV, (ON THE PROBLEM OF THE ORIGIN OF TEKTITES), by I. E. Starik, E. V. Sobotovich, M. M. Shatz, and S. M. Grashchenko, Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 97-103, 4 figs., tbl., 18 refs., (in Russian); also published by the National Aeronautics and Space Administration, Washington, D.C., as ON THE QUESTION OF THE ORIGIN OF TEKTITES, Tech. trans. TT F-113, Dec 62, (OTS $0.50), 10 pp.

Continued

The hypothesis of the terrestrial origin of tektites is discussed. The abundance of U and Pb as well as the isotopic composition of Pb are determined for one philippinite, three indochinites, two moldavites, one australite, and a sample of Libyan Desert glass. The U/Pb ratios and the variations of Pb isotopes are considered in determining the abundance of primordial lead, the time of accumulation of radiogenic lead, and the probable time of tektite separation from their parent terrestrial formations (sedimentary and volcanic rocks). The results obtained by application of statistical and mathematical methods appear to disprove the hypothesis of the terrestrial origin of tektites. Their meteoritic origin can be disproved in a similar way. On the other hand, the results obtained do not contradict the Cherry-Taylor extraterrestrial-terrestrial hypothesis that tektites originate through the fusion of cometary material with terrestrial rocks.

484. Starik, I. E.
K VOPROSU OB IZOTOPNOM SOSTAVE SVINTSA ZHELEZNYKH METEORITOV, (ON THE PROBLEM OF THE ISOTOPIC COMPOSITION OF LEAD IN IRON METEORITES), by I. E. Starik, E. V. Sobotovich, G. P. Lovtsyus, M. M. Shats, and A. V. Lovtsyus, Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 103-113, 4 tbls., 18 refs., (in Russian).

Iron meteorites from the following groups were investigated: hexahedrites, octahedrites, ataxites, and troilite inclusions in iron meteorites; in all, 14 meteorites and 6 troilite inclusions were analyzed. The lead content in the metallic phase of the meteorites was found to be in the range $n \times 10^{-7}$ to $n \times 10^{-8}$ g/g and 1 to 2 orders of magnitude higher in troilites. According to their isotopic composition, the meteorites can be divided into two groups: (1) a group containing primordial lead; and (2) a group containing lead with ages varying from tens to several hundreds of millions of years, corresponding to the ages of terrestrial leads. To the first group belong the following meteorites: Bishtyube, Burgavli, Canyon Diablo, Toluca, and Yardymly. The second group contains: Avgustinovka, Boguslavka, Chebankol, Chinge, Gressk, Henbury, Sikhote-Alin', Tubil, i.e., many hexahedrites and ataxites. As a rule, the lead in troilite is of the same composition as the lead from the metallic phase. Analyses of the uranium in the aforementioned meteorites would make it possible to determine the processes which lead to the transformation of the primordial lead.

485. Starik, I. E.
URAN I SVINETS V TEKTITAKH, (URANIUM AND LEAD IN TEKTITES), by I. E. Starik, E. V. Sobotovich, M. M. Shats, and G. P. Lovtsyus, Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 204-207, 3 tbls., 14 refs., (in Russian).

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The abundances of uranium and lead are determined in 3 indochinites, 2 moldavites, one philippinite, and a specimen of Libyan Desert glass. The results obtained and the isotopic compositions of lead and uranium are presented in tabular form. The Pb/U ratio is found to vary from 0.56 to 5.9, and its mean value is much less than that of terrestrial sedimentary rocks. The results obtained cast serious doubts concerning the terrestrial origin of tektites inasmuch as the data make it necessary to assume that some comparatively recent differentiation process occurred in sedimentary rocks which caused a decrease in lead abundance.

486. Stauffer, H.
COSMIC-RAY-PRODUCED STABLE ISOTOPES IN IRON METEORITES, by H. Stauffer and M. Honda, J. Geophys. Research, v. 67, no. 9, Aug 62, pp. 3503-3512, 2 figs., 8 tbls., 18 refs.

The isotopic composition of vanadium, calcium, and potassium extracted from several iron meteorites was measured. The isotopes V^{50}, Ca^{46}, Ca^{43}, and K^{40} were found to be strongly enriched by cosmic-ray-induced spallation reactions. The concentrations of these isotopes were determined by isotopic dilution techniques. The results are compared with data on cosmogenic Sc^{45} and rare gas isotopes in order to determine the distribution of stable spallation products. The concentration $C(A,Z)$ of a stable spallation product can be given as a function of the total mass loss $\Delta A = 56 - A$ by the equation

$$C(A,Z) = \gamma(A,Z)k_1(\Delta A)^{-k_2} ;$$

where $\gamma = 1$ for cumulative and $0 < \gamma < 1$ for noncumulative isotopes. This equation is experimentally verified for a wide range of ΔA. The constants k_1 and k_2 were calculated for each meteorite. Especially from the constants k_2 we obtain information concerning the location of the samples inside of the preatmospheric meteorite bodies. Exposure ages were estimated by comparing the concentrations of K^{40} with those of stable isotopes. Comparison with Cl^{36}-Ar^{36} exposure ages indicates an essentially constant cosmic-ray bombardment during the time of exposure.

487. Stauffer, H.
MULTIPLE FALL OF PŘÍBRAM METEORITES PHOTOGRAPHED, III. RARE GAS ISOTOPES IN THE VELKA STONE METEORITE, by H. Stauffer and H. C. Urey, Bull. Astron. Insts. Czech., v. 13, no. 3, 1962, pp. 106-108, 3 tbls., 10 refs.

The abundance and isotopic composition of argon, neon and helium extracted from the Příbram chondrite was measured. The argon-potassium age of 3.7×10^9 years was calculated. This exposure age with precise elements of the orbit would lead to an apparent A/K age of 4.0 AE. The suggestion of lunar origin of chondrites is discussed.

488. Stauffer, H.
ON THE PRODUCTION RATIOS OF RARE GAS ISOTOPES IN STONE METEORITES, J. Geophys. Research, v. 67, no. 5, May 62, pp. 2023-2028, 5 tbls., 15 refs.

The abundances and isotopic compositions of argon, neon, and helium extracted from eight stone and four stony-iron meteorites were determined, and argon-potassium ages were calculated. The production ratios of cosmic-ray-produced isotopes were compared with the chemical composition of the samples. It was found that the ratios Ne^{21}/Ar^{38} may be predicted with an accuracy of usually better than 20 percent by the equation

$$\frac{Ne^{21}}{Ar^{38}} = 2.9 \times \frac{(Si) + 1.35(Al) + 6.8(Mg)}{(Fe) + 16.5(Ca)}$$

where (Si), (Al), (Mg), (Fe), and (Ca) are the concentrations of the corresponding elements. It is concluded that the cosmogenic ratios He^3/Ne^{21}, He^3/Ar^{38}, and Ne^{21}/Ar^{38} in stone meteorites are determined essentially by the chemical composition of the samples only and that differences in shielding and possible diffusive losses are of minor importance.

489. Stawikowski, A.
LE SPECTRE DE LA COMÈTE MRKOS (1957d) DANS LA RÉGION λ3884-λ4737, (THE SPECTRUM OF COMET MRKOS (1957d) IN THE REGION λ3884-λ4737), Bull. Soc. Roy. Sci. Liege, v. 31, nos. 5-6, 1962, pp. 414-433, 6 tbls., 20 refs., (in French).

An excellent high dispersion spectrogram of comet Mrkos (1957d) obtained by Dr. J. L. Greenstein has been studied in the blue-violet region. The band systems which are present in this region are described and compared with those of comet Burnham (1959k); the latter was observed at a greater heliocentric distance, using a similar resolution.

490. Stephenson, W. B.
INVESTIGATION OF HIGH-SPEED IMPACT: A TECHNIQUE, Aerospace Eng., v. 21, no. 11, Nov 62, pp. 10-16, 15 figs., 8 refs.

Impacts by spherical, metal projectiles have been obtained at velocities from one to eight km/sec in the AEDC impact ranges. Velocities up to little over 9 km/sec (30,000 ft/sec) have been obtained using light, plastic projectiles in another range at AEDC. It is believed that the maximum speeds that will be reached by two-stage launchers of the type described will be in the neighborhood of 10 to 11 km/sec (33,000 to 36,000 ft/sec). Since impact velocities up to 75 km/sec (250,000 ft/sec) are of interest in space flight, development of theoretical methods appears essential to the prediction of meteoroid effects.

491. Stoenner, R. W.
TESTS OF THE SPATIAL CONSTANCY OF COSMIC RADIATION WITH THE HARLETON METEORITE, (Abstract), by R. W. Stoenner and R. Davis, Jr., J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3601.

Measurements were made of the Ar^{37} and Ar^{39} activities in the iron phase, the stone phase, and the unseparated Harleton meteorite (fell May 30, 1961) and the Ehole meteorite (fell August 31, 1961). The results are given in the table.

	Ar^{39} Activity dis $min^{-1}kg^{-1}$	Ar^{37}/Ar^{39}
Harleton meteorite	9.2 ± 0.4	1.02 ± 0.13
Harleton, iron phase	23.2 ± 1.1	0.84 ± 0.11
Harleton, stone phase	7.0 ± 0.4	1.58 ± 0.25
Ehole meteorite	8.2 ± 0.3	1.65 ± 0.29

The Ar^{37}/Ar^{39} ratio observed for the iron phase of Harleton meteorite is the same as the relative production cross sections for these isotopes from proton bombardment of iron, 0.83 ± 0.04, indicating spatial constance of cosmic radiation in the range 0.2 to 2.0 bev. The activity ratios observed for the whole meteorite and the stone phase will be compared with ratios observed for these samples bombarded with 3-bev protons. The tritium activity observed for the Ehole meteorite was 302 ± dis min^{-1} kg^{-1}.

492. Storebø, P. B.
RAINFALL INITIATION BY METEOR PARTICLES, Nature (London), v. 194, no. 4828, 12 May 62, pp. 524-527, fig., 10 refs.

The computations presented indicate that meteor particles may act as raindrop initiators in clouds by the simple process of collision with cloud droplets. The semi-theoretical formulae used indicate that a lower size limit for this effect exists close to 10μ diameter. Combined with an upper size limit for particles occurring after a meteor shower of about 10μ, this may give a narrow size range for drop-forming particles. It is an open question if such an influence will increase the rainfall over a long period.

493. Suess, H. E.
RADIOCARBON CONTENT AND TERRESTRIAL AGE OF TWELVE STONY METEORITES AND ONE IRON METEORITE, by H. E. Suess and H. Wänke, Geochim. et Cosmochim. Acta, v. 26, Apr 62, pp. 475-480, 2 tbls., 17 refs.

The radiocarbon content of twelve stony meteorites, six with observed time-of-fall and the others finds, and that of an iron, (Aroos), has been determined in the La Jolla Radiocarbon

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Laboratory. The average contemporaneous radiocarbon content of the falls was found to correspond to 48.2 disintegrations/min. A much lower value of 5.4 disintegrations/min was found for the iron. Of the six finds, two were found to be Pleistocene. The average C^{14} content of the finds investigated indicates that terrestrial ages of the order of a thousand years are quite common.

494. Sutton, A.
"Meteors," Chapt. 16, pp. 280-293, 24 refs.; in NATURE ON THE RAMPAGE, by A. and M. Sutton, New York, J. B. Lippincott, 1962, 328 pp.

A nontechnical account of meteors, meteorites and comets, including extracts from old eyewitness reports.

495. Swings, P.
COMPORTEMENT DES RAIES INTERDITES DE L'OXYGENE DANS LES COMETES, I. OBSERVATIONS, (BEHAVIOR OF FORBIDDEN OXYGEN LINES IN COMETS, I. OBSERVATIONS), Ann. Astrophys., v. 25, no. 3, May-Jun 62, pp. 165-170, 4 tbls., 4 refs., (in French).

The forbidden lines of [OI] are present in many cometary spectra. Sometimes the auroral transition λ5577 is strongest, sometimes the nebular transition λ6300-6364. The behavior of [OI] in various comets is described.

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496. Taylor, G. E.
THE DIAMETERS OF MINOR PLANETS, J. Brit. Astron. Assoc., v. 72, no. 5, 1962, pp. 212-214.

Observations of occulations of stars by the asteroids Juno and Pallas have yielded minimum values for their diameters of 110 km and 430 km, respectively.

497. Taylor, H. P., Jr.
OXYGEN ISOTOPE STUDIES ON THE ORIGIN OF TEKTITES, by H. P. Taylor, Jr., and S. Epstein, J. Geophys. Research, v. 67, no. 11, Oct 62, pp. 4485-4490, 2 figs., 2 tbls., 17 refs.

O^{18}/O^{16} ratios of thirteen tektites from Czechoslovakia, Libya, Texas, Indochina, Philippine Islands, Australia, Java, and Peru have been determined by the fluorine-extraction technique. All but one of these lie in relatively restricted range of O^{18}/O^{16} ratio, with $\delta = 9.6$ to 10.4 per mil relative to the ocean-water standard. Tektites are therefore 0.5 to 1.5 per mil heavier than average granitic igneous rocks or about

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the same as average igneous quartz. The sample from Macusan, Peru (δ = 12.0), is anomalous and is probably not a true tektite. Six analyzed shales are isotopically heavier than tektites and show a much wider range in values (δ = 14.2, 14.8, 15.3, 15.5, 17.6, 18.2). Several detrital sedimentary rocks previously analyzed by Silverman and the present authors have δ values of 10.2 to 15.5; analyzed metasedimentary rocks have δ values of 12.1 to 15.7 per mil. Therefore, tektites are not sedimentary or metasedimentary material fused by lightning or by impact of an astronomical body with the earth. Chemically, tektites are unlike terrestrial igneous rocks, and their oxygen isotopic composition is unlike that of sedimentary or metasedimentary rocks. They therefore may be extraterrestrial objects.

498. Taylor, S. R.
THE CHEMICAL COMPOSITION OF AUSTRALITES, Geochim. et Cosmochim. Acta, v. 26, Jul 62, pp. 685-722, 13 figs., 11 tbls., 64 refs.

Seventeen complete and an additional seven partial analyses of australites are given, with details of analytical methods. The average composition is as follows: P, 150 ppm; Si, 34.32%; Al, 6.10%; Ga, 8.1 ppm; Cr 77 ppm; Mg 1.24%; Li, 42 ppm; Ti, 3960 ppm; Ni, 29 ppm; Co, 15 ppm; Cu, 8.1 ppm; Fe, 3.56%; V, 78 ppm; Zr, 400 ppm; Mn, 770 ppm; Sc, 13 ppm; Na, 0.95%; Ca, 2.50%; Sr, 210 ppm; K, 1.89%; Ba, 630 ppm; Rb, 81 ppm; Cs, 2.5 ppm. The analytical data are discussed element by element, and compared with the abundances in chondrites, in several types of igneous rocks, and in sediments. Determinations of Ag, B, Be, Ge, Pb, Ra, Sn, Th, U and Y by other workers are tabulated. The closest match among terrestrial materials to australite composition is given by a mixture of 75% shale and 25% quartz, (corresponding to a sediment intermediate between shale and subgreywacke) which contains zircon and calcite as separate components. This composition accounts for the observed element relationships. Of the elements determined here, all show a significant inverse correlation with SiO_2 except Fe^{3+} and Zr, which display positive correlations, and Cu, P, Ga, Co, Ca and Sr, which show no significant relation with SiO_2. The chemical boundary conditions for place of tektite origin are specified. It is concluded that the parent material for australites came from the surface of the earth, or a planet similar to the earth, which possesses a differentiated crust, an oxidizing atmosphere, probably a hydrosphere, and which has had a similar history.

499. Taylor, S. R.
CONSEQUENCES FOR TEKTITE COMPOSITION OF AN ORIGIN BY METEORITIC SPLASH, Geochim. et Cosmochim. Acta, v. 26, Sep 62, pp. 915-920, 3 tbls., 8 refs.

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Calculations have been made of the contribution to tektite composition from admixture of meteoritic material assuming an origin for tektites as splash from meteoritic impact. This contribution cannot exceed about 0.1 percent for chondrites or 0.03 percent for irons for most tektites. For the groups from Central Java, Billiton, Borneo and South Indochina, with larger nickel and chromium contents, the contribution from a chondritic source will not exceed about 1.3 percent, or 0.2 percent for irons. Contributions from achondrites do not produce the observed Cr/Ni ratios. Necessary boundary conditions for the meteoritic splash hypothesis seem to include a near maximum impact velocity and negligible meteoritic contamination of the splashed material.

500. Taylor, S. R.
FUSION OF SOIL DURING METEORITE IMPACT, AND THE CHEMICAL COMPOSITION OF TEKTITES, Nature (London), v. 195, no. 4836, 7 Jul 62, pp. 32-33, 3 tbls., 19 refs.

Some of the difficulties inherent in the proposal by Schwarcz (Nature (London), v. 194, no. 4823, 7 Apr 62, pp. 8-10), that tektites originate by fusion of soil at meteoritic impact sites are discussed. It is found that loess is very much closer in composition to tektites than any other common terrestrial material, the use of which implies only a surficial melting (without deep excavation of a crater) as envisaged by Urey's comet hypothesis (Nature (London), v. 179, no. 4459, 16 Mar 57, pp. 556-557).

501. Taylor, S. R.
GEOCHEMICAL AND GEOLOGICAL EVIDENCE FOR THE ORIGIN OF DARWIN GLASS, by S. R. Taylor and M. Solomon, Nature (London), v. 196, no. 4850, 13 Oct 62, pp. 124-126, 2 figs., 2 tbls., 19 refs.

A report is presented on preliminary findings of a geological investigation of the occurrence of Darwin glass and of chemical analyses thereof. The glass cannot be slag, because it is within soil that was formed prior to modern occupation and the glass is not at all like the slag from the Crotty smelters. The trace element data show a general similarity with that for sandstones, except that the sodium is lower, and iron, and, in particular nickel and chromium (and cobalt in Group I) are significantly higher in the glass. The presence of high concentrations of titanium and zirconium is to be expected in sandstones containing resistant minerals such as rutile and zircon. The high concentrations of iron and nickel are consistent with a meteoritic impact.

502. THREE BRIGHT FIREBALLS IN SPRING SKIES, Sky and Telescope, v. 23, no. 6, Jun 62, p. 323.

Descriptions are given of three fireballs of sufficient prominence to make nationwide news which were widely observed on March 31st, April 18th and April 23rd, 1962.

503. Tilles, D.
PRIMORDIAL GAS IN THE WASHINGTON COUNTY METEORITE, J. Geophys. Research, v. 67, no. 4, Apr 62, pp. 1687-1689, tbl., 10 refs.

Some parts of the Washington County meteorite may retain rare gases better than others, the loss rates from small samples being dependent on position in the meteorite. It might be expected that at any single location greater loss of primordial gas has occurred in the time since the formation of the meteorite than of cosmogenic isotopes in the time indicated by the apparent exposure age. Both the parallelism of high and low concentrations of primordial and cosmogenic gas contents in different samples and the larger variations observed for the primordial gas content could thus be explained.

504. Tilles, D.
RADIOACTIVITIES IN THE METALLIC PHASE OF THE HARLETON METEORITE, (Abstract), by D. Tilles, J. DeFelice, and E. L. Fireman, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3604.

We measured tritium, Ar^{37}, and Ar^{39} in the magnetic phase (principally metallic), nonmagnetic phase (principally stony), and whole-rock samples of the Harleton meteorite, and we rechecked Bruderheim after storage for a year. Metallic phase results for Harleton and Bruderheim are compared in the table.

In the metallic phase of Harleton the Ar^{39} content is lower than in Bruderheim, and the Ar^{37}/Ar^{39} ratio is similar to the ratio of measured cross sections in iron. These results indicate that in Harleton the cosmic-ray interactions were con-

	Ar^{37}, dis kg^{-1} min^{-1}	Ar^{39}, dis kg^{-1} min^{-1}	Ar^{37}/Ar^{39}	H^3, dis kg^{-1} min^{-1}
Harleton	16 ± 2	21 ± 2	0.78 ± 0.08	195 ± 10
Bruderheim (1961)		36 ± 6		90 ± 20
(1962)		23 ± 5		75 ± 15

stant in space and time, and they suggest that Harleton may have been more shielded in space than was the measured sample of Bruderheim. Evidence exists for tritium loss in metallic meteorites and in the metallic phase of the Bruderheim meteorite. Variations in tritium retention can be caused by differences of temperature history or of structure. X-ray studies revealed no large difference in the structure of the metallic phases of Bruderheim and Harleton. However, Harleton was crushed 17 days after fall and the tritium in metal measured a day later, whereas the metal in Bruderheim was first separated and its tritium in metal measured 11 months after fall. The interiors of stony meteorites with their lower thermal conductivity are less subject to atmospheric heating than irons. Therefore the H^3/Ar^{39} ratio in the metallic phase of stony meteorites could be a

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sensitive thermometer of temperature at perihelion, if tritium loss during atmospheric heating, room-temperature storage, and sawing and crushing has not occurred.

505. Tsikulin, M. A.
PRIBLIZHENNAYA OTSENKA PARAMETROV TUNGUSSKOGO METEORITA 1908G. PO KARTINE RAZRUSHENII LESNOGO MASSIVA, (AN APPROXIMATION OF THE PARAMETERS OF THE TUNGUSKA METEORITE OF 1908 BASED ON FOREST DESTRUCTION), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 87-94, 2 figs., 3 refs., (in Russian).

A ballistic shock wave reflected from the ground was responsible for forest destruction in the area of fall of the Tunguska meteorite. The effect of a ballistic shock wave, which is generated under conditions of supersonic motion, is analogous to the detonation effect of a cylindrical charge. From model studies it was possible to obtain an experimental dependence of Δp at the wave front with respect to distance from the detonation line. Data from the 1958 Tunguska expedition indicate that major and minor forest destruction occurred within 18 and 32 radii respectively (counting backwards along the trajectory). The corresponding Δp amount to 0.15 and 0.27 kg/cm^2 respectivly. It is assumed that energy generation per unit length, ge, and the velocity of the body were constant. The following were determined: velocity, 10-50 km/sec; altitude over the epicenter, 0.1-0.5 km; diameter, 20-130 m; and density, 0.3-1.5 gm/cm. Total wave energy was equal to 10^6 tons of TNT. The bolide was simulated in model studies by a detonation cord stretched above a plane at an angle, and the trees were simulated by small pegs. Results of the experiment were positive. However, study of the wave front indicates that with ge = constant, the radial destruction of the forest cannot be obtained. In order to produce such destruction, a gradual increase of ge along the detonation line up to approximately four times its initial magnitude would be required at the end of the detonation line. In an actual meteorite explosion the radial effect is apparently caused by fragmentation of the meteorite body which in turn increases energy dissipation in the shock wave.

506. Turski, W.
ON THE ORIGIN OF THE LUNAR MARIA, Icarus, v. 1, no. 2, Sep 62, pp. 170-172, tbl.

The reverse side of the moon is covered by maria to a much smaller extent than is the visible side. This is postulated as being the result of "areas of increased meteor activity": these areas are due to the focussing effect of the terrestrial attraction.

U

507. Urey, H. C.
EVIDENCE REGARDING THE ORIGIN OF THE EARTH, Geochim. et Cosmochim. Acta, v. 26, Jan 62, pp. 1-13, tbl., 35 refs.

A discussion of the evidence of the physical events involved in the origin of the solar system and the earth.

508. Urey, H. C.
LIFELIKE FORMS IN METEORITES, Science, v. 137, no. 3530, 24 Aug 62, pp. 623-624, 626, 628, 2 appens. (by C. Sagan and S. R. Silverman), 22 refs.

At a meeting held 1 May 1962 at the New York Academy of Sciences a group of papers were presented dealing with the organized elements which were observed in carbonaceous chondrites. It is doubtful that a conclusion that these compounds and fossil-like objects either are or are not valid evidence for extraterrestrial life can be drawn at the present time, although the evidence for extraterrestrial life is better now than it was before. The opinions expressed by the microbiologists and micropaleontologists are indeed very impressive. If it can be shown that these hydrocarbons and the "organized elements" are the residue of living organisms indigenous to the carbonaceous chondrites, this would be the most interesting and indeed astounding fact of all scientific study in recent years.

509. Urey, H. C.
ORIGIN OF LIFE-LIKE FORMS IN CARBONACEOUS CHONDRITES, Nature (London), v. 193, no. 4821, 24 Mar 62, pp. 1119-1123, 25 refs.

Although the present evidence is not conclusive, there are good reasons for exploring possible origins of life-like forms in the carbonaceous chondrites other than contamination after their arrival on earth. It is unlikely that they could have evolved on a planetary body existing between Mars and Jupiter, or that they could have originated on Mars. That conditions for the evolution of life could have existed on the moon is improbable. The most probable explanation would seem to be that the moon became contaminated temporarily with water and life-forms from earth early in its history, that these life forms have been preserved there and that they are now returning to earth. This conclusion requires that the lunar surface consist of materials of compositions and physical structures similar to those of the stone meteorites. It also requires that processes capable of transferring water to the moon existed at a remote time and that processes capable of removing objects from the moon exist at the present time.

510. Urey, H. C.
ORIGIN OF TEKTITES, Science, v. 137, no. 3532, 7 Sep 62, pp. 746-748, 6 refs.

An analysis of the lunar theory of the origin of tektites yields no resonably probable way by which tektites can come from the moon and arrive at the earth with the observed distribution of the Asian-Australian field.

511. Utah. Univ., Dept. of Electrical Eng., Salt Lake City
HIGH-VELOCITY IMPACT STUDIES, Contr. AF 49(638)-462, Tech. rept. no. OSR-24, Final rept., (15 Jul 58-30 Sep 61), 31 Oct 61, AFOSR-1937, ASTIA AD 271 470, (OTS $1.60), 14 pp., 11 refs.

An annotated bibliography of the reports prepared under Air Force contract.

Contents:
Introduction.
Publications Under Contract AF 49(638)-462.
Impact-Flash and Spray-Particle Investigations.
Light-Gas-Gun Development.
Impact and Cratering Investigations.

512. Utah. Univ., Dept. of Electrical Eng., Salt Lake City
A LABORATORY INVESTIGATION OF METEOR PHYSICS, by J. R. Jensen and E. P. Palmer, Contr. AF 49(638)-462, Tech. rept. no. OSR-22, 15 Oct 61, ASTIA AD 270 181, (OTS $6.60), 57 pp., 17 figs., 20 refs., 2 appens.

Equations of motion for a single particle traveling in a constant density atmosphere are derived. The aerodynamic drag on the particle and the atmosphere-particle energy transfer resulting in loss of particle mass are considered. It is assumed as an initial condition that steady-state ablation is occurring. Emphasis is placed on determining particle size and absolute luminosity from measurements of distance versus time. Micron-size particles, which travel at velocities in lower meteor range of 10 to 20 km/sec, are produced by impact of spherical steel pellets on a steel target. The leading edge of a cloud of particles was detected and velocities to 15 km/sec were measured. By applying the theory to deceleration measurements, the size of the particles was estimated at approximately 1.0 micron diameter. An improved vacuum firing range was designed to correct for the vacuum and size limitations. An experiment is proposed to utilize the improved system to detect and measure individual particles. Data from the experiments can be compared with theory and the results applied directly to determine in detail the physical phenomena occurring in meteor flight.

513. Utah. Univ., Dept. of Electrical Eng., Salt Lake City
PRECISION MEASUREMENT OF LEAD-TO-LEAD IMPACT, by C. Chiou, R. W. Grow, and E. P. Palmer, Contr. AF 49(638)-462, Tech. rept. no. OSR-23, 31 Oct 61, AFOSR-1938, ASTIA AD 270 009, (OTS $7.60), 67 pp., 41 figs., 18 refs., appen.

Lead spheres having a diameter of 3/16 in. (0.476 cm) were impacted normally at velocities up to 2.0 km/sec upon lead targets at different temperatures. The volume, area, and depth of resulting craters were measured and plotted as a function of either the pellet impacting energy, the pellet momentum, or the pellet velocity.

514. Utah. Univ., High Velocity Lab., Salt Lake City
PENETRATION AND CRATERING, by E. P. Palmer, N. P. Bailey, C. E. McDermott, G. H. Turner, E. Moreno, S. M. Taylor, and J. C. Bryner, Contr. AF 04(647)-942, Quart. rept. no. 4, Final rept. (1 Jul 61-30 Jun 62), Tech. rept. no. UU-9, 39 Jun 62, AFBSD-TDR-62-185, ASTIA AD 284 011, (OTS $12.00), 170 pp., 96 figs., 3 tbls., 51 refs., 3 appens.

Work is reported in the following areas: (1) Wave propagation in nonlinear materials: A previously reported study of wave motion in a bar is summarized and an outline of the extension of the work to more complicated systems is given. (2) Energy distribution in cratering: A summary of measurements of energy partitioning in the impact of steel into lead is given. (3) Transient measurements in hypervelocity impact: Two complete reports on projects for the measurement of subsurface pressure and density and subsurface wave propagation are given. (4) Spray particle measurements: A summary of efforts to utilize spray particles for impact studies is given. It is concluded that it is impractical to use spray particles for impact studies if trajectory studies must be used to measure particle properties. Research on the use of spray articles to investigate meteor physics is summarized.

515. Utah. Univ., Institute of Metals and Explosives Research, Salt Lake City
INVESTIGATION OF HIGH VELOCITY IMPACT AND SOME HIGH EXPLOSIVES PHENOMENA, by R. T. Keyes, Contr. AF 18(603)-100, Final rept., (1 Jul 55-30 Sep 61), 1 Dec 61, ASTIA AD 269 769, (OTS $4.60), 45 pp., 2 figs., 9 tbls., 10 refs.

A summary of the important results obtained in this research is given. The subject matter included: (1) high explosive generators for fast particles; (2) mechanism of cratering in ultra high velocity impact; (3) observations of vaporization accompanying ultra high velocity impact; (4) mechanism for crater expansion in shaped charge penetration; (5) ionization and electron densities in detonating solid explosives;

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(6) electrical fields and electromagnetic radiation from chemical detonations; (7) external detonation generated plasmas; (8) the effect of pressure on the degree of ionization in gaseous detonations; (9) ionization and electrical conductivity and its relationship to the deflagration to detonation transition in solid explosives; and (10) transition to detonation in liquid explosives.

516. Utech, K.
FREQUENCY OF METEORITE FALLS THROUGHOUT THE AGES, Nature (London), v. 193, no. 4810, 6 Jan 62, pp. 56-57, ref.

A note reporting the discovery of cosmic spherules (of the same composition as the Sikhote-Alin spherules extracted from the soil after the fall of that meteorite) from Lower Triassic mud and core samples from north-west German oil wells. The findings suggest that there was meteoric activity long before the Quarternary.

V

517. Van Biesbroeck, G.
COMET OBSERVATIONS, Astron. J., v. 67, no. 6, Aug 62, pp. 422-428.

The positions and magnitudes of the following comets (equinox of 1950) are given: 1959h (P/Schaumasse); 1959i (P/Väisälä); 1959j (Mrkos); 1959k (Burnham); 1960c (P/Reinmuth 2); 1960d (P/Finaly); 1960e (Humason); 1960f (P/Comas Solá); 1960h (P/Brooks 2); 1960i (P/Encke); 1960j (P/Schwassmann-Wachmann 2); 1960k (P/Borrelly); 1960n (Candy); 1961a (P/Forbes); 1961d (Wilson-Hubbard); 1961e (Humason); 1961f (Seki); and P/Schwassmann-Wachmann 1.

518. Van Biesbroeck, G.
LES ANOMALIES DE LA COMÈTE SCHWASSMANN-WACHMANN 1925II, (ANOMALIES OF COMET SCHWASSMANN-WACHMANN 1925 II), Bull. Soc. Roy. Sci. Liege, v. 31, nos. 1-2, 1962, pp. 5-8, 2 figs., (in French).

Comet Schwassmann-Wachmann (1925II) has an eccentricity of 0.14, only slightly less than that of Mercury, and has a period of 16 years. Because of its small inclination to the plane of the ecliptic it is visible throughout its orbit. It is the first comet which can be observed from year to year in the manner of an asteroid. The comet also undergoes some rather striking changes in magnitude, considering that the perihelion and aphelion distances are not greatly different. The variations in brightness caused by expulsion of cometary matter from the head may also account for anomalies found in the motion of comet 1925II.

519. Van Biesbroeck, G.
TAIL ACTIVITY OF COMET HUMASON (1961e), Astrophys. J., v. 136, no. 3, Nov 62, pp. 1155-1156, 2 figs.

During the 24 hour 1 minute interval between two photographs of comet Humason a radical disruption took place, the tail moving away bodily from the nucleus in the direction opposite to the sun. There does not remain any link between the tail and the nucleus, from which emanates an independent fan of streamers such as were visible on the previous days.

520. Vdovyikin, G. P.
BITUMY UGLISTYKH KHONDRITOV GROZNAYA I MIGHEI, (BITUMENS OF THE CARBONACEOUS CHONDRITES GROZNAYA AND MIGHEI), Geokhimiya, no. 2, 1962, pp. 134-139, fig., 3 tbls., 21 refs., (in Russian).

The presence of bituminous components in carbonaceous chondrites, soluble in organic solvents, was noted in the last century. The detailed characteristics of this bituminous matter were given by G. N. Mueller in 1953 for the meteorite Cold Bokkeveld. However, up to the present the character of the bituminous material in carbonaceous chondrites, especially the hydrocarbon portion, has not been clearly defined. In order to solve this problem, a study was made of the bitumens in the meteorites Groznaya and Mighei. The quantitative content of bitumens, determined by cold extraction, is 0.0965% for Groznaya and 0.1573% for Mighei. A quantitative study was made with the aid of luminescent-bituminological, chemical and spectral methods. It was found that bitumens of carbonaceous chondrites are in the main represented by the light reduced part. The elementary composition of the Groznaya bitumens is characterized by low C and H contents. The aliphatic character of the hydrocarbons has been ascertained. In the composition of bitumens there is also an acidic part. The formation of bitumen inclusions took place simultaneously with the condensation of meteoritic matter under conditions of a reducing environment at lowered temperatures (300°C) by chemical processes of polymerization.

521. Ventner, S. C.
OBSERVATIONS OF COMET SEKI-LINES 1962c, Monthly Notes Astron. Soc. Southern Africa, v. 21, no. 6, 30 Jun 62, pp. 89-92, 2 tbls.

Positions and magnitudes are given for comet Seki-Lines during the period February to May, 1962.

522. Verniani, F.
ON THE DENSITY OF METEOROIDS - I: THE DENSITY OF BRIGHT PHOTOGRAPHIC METEORS, Nuovo Cimento, Ser. 10, v. 26, no. 2, 10 Oct 62, pp. 209-230, fig., 3 tbls., 29 refs.

The density of 512 meteoroids has been calculated by means of the ablation theory and photographic data published by Whipple,

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Hawkins and Southworth. After a brief introductory exposition of the present knowledge about meteor density, basic assumptions and procedure employed are described; and the results finally presented. This paper concerns only the density of large bodies, which appear in the sky as fireballs; the second part of the article, to be published soon, will be devoted to faint meteors and to concluding remarks. The existence of several types of meteoroids which differ remarkably in physical constitution is clearly evident. Most fireballs have a porous structure and only about 15% of the samples examined are made up of solid bodies. These results are in agreement with the icy comet model advanced by Whipple in 1950. The density and the distribution of the different types generally varies from one shower to another, though several similarities are evident. Taurids and Perseids have a small percentage of solid bodies of relatively low density (light stone); they are constituted for the most part of porous bodies. The only stream with a large percentage of solid bodies (iron, stone and light stone), is Geminids shower. On the contrary all K-Cygnids and most of Leonids are dustballs having an extremely low density. No significant difference is apparent in the relative percentage of solid and porous bodies in sporadic and shower meteors. These results have been obtained by taking as correct the old values of meteor masses: it is shown that, if one introduces into the values of masses the factor of about 200, advanced recently by Cook and Whipple, one reaches several values for meteor density, which are clearly too low.

523. Vinogradov, A. P.
ATOMNYE RASPROSTRANENNOSTI KHIMICHESKIKH ELEMENTOV SOLNTSA I KAMENNYKH METEORITOV, (ATOMIC ABUNDANCES OF CHEMICAL ELEMENTS IN THE SUN AND IN STONY METEORITES), Geokhimiya, no. 4, 1962, pp. 291-295, 4 figs., tbl., 35 refs., (in Russian).

In his early works the author proceeded from the idea that meteoritic matter was the material of the earth's mantle. Therefore he compared experimental data on the abundance of elements in the sun and in stony meteorites, not resorting to interpolation. The atomic abundance of elements proved to be similar. In both cases the abundance of elements without exception is regulated by the Oddo-Harkins rule and by the rule of decrease of element abundance in the ranges of each vertical line of Mendeleev's system (from light elements to heavy ones). Short conclusions are drawn; a more detailed consideration of this problem will be presented in the future.

524. Viste, E.
COSMIC-RAY EXPOSURE HISTORY OF TEKTITES, by E. Viste and E. Anders, J. Geophys. Research, v. 67, no. 7, Jul 62, pp. 2913-2919, 2 figs., 3 tbls., 25 refs.

Continued

To establish whether tektites are extraterrestrial in origin, five composites including a total of 79 tektites from the Far East and Australia were examined for cosmic-ray-induced Al^{26} by γ-γ coincidence spectrometry. No activity was found in any of these samples, corresponding to 2σ upper limits for the Al^{26} content of ≤ 1.6 to ≤ 8 dpm/kg, or about ≤ 3 to ≤ 13 percent of Al^{26} content of meteorites. A grand composite of all the above samples showed a marginal positron activity corresponding to an Al^{26} content of 0.48 ± 0.26 dpm/kg, but this activity can apparently be accounted for by reactions of cosmic-ray secondaries at the surface of the earth with silicon and aluminum in the tektites. No evidence was found for a preterrestrial exposure to cosmic rays. These results do not completely rule out an extraterrestrial origin but do place the following restrictions on it: if the tektites arrive as small, unshielded bodies, their "flight" or cosmic-ray exposure time was less than 90,000 years; if they arrived in a large, well-shielded body, this "prototektite" body must have had a radius of ≤ 54 meters.

525. Vogel, R.
ERGEBNISSE TERNÄRER ZUSTANDSDIAGRAMME DES EISENS, ANGEWANDT AUF FRAGEN DER KOSMOCHEMIE, (THE IRON TERNARY PHASE DIAGRAM AND ITS APPLICATION TO COSMOCHEMISTRY), Chem. Erde, v. 21, no. 1, 1961/62, pp. 24-47, 5 figs., 4 tbls., 11 refs., (in German).

In the case of meteorites, whose structure is used as the basis of earth models, the affinity between metals and sulfur is of great interest since it provides a possibility of comparing the sulfur affinities of ternary systems with the available meteoritic data. This should make it possible to obtain further information as to the nickeliferous iron-troilite phase system. Discussed are: (1) the affinity between metals and sulfur, and the sulfur distribution in nickeliferous and troilite phases of meteorites; (2) the existence and the relative thickness of a sulfide layer in meteorite bodies and the absolute thickness of the terrestrial sulfide stratum; and (3) summary.

526. Volz, F. E.
THE INTENSITY OF THE TWILIGHT AND UPPER ATMOSPHERIC DUST, by F. E. Volz and R. M. Goody, J. Atmospheric Sci., v. 19, no. 5, Sep 62, pp. 385-406, 17 figs., 2 tbls., 50 refs.

Absolute intensities have been measured over the whole twilight at an angle of elevation of 20° in an attempt to derive quantitative data on dust concentrations in the mesosphere.

With the aid of model computations based on single scattering we have been able to separate the effects of cloud and haze at the senset point, ozone absorption, the airglow, multiple scattering and mesospheric dust in a series of 93 twilight recordings.

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The effect of ozone absorption on green, orange and red wavelengths is readily interpretable in terms of simple atmospheric models, and can be used as a remarkably accurate measure of the total ozone amount.

Profiles of turbidity are derived up to 65 km and indicate significant quantities of dust at every level. A maximum concentration is commonly observed near 20 km, and corresponds quantitatively to that found by direct sampling by Junge and his colleagues. Above 30 km the dust mixing ratio is constant at about 25 percent of its value at 15 km. This concentration is very small compared with particle concentrations in a noctilucent cloud, but it is consistent with the amounts of matter inferred from the sodium resonant emission in the twilight glow. A seasonal maximum in winter months is also consistent with the sodium twilight glow.

Negative results include: definite evidence against the existence of the 100-150 km haze layer invoked to account for some aspects of lunar eclipses; lack of correlation with meteor shower activity, speaking against Bowen's theory of rainfall anomalies; computations indicating that thermal and photochemical effects of the dust are probably small.

527. Vorob'ev, G. G.
METOD KOLICHESTVENNOGO SPEKTRALNOGO ANALIZA TEKTITOV I SILIKATNOI FAZY METEORITOV, (A METHOD OF QUANTITATIVE SPECTROSCOPIC ANALYSIS OF TEKTITES AND OF THE SILICATE PHASE OF METEORITES), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 185-192, 3 figs., 5 tbls., 4 refs., (in Russian).

The application of spectroscopic analysis to meteorites and tektites is discussed. Out of 78 elements whose existence in the silicate phase of meteorites is known, 19 can be identified effectively and 14 with some limitations, by means of spectroscopic analysis. A method for quantitative determination of 17 elements occurring in meteorites and tektites in the ultraviolet region of the emission spectrum is proposed. Probable determination errors amounting on the average to 8.9% are computed. Comparative spectroscopic and chemical analyses of three meteorites (Tarbagatai, Demina, and Kunashak) and of a tektite (moldavite) are presented. For a more detailed investigation of the composition of meteorites and tektites combined chemical and spectroscopic analyses are recommended.

528. Vorob'ev, G. G.
OPYT ISPOLZOVANNA PERFOKART PRI IZUCHENII PROBLEMY TEKTITOV, (APPLICATION OF PUNCHED CARDS TO THE STUDY OF THE TEKTITE PROBLEM), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 157-161, fig., 6 refs., (in Russian); also published by the National Aeronautics and Space Administration, Washington, D.C., as AN EXPERIMENT IN THE USE OF PUNCHED CARDS IN THE STUDY OF PROBLEMS RELATING TO TEKTITES, Tech. trans. TT F-114, Dec 62, (OTS $0.50), 7 pp.

Continued

The study of the tektite problem, which has been conducted over more than 150 years, is related to several scientific disciplines, such as astronomy, meteoritics, geography, geology, chemistry, and others. Knowledge of the vast tektite literature, as well as processing of the available data, many significantly contribute to the solution of the problem. The application of a punched card system to the problem of tektite information retrieval is discussed. It is proposed that a similar system be applied to the study of meteorites.

529. Vorob'ev, G. G.
SPEKTROKHIMICHESKOE ISSLEDOVANIE MONGOLSKOGO METEORITA NOYAN-BOGDO, (SPECTROCHEMICAL STUDY OF THE MONGOLIAN METEORITE NOYAN-BOGDO), by G. G. Vorob'ev and O. Namnandorzh, Meteoritika, Akad. Nauk S.S.S.R., no. 21, 1961, pp. 60-63, fig., 2 tbls., 8 refs., (in Russian).

A spectrochemical quantitative determination of Na, Mg, Al, Si, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Sr, and Ba in the nonmagnetic fraction and a spectroscopic semiquantitative determination of these elements plus Ag, Ga, and Ge in the magnetic fraction of the Noyan-Bogdo meteorite are presented in tabular form. Sampling methods, preparation of specimens, and evaluation of the results are discussed. A brief description of the history of the fall in 1933 is also given. The petrographic characteristics and the results of chemical analyses made in 1950 permit classification of the meteorite as a chondrite of the fourth group.

530. Voroshilov, M. V.
METEORITNYI KRATER V ZAPADNOM SAYANA, (METEORITIC CRATER IN WESTERN SAYAN), Priroda, no. 3, Mar 62, pp. 107-109, 2 figs., (in Russian).

The existence of a crater, apparently of meteoritic origin, located near the village of Udzhei, Khakas Autonomos Region, R.S.F.S.R., is reported. The crater, partially lake-filled and overgrown with a thick birch forest is elliptical in outline with the major axis almost perfectly oriented southwest-northeast. The approximate length of the major axis is 370-400 m and that of the minor axis is 250-350 m. The elevation of the rim varies from 10-40 m, the slope of which is 45-50°. The crater is formed in loess-like loam, but the surrounding hills in the immediate vicinity are composed of Lower Devonian effusive rocks. It is recommended that a thorough investigation of the area be made in order to prove meteoritic origin of the crater.

531. Voshage, H.
EISENMETEORITE ALS RAUMSONDEN FÜR DIE UNTERSUCHUNG DES INTENSITÄTSVERLAUFES DER DOSMISCHEN STRAHLUNG WÄHREND DER LETZTEN MILLIARDEN JAHRE, (IRON METEORITES AS SPACE SAMPLES FOR RESEARCH OF INTENSITY VARIATIONS OF COSMIC RAYS DURING THE LAST BILLION YEARS), Z. Naturforsch., v. 17a, no. 5, May 62, pp. 422-432, 6 figs., 2 tbls., 36 refs., (in German).

The use of iron meteorites for the establishment of possible long-time variations (10^8 - 10^9 years) of the cosmic ray intensity in interplanetary space is based upon the study of the production rates of nuclides which are formed by the interaction of cosmic ray particles with nuclei in meteorites. Mass spectrometric measurements of the isotopic composition of meteoritic potassium are combined with data on cosmogenic rare gases and other elements to give K^{41}-K^{40}-exposure ages and rare gas production rates. The K^{41}-K^{40}-exposure ages are larger than the exposure ages obtained from the study of short-lived activities (e.g., Cl^{36}, A^{39}), by a factor 1.3 to 1.8. This result indicates that the cosmic ray intensity increased during the bombardment history of the meteorites. The data, for example, are consistent with the following assumptions: (1) The cosmic ray intensity was constant during most of the bombarding time and increased by a factor of about 1.5 only a few million years ago. (2) The intensity rose as $I(t) = I_0 e^{-\gamma t}$ with $-1.1 \times 10^{-9} \leq \gamma \leq -0.6 \times 10^{-9}$ a^{-1}. The consequences of this result for the interpretation of meteorite data are discussed.

532. Vronskii, B. I.
O NAKHODKE ZHELEZNOGO METEORITA ELGA, (THE DISCOVERY OF THE IRON METEORITE ELGA), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 47-50, 2 figs., (in Russian).

The Elga meteorite was found on August 28, 1959, in the Razvedchik gold mine, which is located in the basin of the Indigirka river (left tributary of the Elga river), in Yakutsk S.S.R. This is the fifth meteorite found in southeastern Siberia during the period 1939 to 1959. The other four are: Maldyak (1939); Burgavli (1941); Yudama (1946); and Susuman (1957). The Elga is an iron meteorite with stone inclusions. It weighs 28.8 kg. The meteorite was found on a conveyor belt which was being used to transport alluvial gravels extracted from a depth of about 20 m. The meteorite apparently fell many thousands of years ago and penetrated the alluvial deposits, which in turn were covered by erosion products from the neighboring hillsides. In 1950, in the same general area, another iron meteorite, weighing 19 kg, was found. Owing to the carelessness of local authorities it was never studied and was eventually lost.

533. Vsekhsvyatskii, S. K.
COMETS, SMALL BODIES AND PROBLEMS OF THE SOLAR SYSTEM, Publs. Astron. Soc. Pacific, v. 74, no. 437, Apr 62, pp. 106-115, tbl., 16 refs.

It is postulated that planetary bodies lose a very appreciable part of their matter in volcanic eruptions which are responsible for the existence of planet families of comets. The theory accounts for the number of comets in the solar system (mainly parabolic comets) as well as the number of hyperbolic comets leaving the solar system, and also the elliptical ones, which, moving in the sphere of solar influence, must have disintegrated very rapidly. The comets and other small bodies permit the evaluation of the real size of these eruptive losses.

534. Vsekhsvyatskii, S. K.
FIZICHESKIE KHARAKTERISTIKI KOMET, (PHYSICAL CHARACTERISTICS OF COMETS), Moscow, Fizmatgiz, 1958, 575 pp., 45 figs., 23 tbls., 144 refs. (in Russian).

Contents:
Introduction.
The Nature of Comets.
Comet Photometry.
Statistical Analyses of Comet Orbital Elements.
Catalogue of Absolute Magnitudes of Comets.
Observations and Physical Characteristics of Comets.
(Descriptions of 560 Comets, Arranged Chronologically.)

535. Vsekhsvyatskii, S. K.
POSSIBLE EXISTENCE OF A RING OF COMETS AND METEORITES AROUND JUPITER, Soviet Astronomy (AJ), v. 6, no. 2, Sep-Oct 62, pp. 226-235, 3 figs., 5 tbls., 11 refs.; trans. of Astron. Zhur., v. 39, no. 2, Mar-Apr 62, pp. 290-302.

1. The various arguments supporting the eruption theory, which provide a basis for the view that cometary and meteoritic masses orbiting around planets exist, are reviewed. These arguments are: impossibility of accounting for the young age and peculiarities in the motion of short-period comets in terms of capture; the existence of asteroids and meteor streams in the central regions of the solar system; the existence of cometary families in association with the planets Saturn, Uranus, and Neptune; the common features of cometary gases and the chemical structure of planetary atmospheres; characteristics of the system of parabolic comets; the presence of ice in comets; data on the structure and chemical composition of meteorites; evidence of volcanic activity on planetary bodies.

2. Significant changes observed in the Saturnian rings are noted, and data compiled by Otto Struve (19th century) and later observations are studied to find the rate of expansion of the rings and the speed with which they approach the surface of

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the planet. The decrease in the total energy of ring particles is calculated as a minimum of 3×10^{36} ergs over a 300-year interval. Findings indicate that a rapid evolution, at a faster rate than that predicted by earlier estimates, of the ring must be ascribed to replenishment of the ring material and to collision between components of the ring.

3. The reader's attention is drawn to some conspicuous features of Jupiter's equatorial band, and observations of that band are reviewed.

4. It is shown that a correlation of the periods of best visibility of the Jovian equatorial band and the zenographic position of earth and sun and an examination of the position of the band on the disk furnish a powerful argument for the view that the band constitutes the shadow of a comet-meteorite ring surrounding Jupiter and lying in the plane of the planet's equator.

5. Some special features of a hypothetical ring around Jupiter with an optical thickness several tenths smaller than that of the Saturnian ring are discussed, as well as the possibilities of observing such a ring.

W

536. Wallace, R. R., Jr.
EFFECTS OF HYPERVELOCITY PARTICLES ON SHIELDED STRUCTURES, by R. R. Wallace, Jr., J. R. Vinson, and M. Kornhauser, Paper presented at A.R.S. Lifting Re-entry Vehicles: Structures, Materials and Design Conf., Palm Springs, Calif., 4-6 Apr 61, A.R.S. paper 1683-61, 11 pp., 8 figs., 5 refs.; a revised version is published in A.R.S. J., v. 32, no. 8, Aug 62, pp. 1231-1237, 13 figs., 2 tbls., 5 refs.

One of the prime considerations in the design of future re-entry systems is vulnerability. From an offensive point of view optimum hardening is desirable, and from a defensive viewpoint maximum destruction of incoming vehicles is imperative. One defensive measure to which a vehicle may be hardened is the use of hypervelocity projectiles. Furthermore, all vehicles with orbital or space mission capability will be continuously subjected to hypervelocity particles in space (meteoroids). It, therefore, becomes desirable to develop advanced design criterial for efficient, lightweight shielding by investigating each of the parameters involved.

To accomplish this a test program has been conducted in which over 300 hypervelocity projectiles have been fired at structural walls protected by single shields. Projectile material, projectile size, projectile velocity, shield material, shield thickness and shield to wall spacing were the variables investigated. An extensive statistical analysis of variance for the five phases of the test program and a three step breakdown involving each of the above parameters have been made.

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Pertinent results of the test program and statistical analysis are presented, and, based upon these, design criteria, data, and trends are set forth. It was found, as an example, that in these structures over 50% of the external structural weight for single walled particle protection can be saved by proper design and use of meteor bumpers without sacrifice of safety. It is believed that a definite advance in hypervelocity impact knowledge has been attained.

537. Weaving, B.
MAGNETIC ANISOTROPY IN CHONDRITIC METEORITES, Geochim. et Cosmochim. Acta, v. 26, Apr 62, pp. 451-455, 2 figs., tbl., 4 refs.

The magnetic susceptibilities of samples from six chondritic meteorites have all been shown to be anisotropic. The maximum, minimum and intermediate susceptibility directions were constant throughout each meteorite.

538. Weber, R. J.
INFLUENCE OF METEOROID HAZARDS ON SELECTION OF SPACECRAFT PROPELLANTS, A.R.S. J., v. 32, no. 7, Jul 62, pp. 1105-1106, 2 figs., 3 refs.

A note which considers, in a very elementary fashion, the weight of a hypothetical space stage whose propellant tank thickness is determined on the basis of protection from meteoroid damage. In the model considered the storable propellant system is found to be better for long exposure time (500 days) but poorer for short exposure time (10 days). Thus, low impulse propellants may still have a place in the deep-space missions of the future.

539. Welsh, H.
FOSSILS IN METEORITES, J. Brit. Astron. Assoc., v. 72, no. 7, 1962, p. 353.

A note expressing doubt that the "organized elements" in certain meteorites are microfossils indigenous to the meteorites. The chances of a tiny portion of the thin and comparatively scarce fossily-bearing crust of some presumably disintegrated planet reaching the earth are considered infinitesimally small.

540. Wentorf, R. H., Jr.
STISHOVITE SYNTHESIS, J. Geophys. Research, v. 67, no. 9, Aug 62, p. 3648, 2 refs.

Stishovite has been synthesized in the General Electric Research Laboratory from vitreous silica, from silica gel, and also from pyrophyllite, $Al_2Si_4O_{10}(OH)_2$. The X-ray diffraction

Continued

patterns of these preparations agree very nicely with those reported by Stishov and Popova (Geokhimiya, no. 10, 1961, pp. 837-839). When pyrophyllite is used as the starting material, Kyanite, $Al_2O_3 \cdot SiO_2$, is also present in these products.

541. Wexler, H.
GLOBAL ATMOSPHERIC PRESSURE EFFECTS OF THE OCTOBER 30, 1961, EXPLOSION, by H. Wexler and W. A. Hass, J. Geophys. Research, v. 67, no. 10, Sep 62, pp. 3875-3887, 11 figs., 3 refs.

The atmospheric pressure waves set off by the explosion of October 30, 1961, were traced over a large portion of the world. The observed geographic variations in propagation speed and maximum amplitude are examined with the aid of air density and wind analyses. Comparison is made with the waves resulting from the great Siberian meteor of 1908 and the Krakatoa eruption of 1883.

542. Wheelon, A. D.
AMPLITUDE DISTRIBUTION FOR RADIO SIGNALS REFLECTED BY METEOR TRAILS, II, J. Research Nat. Bur. Standards, D. Radio Propagation, v. 66D, no. 3, May-Jun 62, pp. 241-247, fig., 3 refs.; also available from STL as Reprint no. 369.

The bivariate probability distribution for two composite meteor signals displaced in time is derived theoretically using the Markoff statistical combination technique. Both the effects of numerous, small meteors and the residual reflections from infrequent large meteors are treated simultaneously. For the case of exponential decay of component signal spikes which are themselves distributed as the inverse square of their initial amplitudes, we find that the joint probability that a composite signal R_1 is observed at time t_1 and R_2 at t_2, seconds later, is given exactly by the following expression involving elliptic functions:

$$W(R_1,R_2,\tau) = \frac{2}{\pi}\,\frac{\sigma^2(1-e^{-\tau/\eta})}{(R_1^2+\sigma^2)^{3/2}} \cdot \frac{1}{\left[\sigma^2(1-e^{-\tau/\eta})^2 + (R_2-R_1e^{-\tau/\eta})^2\right]}$$

$$\frac{E\left[\sqrt{\dfrac{4R_1R_2e^{-\tau/\eta}}{\sigma^2(1-e^{-\tau/\eta})^2 + (R_2+R_1e^{-\tau/\eta})^2}}\right]}{\left[\sigma^2(1-e^{-\tau/\eta})^2 + (R_2+R_1e^{-\tau/\eta})^2\right]^{1/2}}$$

where $\sigma = Q\nu\eta$ and ν is the average rate of occurrence of meteor signal spikes of all sizes and η is the exponential decay time of each initial spike. This result reduces to the usual limiting forms in the case of τ very large or very small relative to the decay time η.

543. Whipple, F. L.
DUST AND METEORITES, Astronautics, v. 7, no. 8, Aug 62, pp. 40-42, 3 figs.

A survey of measurements of interplanetary dust and micrometeorites. With considerable assurance it is now possible to visualize the small, particulate matter of the solar system as originating primarily in comets, distributed first from typical comet orbits, with a considerable concentration toward the plane of the ecliptic.

544. Whipple, F. L.
METEORITIC EROSION IN SPACE, (Abstract), Astron. J., v. 67, no. 5, Jun 62, pp. 285-286.

Photographic meteor studies and spallation products of cosmic rays in meteorites provide upper limits or evaluations of erosion rates for meteoroids in orbit. The rate increases by several orders of magnitude in the sequence: irons, stones, and photographic meteoroids. The sequence suggests that the erosion rate depends in some inverse fashion upon the strength or brittleness of the materials, a natural expectation if erosion is produced by crater-forming impacts with interplanetary dust. On this assumption and by applying a high-velocity impact theory, the author derives a mean space density for the dust at roughly 10^{-21} g cm^{-3}.

Only the very smallest cometary meteoroids can spiral into the sun by the Poynting-Robertson effect if the assumptions of this paper are true. Strong evidence for a high concentration of dust in the earth's immediate vicinity suggests that erosion rates may be greater near the earth than in deep space from Venus to Mars and even beyond. The surface of space vehicles should be carefully chosen or protected to minimize etching by interplanetary dust, if long exposure times are anticipated. The hazard may be greatest at the moon's surface.

545. Wilson, A. T.
ORIGIN OF PETROLEUM AND THE COMPOSITION OF THE LUNAR MARIA, Nature (London), v. 196, no. 4849, 6 Oct 62, pp. 11-13, fig., 15 refs.

Adopting a cold accretionary hypothesis for the origin of the solar system, it is proposed that the primitive material from which the earth and moon were formed contained a small percentage of high molecular weight hydrocarbon, as do some of the meteorites falling on the earth at the present time (carbonaceous chondrites). During the agglomeration of this material it would have been heated, by release of gravitational heating and radioactive heating. As the temperature approached 400°C the hydrocarbon would have undergone thermal cracking.

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The products of this reaction would flow and be distilled to the surface regions of the planet (or moon). It is suggested that the maria on surface of the moon are the residue of this material after the lighter hydrocarbons have evaporated from the exposed surfaces (that is, vacuum-reduced crude oil or asphalt). It is proposed that on earth this material is petroleum and that it has moved around through porous strata picking up from sedimentary deposits, by solvent extraction, small quantities of biogenic materials.

546. Wilson, D.
SOLAR SYSTEM SCIENCE: 1961 LITERATURE SURVEY, PART I, Icarus, v. 1, no. 1, May 62, pp. 77-93, 349 refs.

A bibliography on the following subjects, arranged by publication date: solar physics; solar-terrestrial relations, interplanetary physics; atmospheric physics; planetary physics; planetary geodesy; planetary geology; solar system dynamics; and cosmogony.

547. Wilson, D.
SOLAR SYSTEM SCIENCE: 1961 LITERATURE SURVEY, PART II, Icarus, v. 1, no. 2, Sep 62, pp. 175-189, 345 refs.

A continuation of Part I (see preceding reference - Ed.).

548. Wilson, D.
SOLAR SYSTEM SCIENCE: 1961 LITERATURE SURVEY, PART III, Icarus, v. 1, no. 3, Oct 62, pp. 286-295, 40 refs.

An annotated bibliography of books arranged in the manner of Parts I and II (see preceding references - Ed.).

549. Witt, G.
HEIGHT, STRUCTURE AND DISPLACEMENTS OF NOCTILUCENT CLOUDS, Tellus, v. 14, no. 1, Feb 62, pp. 1-18, 14 refs.

Observations of noctilucent clouds have been carried out during the summer of 1958 at Torsta (63.3°N; 14.6°E) in Central Sweden as part of the IGY working program of the Institute of Meteorology, University of Stockholm. Simultaneous pairs of cloud photographs have been taken with accurate phototheodolite cameras from the end-points of a geodetically determined baseline of length 51.5 km. The picture pairs were subsequently analyzed in stereo instruments (autographs) by which Cartesian space coordinates were obtained for various points in the cloud system. These coordinates, duly corrected for atmospheric refraction, were used for determination of the height of the individual features. Through the stereoscopic effect, measurements could be made on diffuse parts of the cloud system as well as on marked details. Additional information about movements of the cloud system was obtained from a time-lapse film

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in Kodachrome. The results were plotted and analyzed by conventional methods and maps of the cloud topography at consecutive time intervals could be prepared. In addition to these maps, vertical cross-sections through the cloud system were made as well as detailed studies of particularly interesting cloud features. This paper gives a presentation and interpretation of the results obtained so far and a brief description of the photogrammetric technique applied.

The results presented were obtained during a very bright cloud display with good visibility conditions on August 10-11th, 1958. Thirty pairs of pictures were taken of various parts of the cloud system, which covered the entire northern horizon. Eight of these have been analyzed so far. The results can be summarized as follows. The cloud system moved in a direction north-east to south-west with velocities of the order of 50 to 100 m/s. It consisted of a continuous diffuse layer interchanging with regions of sharply defined features such as systems of parallel billows and bands, blobs and other smaller-scale irregularities of various shapes. The measured heights varied between 81.5 and 85.5 km. The long parallel bands were identified as a system of waves with wavelengths of the order of 50 km and amplitudes up to 4 km which propagated in a direction nearly opposite to that of the cloud system with absolute velocities of the order of 10 to 20 m/s. The wave crests were oriented nearly perpendicular to the main air flow and were continuous over distances of hundreds of kilometers and exhibited local refraction effects. The smaller billows had wavelengths of the order of 5-10 km and amplitudes about 0.5-1.0 km; they moved with the cloud system. The billows showed no preferred orientation and were observed to pass through the crests of the longer waves. It is indicated by the analysis the regular changes in the brightness of these clouds are due to changes of the optical thickness of the cloud layer, particularly at the rear slope of the long waves. The measured details had well-defined lower boundaries.

550. Wood, J. A.
CHONDRULES AND THE ORIGIN OF THE TERRESTRIAL PLANETS, Nature (London), v. 194, no. 4824, 14 Apr 62, pp. 127-130, 3 figs., 11 refs.

Chondrules are solid spheres or spheroids of silicate and metallic minerals (usually mixed) ranging in diameter from 0.5 to 3 mm. No terrestrial geologic process produces structures which resemble chondrules more than superficially. Chondrules may make up roughly 50 percent of the volume of a chondrite. Many chondrites contain fewer chondrules, but these have probably suffered recrystallization which obliterated chondrules during a period of high temperature. Tieschitz and a few other chondrites appear to have been spared this thermal metamorphism. If so, chondrules must earlier have been the dominant structural characteristic of meteoritic material, since 84

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percent of meteorites seen to fall are chondrites. If chondrules are indeed surviving condensations dating back to the origin of the solar system, it is not unreasonable to suppose that the whole system of terrestrial planets accreted from "planetismals" of this type. Conceivably the moon accreted at a late date from chondrules which had been exposed to an oxidizing atmosphere so long that they no longer contained metallic iron. Oxidation of all metallic iron in the "average chondrite" would depress its specific gravity from 3.58 to $\sim$3.4, close to the moon's density of 3.36.

551. Wood, J. A.
METAMORPHISM IN CHONDRITES, Geochim. et Cosmochim. Acta, v. 26, Jul 62, pp. 739-749, 9 figs., 16 refs.

The concept of chondrites as metamorphic rocks is examined. Mineralogies of four chondrites whose textures indicate different degrees of thermal recrystallization are presented. It appears that relatively unmetamorphosed or "primary" chondritic material consisted of reduced chondrules (metallic iron, magnesian silicates) in an oxidized matrix (containing ultrafine-grained magnetite, no metallic iron). It is suggested that chondrules condensed as liquid droplets from cooling solar gases during the formation of the sun, later accreting into planets and asteroids. Such a process could account for the peculiar oxidation-reduction state of relatively unmetamorphosed chondrites, such as Renazzo.

552. Woszczyk, A.
LE SPECTRE DE LA COMÈTE MRKOS (1957d) DANS LA RÉGION VISIBLE, (THE SPECTRUM OF COMET MRKOS, 1957d, IN THE VISIBLE REGION), Bull. Soc. Roy. Sci. Liege, v. 31, nos. 5-6, 1962, pp. 396-413, 2 tbls., 13 refs., (in French).

In the spectral region covered by this study the only characteristic emissions were those of C_2, NH_2, [OI] and NaI. It is possible there was also a weak emission at λ4877 which was due to CH (0-1). None of the other molecules were identified with certainty and there were an appreciable number of unexplained emissions.

553. Woszczyk, A.
MÉCANISME D'ÉMISSION DES BANDES DE SWAN DANS LES COMÈTES, (THE EMISSION MECHANISM OF SWAN BANDS IN COMETS), by A. Woszczyk and C. Arpigny, Bull Soc. Roy. Sci. Liege, v. 31, nos. 5-6, 1962, pp. 382-389, 4 tbls., 5 refs., (in French).

High resolution spectrograms of comet 1957d reveal irregularities in the rotational intensity distributions of the $\Delta_v = 0$ and -1 sequences of swan bands. These complex profiles may be assigned to the fluorescence excitation mechanism.

554. Wright, F. W.
SPACE DENSITY OF DUST IN THE STRATOSPHERE, by F. W. Wright and P. W. Hodge, Nature (London), v. 195, no. 4838, 21 Jul 62, p. 269, tbl., 6 refs.

The Smithsonian meteoritic dust program has included a number of aerosol collections made by various aircraft in different altitude ranges. It has been determined that the density of meteoritic particles is approximately $3/m^3$ at 45,000 ft. Approximately 2×10^8 kgm of this material fall to earth per year.

555. Wright, R.
TEKTITES FROM TEXAS, Rocks and Minerals, v. 37, nos. 11/12, Nov-Dec 62, pp. 569-571, 3 figs.

A nontechnical account of searching for tektites in Grimes County, Texas.

556. Wurm, K.
DIE IONISIERUNG IN DEN KOMETEN, (IONIZATION IN COMETS), Icarus, v. 1, no. 2, Sep 62, pp. 144-150, 2 figs., 10 refs., (in German).

New arguments are added to those published earlier which support the view that the ionization of the molecules in comets is intrinsic to the cometary atmospheres themselves. The ionization occurs within a very limited region in front of the nucleus and the ions are expelled only within a small cone directed towards the sun, and in the form of narrow rays. The outbursts have next a high velocity (estimated at 30 to 50 km/sec), which decreases after about 15 to 20 hours to a few km/sec. Each outburst leads to the formation of a shrinking parabolic envelope around the nucleus. The shrinking of the envelopes is accompanied by a closing-in of the tail rays to the tail axis. -- The true mechanism of ionization (which must be a kind of discharge) remains as yet obscure.

Y

557. Yavnel', A. A.
O ZAVISIMOSTI STRUKTURY ZHELEZNYKH METEORITOV OT KHIMICHESKOGO SOSTAVA I USLOVII KRISTALLIZATSII, (DEPENDENCE OF IRON METEORITE STRUCTURE ON CHEMICAL COMPOSITION AND CRYSTALLIZATION CONDITIONS), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 114-120, 2 figs., 2 tbls., 11 refs., (in Russian).

The dependence of the width of kamacite needles on nickel abundance in Ga-Ge groups of iron meteorites can be explained by differential crystallization conditions of meteoritic iron.

Continued

In order to determine the cooling rate variations of meteoritic iron and variations of its final temperature during the slow cooling period, local spectroscopic analysis of phase composition was made. Three iron meteorites (Henbury, Boxhole and Bethany) having equal nickel content but belonging to different Ga-Ge groups were examined. The results obtained confirm that the crystallization conditions were different for each meteorite, a fact reflected by their structure and phase composition.

558. Yavnel', A. A.
SOOTNOSHENIE RAZLICHNYKH FORM ZHELEZA V KHONDRITAKH, (RATIO OF VARIOUS IRON COMPOUNDS IN CHONDRITES), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 74-82, fig., 2 tbls., 22 refs., (in Russian).

The abundance of iron compounds in achondrites, chondrites, mesosiderites, pallasites, and siderites is investigated. The results are compared with data obtained from similar studies conducted by Prior, Brown, Patterson, Urey, Craig, and Lovering. The abundance of Ni in four meteorites (Elenovka, Staroe Pesyanoe, Pallas Iron, and Marjalahti) is determined by means of spectrometric analysis. It appears that conditions under which the interplanetary matter is formed are determined not only by its location in space, but also by the time factor as well, the latter contributing additional variations. It can be assumed that the formation of various groups of iron meteorites (i.e., the differentiation of their elements) occurs at different stages during the development of the interplanetary matter.

559. Yavnel', A. A.
SOSTAV, STRUKTURA I USLOVIYA KRISTALLIZATSII ZHELEZNYKH METEORITOV, (COMPOSITION, STRUCTURE, AND CRYSTALLIZATION CONDITIONS OF IRON METEORITES), Meteoritika, Akad. Nauk S.S.S.R., no. 22, 1962, pp. 83-93, 2 figs., 28 refs., (in Russian).

The composition, structure, and crystallization of iron meteorites are discussed in the light of the existing literature. The following basic conclusions were made:

1. The phase composition of iron meteorites is determined by the phase diagram of the Fe-Ni-Co-P-S system.
2. The composition and phase ratio of meteoritic iron is determined by the phase diagram of the Fe-Ni system.
3. Iron meteorites can be divided into four groups, depending on their Ga and Ge content.
4. The exceptionally large dimensions of α-crystals and γ-phases indicate that the conditions under which the meteoritic iron was formed can be considered as quasi-equivalent.

560. Yoke, H. P.
"Ancient and Medieval Observations of Comets and Novae in Chinese Sources," pp. 127-225, 7 figs., 35 refs., 3 appens; in VISTAS IN ASTRONOMY, v. 5, Ed. by A. Beer, New York, Pergamon Press, 1962, 225 pp.

Continued

The existing catalogues on ancient and medieval Chinese comets and novae known to western astronomers are neither complete or accurate mainly because they do not generally come from the best sources available to us. The errors in these catalogues are discussed and the most important sources extant and the astronomical terms employed by the observers described. Comparative sources and parallel Korean and Japanese records are then given, whenever possible, together with the Chinese observations. The revised catalogue gives 338 comets from ancient times to the year A.D. 1600.

561. Yudin, I. A.
MINERAGRAFICHESKOE I RENTGENOSTRUKTURNOE ISSLEDOVANIE UGLISTYKH KHONDRITOV MEGEI, STAROE BORISKINO I GROZNAYA, (MINERAGRAPHIC AND X-RAY DIFFRACTION STUDIES OF THE CARBONACEOUS CHONDRITES MIGHEI, BORISKINO, AND GROZNAYA), by I. A. Yudin and N. F. Obotnin, Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 163-170, 4 figs., 4 tbls., 12 refs.

Results of microscopic and X-ray diffraction studies of opaque minerals from three carbonaceous chondrites are presented. The following minerals are described, based on microscopic analysis; (1) Mighei - troilite, plessite, and chromite; (2) Boriskino - troilite, plessite, graphite, and secondary goethite, possibly of terrestrial origin; and (3) Groznaya - troilite and graphite. The opaque minerals amount to about 1% in Mighei and Boriskino and to 3.4% in Groznaya. An X-ray diffraction study made it possible to confirm the occurrence of troilite in Mighei and Boriskino as well as the occurrence of chlorite and olivine in both of these meteorites, and olivine and magnetite in Groznaya. The olivine, chlorite, and magnetite do not differ from the same minerals of terrestrial origin.

Z

562. Zadunaisky, P. E.
PRELIMINARY REPORT ON A NEW COMPUTATION OF THE ORBIT OF HALLEY'S COMET, (Abstract), Astron. J., v. 67, no. 5, Jun 62, p. 286.

An improvement of the orbit computed by Cowell and Crommelin has been made by J. Bobone, from Cordoba. He used 1146 observations covering the period from August, 1909, to March 1910. A final computation is being made based on Bobone's results and using 2862 observations made between August, 1909, and May, 1911.

563. Zähringer, J.
ISOTOPIE-EFFEKT UND HÄUFIGKEITEN DER EDELGASE IN STEINMETEORITEN UND AUF DER ERDE, (ISOTOPIC VARIATIONS AND ABUNDANCE OF RARE GASES IN STONE METEORITES AND ON EARTH), Z. Naturforsch., v. 17a, no. 6, Jun 62, pp. 460-471, 5 figs., 2 tbls., 25 refs., (in German).

Continued

The rare gas content of 19 various stone meteorites has been investigated mainly for the abundance of the heavier components. Nine normal chondrites have been selected, which indicated from the A^{36}/A^{38}-ratio the presence of primordial rare gases. All of them contain primordial Kr and Xe as well as Xe^{129}-excess. Their content is proportional to the A^{36}-content and increases in the sequence: normal chondrites, enstatite chondrites and carbonaceous chondrites.

The relative abundances of the rare gases in the Staroe Pesjanoe and Kapoeta meteorites follow very closely the Suess-Urey abundance curve. This may indicate that their composition is very similar to that of an undifferentiated solar nebula.

The isotopic variations of meteoritic and terrestrial Ne and He can be explained by isotope dependent diffusion in solids under the assumptions, that all matter contained the rare gases in solar composition previous to degassing and that Kr and A has been lost to a much smaller extent. A similar process may be responsible for the Xe-anomalies. Heating experiments confirm, that the remaining gases are in thermally resistant components. The Xe^{129}-problem is discussed under these aspects.

564. Zähringer, J.
UEBER DIE UREDELGASE IN DEN ACHONDRITEN KAPOETA UND STAROE PESJANOE, (ON THE PRIMORDIAL RARE GASES IN THE ACHONDRITES KAPOETA AND STAROE PESYANOE), Geochim. et Cosmochim. Acta, v. 26, Jun 62, pp. 665-680, 2 figs., 2 tbls., 22 refs., (in German).

The two chondrites Kapoeta and Staroe Pesjanoe contain high amounts of primordial He, Ne and A. Primordial He^3 is present with the He^4/He^3 ratio of about 3800. The isotopic composition of primordial Ne has a 30 percent higher Ne^{20}/Ne^{22} ratio than atmospheric Ne. In the Kapoeta meteorite the primordial rare gases were found to be concentrated in the glass phase only.

By degassing the samples in steps at increasing temperatures the primordial gases could be separated from the radiogenic and spallation produced components. From the gas release it is concluded that the primordial gases are mainly trapped in crystal imperfections and that the temperature of these meteorites has always been below 300°C since the gases have been trapped.

The relative abundance of all rare gases is in good agreement with the cosmic abundance. This indicates, that these gases were trapped from a nearly undifferentiated protoplanetary cloud.

565. Zolotov, A. V.
SOME RECENT DATA ON THE TUNGUSKA CATASTROPHE OF 1908, Doklady Acad. Sci. U.S.S.R., Earth Sci. Sect., v. 136, nos. 1-6, Sep 62, pp. 160-162, 2 figs., 8 refs.; trans. of Doklady Akad. Nauk S.S.S.R., v. 136, no. 1, 1961, pp. 84-87.

Continued

Some recent data, obtained in the summer of 1959, are presented. An estimate of the lower limit of the Tunguska explosion is made by considering three factors: (1) burns on the trees, R = 17 km; (2) eyewitness accounts of the explosion from the factory at Vanovara, R = 65 km; and (3) eyewitness accounts of the explosion in the village of Kezhma, R = 200 km. The radiant energy of the explosion is found to be: estimate (1), $E_c = 1.5 \times 10^{23}$ ergs; estimate (2), $E_c = 1.1 \times 10^{23}$ ergs; and estimate (3), $E_c = 2.8 \times 10^{23}$ ergs. Thus, from these independent determinations, completely satisfactory agreement is obtained. An interesting conclusion emerges from this: the ratio of the radiant energy of the Tunguska explosion to its total energy is of the same order of magnitude as that in a nuclear explosion (i.e., around 30%).

566. Zotkin, I. T.
OB ANOMALNYKH OPTICHESKIKH YAVLENIYAKH V ATMOSFERE SVYAZANNYKH S PADENIEM TUNGUSSKOGO METEORITA, (THE FALL OF THE TUNGUSKA METEORITE AND RELATED OPTICAL PHENOMENA IN THE ATMOSPHERE), Meteoritika, Akad. Nauk S.S.S.R., no. 20, 1961, pp. 40-53, fig., 2 tbls., 47 refs., (in Russian).

The anomalous luminous phenomena observed in the earth's atmosphere after the fall of the Tunguska meteorite are described. Data published in scientific journals and newspapers, as well as additional data at the disposal of the Committee on Meteorites of the Academy of Sciences of the U.S.S.R. were utilized. During the night of 30 June-1 July, 1908, an anomalous red evening glow, very bright clouds, and a marked increase in night sky luminescence were observed in many European and some Asiatic countries. Bright noctilucent clouds were observed in some countries. The arctic twilight inhibited detection of these phenomena in the north. The western boundary of the region in which these phenomena were observed passed through Ireland, the southern boundary followed a great circle from the Brittany peninsula to the Northern Caucasus; the eastern boundary was not established accurately. However, no anomalous phenomena were observed to the east of the area of fall of the Tunguska meteorite. In addition to purely descriptive data, instrumental data were also available which made it possible to conclude that these phenomena were caused by turbidity in the atmosphere which was the result of the fall of the Tunguska meteorite. It is concluded that this atmospheric turbidity was actually composed of material ablated from the envelope and nucleus of a comet, not a meteorite.

567. Zotkin, I. T.
ON THE RING ENCIRCLING JUPITER, Soviet Astronomy (AJ), v. 6, no. 2, Sep-Oct 62, p. 236, 3 refs.; trans. of Astron. Zhur., v. 39, no. 2, pp. 303-304.

The outer form of the equatorial belt and its position on Jupiter provide no sure grounds as yet, on the basis of available observational data, for assuming it to be the shadow of a ring (a comet-meteorite ring as proposed by S. K. Vseksvyatskii).

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