Space TECHNICAL INFORMATION DIGEST

SPACE SYSTEMS INFORMATION BRANCH, GEORGE C. MARSHALL SPACE FLIGHT CENTER

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SPECIAL ISSUE

ABSTRACTS AND SUMMARIES OF PAPERS PRESENTED AT THE 129th MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND THE 112th MEETING OF THE AMERICAN ASTRONOMICAL SOCIETY.

129th MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (Philadelphia, December 1962). Thousands of scientists and engineers from many disciplines congregated at Philadelphia at the end of last December to attend the AAAS meetings. As part of the AAAS special sessions, Dr. Homer E. Newell, Director of Office of Space Sciences, NASA Headquarters, gave a survey lecture on "Space Sciences: Past, Present, and Future." Later, within the framework of the AAAS general sessions, a symposium was held on recent results of space research under the chairmanship of Dr. John H. Clark, Associate Director and Chief Scientist, Office of Space Sciences, NASA Headquarters. Other programs of interest during the sessions are listed below:

INTERDISCIPLINARY SYMPOSIUM IN THE PHYSICAL SCIENCES: DYNAMICS OF PLANETARY ATMOSPHERES. This was a joint program of AAAS Sections B-Physics and D-Astronomy, cosponsored by the American Geophysical Union, the American Meteorological Society, and Sigma Pi Sigma; it was arranged by Julius London of the University of Colorado.

1. The Role of Convection in the Dynamics of Planetary Atmospheres. Philip D. Thompson, National Center for Atmospheric Research, Boulder, Colorado.

2. The Vertical Propagation of Energy in the Atmosphere. Arnt Eliassen, University of Oslo, Blindern, Norway.

3. Turbulence in the Upper Atmosphere. Colin O. Hines, University of Chicago.

4. The Atmospheric Circulations of Venus, Mars, and Jupiter. Seymour L. Hess, Department of Meteorology, Florida State University.

THE INTEGRITY OF SCIENCE. Part of this symposium was concerned with the Scientific Consequences of Large-scale Experimentation in Space. James Alfred Van Allen, State University of Iowa, and James W. Warwick, University Corporation for Atmospheric Research, Boulder, Colorado, participated.

SCIENTIFIC SATELLITES--A PERSPECTIVE. This lecture was given by Alexander Kossiakoff, Associate Director, Applied Physics Laboratory, Johns Hopkins University at the joint AAAS-American Astronautical Society session.

SCIENTIFIC SATELLITE, PART I: CURRENT SCIENTIFIC SATELLITES. This symposium of the American Astronautical Society was cosponsored by the National Aeronautics and Space Administration; John E. Naugle, Director of Geophysics and Astronomy Programs, National Aeronautics and Space Administration, Washington, D. C., presiding. The following papers were presented:

1. S-6, An Aeronomy Satellite, Richard Horowitz, NASA Headquarters, Washington, D. C.

2. Topside Sounding of the Ionosphere. John H. Chapman, Defense Research Telecommunication Establishment, Ottawa, Ontario.

3. NASA Topside Sounding Program. John E. Jackson, S-48 Project Manager, Goddard Space Flight Center, NASA, Greenbelt, Maryland.

4. Geophysical Research with Injun I, II, and III. Brian J. O'Brien, State University of Iowa.

SCIENTIFIC SATELLITES, PART II: THE OBSERVATORY GENERATION OF SATELLITES. This portion of the program was chaired by John W. Townsend, Jr., Assistant Director, Goddard Space Flight Center, NASA, Greenbelt, Maryland. Papers were:

1. The Mission of the Orbiting Geophysical Observatories. Wilfred E. Scull, OGO Project Manager, Goddard Space Flight Center, NASA, Greenbelt, Maryland.

2. The Engineering Design of the Orbiting Geophysical Observatories. George E. Gleghorn, OGO Project Manager, Space Technology Laboratories, Redondo Beach, California.

3. The Mission of the Advanced Orbiting Solar Observatory, John C. Lindsay, AOSO Project Scientist, Goddard Space Flight Center, NASA, Greenbelt, Maryland.

4. One Approach to the Engineering Design of the Advanced Orbiting Solar Observatory. A. J. Cervenka, AOSO Project Manager, Goddard Space Flight Center, NASA, Greenbelt, Maryland.

5. The Mission of the Orbiting Astronomical Observatory. Robert R. Ziemer, OAO Project Manager, and James E. Kupperian, Jr., OAO Project Scientist, Goddard Space Flight Center, NASA, Greenbelt, Maryland.

6. The Engineering Design of the Orbiting Astronomical Observatory. Walter H. Scott, Project Manager, Grumman Aircraft Engineering Company, Bethpage, New York.

THE METEOROLOGICAL ROCKET PROGRAM. This symposium was sponsored by the Physics of the Atmosphere and Space Committee of the American Rocket Society; Francis S. Johnson, Graduate Research Center of the Southwest, Dallas, Texas, presided. Papers included:

1. Applied Meteorological Requirements. Robert S. Long, Commander 4th Weather Group, Andrews AFB, Washington, D. C.

2. Theoretical Meteorological Requirements. Richard A. Craig, Department of Meteorology, Florida State University.

3. Rocket Vehicles for Meteorology. Willis L. Webb, Missile Meteorology Division, Signal Missile Support Agency, White Sands Missile Range, New Mexico.

4. Meteorological Rocket Instrumentation, Robert Leviton, Meteorological Development Laboratory, Air Force Cambridge Research Laboratories, Bedford, Massachusetts.

5. The Meteorological Rocket Network. Lt. Col. Gernard D. Dean, U. S. Army Electronics Command, Fort Monmouth, New Jersey.

6. Survey of the Balloon Program. Thomas Kelly, Research Instrumentation Laboratory, Air Force Cambridge Research Laboratories, Bedford, Massachusetts.

7. Analysis of Meteorological Rocket and Balloon Data. Frederick G. Finger, U. S. Weather Bureau, Washington, D. C.

8. Meteorological Data above 60 km. Francis S. Johnson, Graduate Research Center of the Southwest, Dallas, Texas.

9. Global Aspects of Sounding Rocket Research. Maurice Dubin, Goddard Space Flight Center, NASA, Greenbelt, Maryland.

10. IQSY--The Year of the Quiet Sun. Martin Pomerantz, Director, Bartol Research Foundation, Swarthmore, Pennsylvania.

THE HISTORY OF ROCKET TECHNOLOGY. This symposium was presented by the Society for the History of Technology, cosponsored by AAAS Section L-History and Philosophy of Science. This portion was arranged by Eugene M. Emme, Historian, NASA Headquarters.

1. Robert H. Goddard and Early A.R.S. Rockets. G. Edward Pendray, Pendray & Company, Bronxville, New York.

2. The V-2 Rocket. Walter E. Dornberger, Bell Aerosystems, Buffalo, New York.

3. Viking and Vanguard. John P. Hagen, Pennsylvania State University.

4. Atlas, Titan, and Thor. Simon Ramo, Thompson-Ramo-Wooldridge, Inc., Canoga Park, California.

SPACE BIOLOGY AND LIFE SUPPORT PROBLEMS OF MANNED SPACE MISSIONS, PART I. This was a joint program of the American Physiological Society and NASA, cosponsored by the American Society of Zoologists; Freeman H. Quimby, Chief, Exobiology, Bioscience Programs, Office of Space Sciences, NASA, and Stanley C. White, Chief, Life Systems Division, Manned Spacecraft Center, NASA, presiding.

1. Theoretical Studies on Absence of Mechanical Stress. Ernest C. Pollard, Pennsylvania State University.

2. Detection and Characterization of Extraterrestrial Life. Carl Sagan, Stanford University.

3. An Integrated Model of Abiogenesis. Sidney Fox, Florida State University.

4. Biologists Role in the Space Program. Colin S. Pittendrigh, Princeton University.

5. Space Radiation Biology. Cornelius A. Tobias, University of California.

6. NASA's Manned Space Flight Programs. William A. Lee, Director, System Studies, Office of Systems, Office of Manned Space Flight.

7. Spacecraft Life Support Environment. Richard S. Johnston, Assistant Chief, Life Systems Division, Manned Spacecraft Center.

8. Space Suits. James Correale, Crew Equipment, Life Systems Division, Manned Spacecraft Center.

9. Radiation. Joseph A. Conner, Assistant Director, Development. Test and Evaluation, Aerospace Medicine, Office of Manned Space Flight.

10. Acceleration and Weightlessness. Edward J. McLaughlin, Acting Chief, Space Medicine Branch, Development, Test, and Evaluation, Aerospace Medicine, Office of Manned Space Flight.

THE EARTH'S MAGNETIC FIELD AND ITS EFFECTS ON COSMIC RADIATION. This symposium was arranged by the American Geophysical Union and was co-sponsored by AAAS Section B-Physics. It was managed by Martin Pomerantz, Bartol Research Foundation, Swarthmore, Pennsylvania. The following papers were read:

1. Earth's Magnetic Field and Its Variations. Scott E. Forbush, Carnegie Institution of Washington.

2. Cosmic Rays in the Earth's Magnetic Field. Martin A. Pomerantz, Bartol Research Foundation.

3. U. S. Navy Project MAGNET. Wilburt H. Geddes, Airbo, U. S. Naval Oceanographic Office, Washington, D. C.

<u>112th MEETING OF THE AAS (White Sulphur Springs, Virginia, December 27-29, 1962)</u>. Abstracts of selected papers read at the meeting are presented below. In addition, a summary of a special lecture on space telescopes, by Dr. Lyman Spitzer, is given.

THE 300-FOOT TRANSIT TELESCOPE AT THE NATIONAL RADIO ASTRONOMY OBSERVATORY, John W. Findlay, National Radio Astronomy Observatory. The transit telescope which has recently been built at the National Radio Astronomy Observatory is a parabolic dish 300-ft in diameter mounted on two towers fixed on an east-west line. The antenna may be pointed to within ± 10 sec of arc anywhere within the declination range -20^{o} to $+90^{o}$. The mesh surface allows the telescope to be used at frequencies up to at least 1420 Mc/s. Measurements of the gain and beam width of the telescope have been made at 750 Mc/s and 1400 Mc/s, and position calibration curves have been prepared. The telescope has been used in a number of observational programs, the results of which are being reported by other authors.

LINEAR POLARIZATION OF JUPITER, SATURN, AND WEAK RADIO SOURCES USING A 9.4 CM MASER, W. K. Rose, J. M. Bologna, R. M. Sloanaker, Radio Astronomy Branch, U. S. Naval Research Laboratory and Columbia Radiation Laboratory, Columbia University. A two cavity, solid state maser amplifier designed at the Columbia Radiation Laboratory was mounted at the focus of the Naval Research Laboratory 84-ft radio telescope and used in a series of measurements of radio sources. An improved signal-to-noise ratio was made possible by the low noise fluctuation level of the maser, which was typically .02° K rms for a 7 sec integration time.

During the months July-October 1962 linear polarization and flux measurements were made on a number of radio sources listed in the Third Cambridge Catalogue. The results which are presented include observations of the sources 3C295, Hercules-A, 3C433, 3C48, 3C286, and 3C147.

A series of measurements of the planet Jupiter's 9.4 cm radiation has made possible an independent determination of the degree of linear polarization, positions of the magnetic poles with respect to System III as well as the angle of tilt between the magnetic axis and rotational axis of the planet. Evidence for a beaming effect will also be presented.

A large number of drift curves on the planet Saturn were taken in an effort to determine if the planet's decimeter emission is linearly polarized as is the case for Jupiter. The results of these measurements will be reported.

RADIO OBSERVATIONS OF SUPERNOVAE REMNANTS, D. E. Hogg, National Radio Astronomy Observatory. Observations of five supernovae remnants--HB 21, HB 9, vdB 2, S 147, and CTA 1--have been made at 750 Mc/s and 1400 Mc/s; the first three have in addition been studied at 3000 Mc/s. The spectral indices derived from these and earlier observations are all small, supporting the theory that old remnants have flat spectra. In no case was a positive spectral index found.

Four smaller objects (diameter 10' - 15') which have previously been suggested as supernovae remnants have also been detected. With the possible exception of NGC 2359, these all appear to be normal thermal sources.

The correlation between the optical and radio brightness distributions in the two strong sources HB 21 and IC 443 is discussed.

MEASUREMENTS OF RADIO SOURCES IN THE 3C CATALOGUE, D. J. Crampin, D. S. Heeschen, I. I. K. Pauliny-Toth, and C. M. Wade, National Radio Astronomy Observatory. The new 300' paraboloidal antenna of the National Radio Astronomy Observatory is being used to make measurements of the positions and flux densities of all the sources in the 3C list at frequencies of 750 Mc/s and 1400 Mc/s. (The beam-width at these frequencies is 18'.5 and 10'.0 respectively). At 1400 Mc/s, a source with a flux density of about 0.3×10^{-26} $w/m^2/(c/s)$ gives a signal equal to the peak-to-peak noise level. For a source with a spectral index of 1, this corresponds to a flux density of about 3×10^{-26} $w/m^2/(c/s)$ at the frequency of the 3C survey (159 Mc/s). Since the lower flux limit of the 3C catalogue is 8×10^{-26} $w/m^2/(c/s)$, all sources included in it should be observable.

These expectations have been confirmed by the observations made so far. Sources at the lower flux limit of the 3C list can be detected easily and their positions can be measured with an accuracy better than ±2' in declination and $\pm 2^s$ in R.A. It should therefore be possible in the present program to improve the accuracy in the declinations of the positions given in the 3C lists, to remove ambiguities due to possible lobe-shifts and to obtain spectral indices for a large number of sources.

The present results have confirmed the general reliability of the 3C catalogue. About 20 per cent of the sources in the 3C list are shown as "possibly lobe-shifted;" about 30 per cent of the sources observed so far are in lobe-shifted positions. Some sources, such as 3C 398, have been resolved into two or more components, and in a number of others, the brightness distribution has been found to be asymmetrical.

CHARACTERISTICS OF IDENTIFIED EXTRAGALACTIC RADIO SOURCES, Thomas A. Matthews, California Institute of Technology. A considerable amount of information is available on the distance of the galaxies identified with radio sources, and thus about the absolute radio characteristics of some 57 identified sources. The flux radiated by the source, L, and the projected radio size, D, have been calculated for these sources. The flux has been integrated over a bandwidth of approximately 10^7 to 5×10^{10} c/s, where the limits used take into account any curvature in the radio spectrum. A plot of log L against D illustrates that radio sources vary in L over a factor of 10^7, while D varies by $\approx 10^3$. Selection effects have prevented us from seeing or studying sources which have a large angular diameter, but which have low apparent flux. Such sources probably exist since all sources of large diameter will eventually run out of energy and enter this unobserved region. At least 75 per cent, and perhaps 90 per cent, of extragalactic radio sources are radio doubles. Those that have a small size are found nearest the nucleus of a galaxy; those that are largest are found well separated from the parent galaxy. This suggests an evolution where the source is born in the nucleus of a galaxy and the energy is supplied from that region. The components move away from the galaxy and also expand in size. However, the translation occurs at a higher velocity than the expansion, which indicates a channeling of the energy into specific directions. We do not know how the radiated flux changes as a function of time, but almost invariably the radio centroid is very close to the apparent galaxy even when the brightness distribution is very asymmetrical. All these observed characteristics must be explained by whatever mechanism is proposed for the production and evolution of extragalactic radio sources.

COSMIC RADIO INTENSITIES AT 1.2 AND 2.0 MEGACYCLES/SEC MEASURED AT AN ALTITUDE OF 1700 KILOMETERS, F. T. Haddock, H. F. Schulte, and D. Walsh. On September 22, 1962 at 01:46 AM EST a four-stage Journeyman rocket was launched from Wallops Island, Virginia with a radio astronomy payload of 144 lb. Maximum altitude attained was 1700 km (1050 mi), and the duration of the flight was 1524 sec (25.4 min). Five ground-based telemetry stations, including one at Bermuda Islands, obtained clear recordings of the six FM/FM channels on 240 Mc/sec throughout the flight.

The experiment payload consists of three radiometers operating simultaneously at 0.75, 1.225 and 2.0 Mc/sec connected to a common electric dipole antenna 12.5 meters overall length; this is only 0.03 λ long at 0.75 Mc/sec. A solid-state noise diode for receiver gain calibration and a circuit designed to measure antenna capacitance operated satisfactorily with a 12-sec sampling period throughout the flight. The free-space antenna radiation resistance and capacitance was measured before flight on a large conducting ground plane using the method of images.

The in-flight antenna capacitance at 1.2 Mc/sec measufed beneath the ionosphere agreed with this pre-flight ground calibration. The measured apogee value of antenna capacitance at 1.2 Mc/sec was about 15 per cent below the free-space value due to the presence of residual ionospheric plasma. This small reduction requires a simple correction to the measured cosmic intensity at this frequency to obtain the free-space value. Only a very small correction for ambient plasma is required for the 2.0 Mc/sec measured intensity. The 0.75 Mc/sec measurement was seriously affected by ambient plasma and the local gyro-frequency resonance. Further study is required to deduce even an approximate cosmic intensity of this frequency.

THE ORIGIN OF RADIO STAR SCINTILLATIONS, James W. Warwick, High Altitude Observatory. Radio-star scintillations arise from irregularities in the electron density of the ionosphere. Different regions of a plane-wave front impinging on the ionosphere undergo relative phase retardations and advances corresponding to the fluctuating electron density. If the fluctuations are thin, weak, and randomly distributed, the phase variations along the ionosphere may follow the same distribution as the electron density. However, a thick region of large fluctuations may produce phase variations not described well by the given function. Therefore, any direct guide that scintillations may provide towards an understanding of the nature of the irregularities in the ionosphere is very welcome.

Wild and Roberts, in Australia, showed that scintillations of Cygnus A were very broadband and probably did not arise from a superposition of waves from many independent irregularities, but from focussing effects in ionospheric prisms and lenses.

The Boulder interferometric radio spectrograph confirms broad bandwidths of scintillations on Cassiopeia A. Scintillations last long at high frequency, short at intermediate frequency, and long at low frequency. At a fixed frequency, the apparent source moves monotonically, the shift being in opposite senses on either side of the region of shortest duration.

At one frequency, rays come to a sharp focus on the ground. At higher frequencies, motion of the irregularity first brings rays from the leading edge of the lens, which are tilted away from the drift. At frequencies lower than the focussed frequency, the observer first records the rays from the trailing edge of the lens, which are tilted towards the drift. Inside and outside of the focus, drifts therefore occur monotonically, but in opposite senses.

The converging bundles of rays producing scintillations arise in ionospheric lenses whose minimum dimension subtends about one-half degree at the ground, corresponding to a few kilometers in the ionosphere. Diffraction effects therefore are small relative to refraction.

MAINTAINING LINEAR PERSPECTIVITY IN LARGE OPTICAL AND RADIO TELESCOPES, Edwin A. Roth. During the Astrometry Symposium at the 111th American Astronomical Society meeting, several points of interest were discussed. One is the equation that Dr. Doritt Hofleit suggested $\Delta X = ax + by + c + dx^2 + exy + fy^2 + A(m)x + B(I)x$ where the last two terms are similar to those for magnitude and color proposed by Dr. Heinrich Eichhorn (Astron. Nachr. Band 285 Heft 5/6, 1959). In addition Dr. K. Aa. Strand proposed the use of large aperture reflectors for astrometric work. As pointed out by Dr. S. Vasilevskis there is no simple formula in the literature for determining the absolute focal length (using a temperature coefficient) of large telescopes.

As Dr. Dirk Brouwer pointed out in the equation $E^2 = \frac{h^2}{f^2} + c^2$ recorded in the literature by Schlesinger the focal length f is merely for use as a scale factor.

From the above it is obvious that the predictability of the focal length of a telecentric system is of major concern because astrographic plates can now be measured to within one micron accuracy. However, mere temperature change corrections are inadequate.

During the Third Summer Institute on Dynamical Astronomy held at Steward Observatory, University of Arizona, Tucson, in 1961, Dr. Jean Kovalevsky, Bureau des Longitudes, Paris, pointed out that the displacement of a stellar image from its true position due to atmospheric refraction can be approximated by $r/y = 0''.15 + 0''.25 \tan^2 \phi + \cdots$.

Where the numerical coefficients are in seconds of arc and ϕ is the zenith distance. When the image is on the zenith ray, ϕ is zero and the result reduces to 0.15 seconds of arc. This indication of the "lens" effect of the atmosphere is measureable on 2 meter focal length astrographic plates with micron measuring engines and becomes more readily detectable with larger telescopes.

This author recommends a function F (at) be included in the proposed equation to compensate for changes in focal length of the telescope - atmosphere telecentric system due to both temperature and atmospheric conditions. A method (developed for other work) for measuring this effect for calibration purposes is also adaptable to large radio telescopes.

These items must be considered and applied if future star catalogs and radio source listings are to incorporate the most reliable data attainable.

SEARCH FOR X-RAY EMITTERS IN THE NIGHT SKY, P. C. Fisher, A. J. Meyerott, H. A. Grench, Lockheed Missiles and Space Company. Measurement of the energy spectra of photons in the 0.2 to 20 Kev range which might be emitted by celestial sources was attempted in September, 1962 by flying a number of soft x-ray detectors on an Aerobee sounding rocket. One of the purposes of the investigation is to obtain information about the physical properties, elemental abundances in particular, of any emitting regions observed. Naive calculation had indicated that radiation from at least one of the close bright supergiants might be detected.

Data were obtained from two different types of gas filled proportional counters which scanned all the northern sky for galactic longitudes of 40 to 190 degrees. Detector acceptance angles were either 3 x 50 or 20 x 70 degrees. A very brief description of the experiment will be given, and then results from analysis of part of the available data will be presented. A flux level map will be given for the sky and limiting intensities of several of the brighter radio sources discussed.

OPTICAL MEASUREMENTS ON TELSTAR, J. S. Courtney-Pratt, D. W. Hill, J. W. McLaughlin, J. H. Hett, Bell Telephone Laboratories Inc. The problem was to determine the orientation of the spin axis of the Telstar satellite as a function of time. Plane and fluted metal reflectors were fitted to

Telstar, and for certain positions of the satellite in its orbit these mirrors reflected light from the Sun to an observing station at Crawford's Hill, New Jersey.

For any one mirror the signal received was a short train of small pulses of light--one pulse per revolution of the satellite. An 11-inch aperture Cassegrainian telescope was set up on an M-33 radar mounting which could be driven so that the telescope was pointed continuously at the satellite. A pulse operated camera was used with the telescope, or alternatively the light pulses could be made to fall on the cathode of a photomultiplier tube. The electronic equipment was triggered by the resulting pulses, and produced records of the time of occurence of the pulses. From such data it was possible to show that soon after launch, the spin rate was about 3 r.p.s. and the axis of spin was oriented close to the perpendicular to the plane of the ecliptic.

To obtain sufficient time resolution with the incoming signal, the photomultiplier output was continuously displayed on a cathode ray tube with a long persistence screen. Whenever a pulse was received of an amplitude sufficient to operate the triggering circuit, a drive pulse was passed to a camera which photographed the trace still persisting on the cathode ray tube screen.

CORONAL EMISSION FROM SOLAR FLARES, Harold Zirin, High Altitude Observatory. The spectra of limb flares almost invariably show intense radiation of the coronal lines of Ca XV, Ca XIII and A XIV, as well as strong continum. The electron density in the flare condensation may be obtained on the assumption that the continum is due to Thompson scattering. Calculation of the excitation of Ca XV shows that the ratio of line to continum emission is also a function of density. The results of these two determinations are compared for a number of flares. The effect of filamentation may also be evaluated.

Recombination radiation from He II in such condensations is also a function of density, and gives us a third determination.

Densities ranging from 5×10^9 to 2×10^{11} particles per cm^3 are found.

In general, the line: continum ratio depends on abundance. Approximate abundances for calcium, argon, iron, and helium are given.

ORIGIN AND TERRESTRIAL CAPTURE OF INTERPLANETARY DUST, Martin Harwit, Cornell University. We establish that most of the dust observed in comet tails is soon lost to interstellar space, because the Sun's radiation pressure pushes grains out of the solar system. This argument differs from the usual hypothesis that only those grains can be ejected, whose gravitational attraction to the Sun is less than their gravitational repulsion. Instead, one finds that grains are forced out of the solar system whenever the change in solar (gravitational plus radiative) potential is large enough for the grain's total energy to become positive. One can show that debris from some short period comets and from asteroids tends to be more easily retained in interplanetary space and can contribute to the zodiacal cloud. However, since short period comets are weak emitters, it is not at all clear that their rate of dust supply can equal the Poynting-Robertson loss. Collision of asteroids should provide sufficient debris, but it is shown that this debris is only liberated sporadically in catastrophic collisions of the largest asteroids. It is not clear whether a sufficient amount of dust can be liberated in this manner or whether, if liberated, this dust would not all descend into the Sun during a brief interval of a few thousand years. The effects of radiation pressure on the terrestrial capture of dust are discussed and the capture rate for different sized debris of cometary and of asteroidal origin are given.

RED GIANTS AND NEUTRINO PROCESSES, H. Y. Chiu, Goddard Institute for Space Studies. Recent work of Adams et al (Adams, Ruderman, and Woo, to be published in Physical Review) have indicated that neutrino processes are important in the red giants. It is found that the total neutrino energy loss rate of the core of the red giant studied by Schwarzschild and Selberg (Schwarzschild and Selberg, Astrophysical Journal 136, 150, (1962)) is $2.8L_{\odot}$. This is not negligible as compared to the gravitational energy flux which is $13.8L_{\odot}$.

This also brings up the problem whether neutrino processes exist. Hayashi and Cameron have suggested that, because of the incompatibility of neutrino processes with their stellar models, they do not seem to exist. However, from a more thorough analysis we conclude that neutrino processes are not incompatible with the astronomical data. There are also strong physical reasons to believe that they exist.

MOLECULAR ABUNDANCES IN STELLAR ATMOSPHERES, Philip C. Stanger, Perkins Observatory. Tables have been computed for the partial pressures of some twenty diatomic molecules and five polyatomic molecules likely to occur in stellar atmospheres as well as the partial pressures of the neutral and singly ionized forms of fifteen chemical elements. The partial pressures are available for ten different sets of relative abundances of the elements involved, for temperatures ranging from 4000 K to 1500 K, and for total gas pressures of 10^5, 10^4, 10^3, 10^2, and 10^1 dynes/cm^2. The computations were accomplished by iterative procedures carried out on an I.B.M. 650 digital computer.

The partial pressures found for the oxides and dioxides of Titanium and Zirconium are of particular interest. The abundances of the elements given by H. C. Urey ("The Planets," p. 231, Yale University Press, New Haven, 1952) were assumed to represent the composition of the main sequence stars in this investigation. In this case, the partial pressures of TiO and ZrO are governed strongly at higher temperatures by the concentration of the neutral atoms of Ti and Zr while at the lower temperatures by the formation of TiO_2 and ZrO_2. The ZrO passes into the dioxide form in significant amounts at higher temperatures than does the TiO and this appears to be a more important factor in controlling the relative abundance of TiO and ZrO than the total amounts of Ti and Zr involved.

ON THE SYSTEMATIC ACCURACY OF PHOTOGRAPHIC STAR POSITIONS AND PROPER MOTIONS, Heinrich Eichhorn, Van Vleck Observatory, and Carol Ann Williams, Yale University Observatory. The accurate knowledge of the covariance matrix associated with a set of observed positions and/or proper motions substantially increases their usefulness whenever they are to be used as basic material for statistical investigations.

The variance (essentially the error) of a photographic star position is composed of intrinsic variance, which as a rule increases toward the plate edges, the measuring variance, and the variance introduced as a function of the covariance matrix of the plate constants. The error connected with the latter is systematic and can be estimated from the covariance matrix of the plate constants.

Theoretical expressions for the covariance matrices of the plate constants were established replacing, by definite integrals, the product sums occuring in the matrix of the system from which they are obtained by a least squares solution. This was done for several models for the connection between standard and measured coordinates and various plate formats. For all models considered, diagrams were constructed showing loci of equal "plate constant variance" referred to unit star density. From these, in connection with appropriate tables, many questions concerning the systematic accuracy of photographic astrometric data can be answered, the most important being: (a) How many reference stars are needed (given a model for the connection between standard and measured coordinates) if the maximum (average, minimum) systematic error of a star position is not to exceed a certain limit? and (b) Under given circumstances, will an added term in the formula for the conversion of measured to standard coordinates increase or decrease the systematic accuracy of the positions?

SPACE TELESCOPES: THEIR CHALLENGE AND THEIR PROBLEMS. In a special survey lecture at the AAS meeting Professor Lymon Spitzer looked at the problems and promises of telescopes situated beyond the Earth's atmosphere.

He pointed out that so far no successful experiments have been conducted permitting the light from individual stars to be individually examined. He emphasized that above the atmosphere not only could high astronomical resolution be obtained but a wide frequency range of electromagnetic radiation could be examined. Some of the research problems that can better be handled above the atmosphere, from the point of view of the stellar astronomer, are investigations of the ultraviolet regions of the spectrum and the analysis of interstellar absorption lines.

Among the points made by Prof. Spitzer were that atomic hydrogen is seen in the ultraviolet medium. Molecular hydrogen is not known to exist but it is suspected, and may be as abundant as atomic hydrogen. A space telescope would certainly help to find out. It could also be used to check on the abundance of deuterium in interstellar space, to investigate the nature of interstellar atoms, and to measure electron density.

The four major problems of space telescope were then outlined and were found to be (1) launching dynamics, (high acceleration, vibration, etc.), (2) pointing accuracy and attitude control, (3) communications, and (4) power.

The final portion of Prof. Spitzer's lecture dealt with the Orbiting Astronomical Observatory project for which he is developing instrumentation under a NASA contract. Besides the obvious problems of successfully orbiting the astronomical satellite and assuring that its instruments operate perfectly, means of handling the great quantity of data produced must be devised.