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line. The flux was then integrated over frequency to give total flux at each optical depth.

O12. Three-Color Photometry of CY Aquarii. ROBERT H. HARDIE AND CHARLES R. TOLBERT, *Vanderbilt University.*—Approximately 1000 observations were made on the ultrashort period variable star, CY Aquarii, period 88 min, in the UBV system. Those observations were made during a 4-month period with the 24-in. telescope at Dyer Observatory. The amplitudes of the three colors are: $V=0.72$ mag, $B=0.92$ mag, and $U=0.80$ mag. The B-V color index changes by 0.20 mag and the U-B color index changes by 0.14 mag.

O13. Method for the Detection of Faint Early-Type Stars. CARL K. SEYFERT, *A. J. Dyer Observatory, Vanderbilt University.*—With the Dyer Observatory telescope and 24-in. objective prism it has been possible to classify stellar spectra to a limit of about 11.5 mag of 15-min exposures on fast blue-sensitive emulsions. This limit is imposed by the light of the night sky, which produces a background fog on the photographs. Hot, high-luminosity stars (A and B type) may be classified or detected solely through observations of the H and K lines of Ca II ($\lambda=3933$ and 3969). If spectrum plates are taken behind a filter which transmits only in this region, much longer exposures may be made before the sky background becomes too strong. Liquid and interference filters have been developed for this purpose, and it is found that, with these, exposures of at least 3 hr now may be made. On such, A-type stars can be classified and B-stars detected 1 to 2 mag fainter than had been possible previously.

Biophysics and General Physics

Invited Papers

P1. Biophysical Approaches to the Study of Radiation-Induced Chromosomal Breakage. J. KIRBY-SMITH, *Oak Ridge National Laboratory.*

P2. Direct Action Biological Target Studies with Heavy Ions. D. J. FLUKE, *Duke University.*

Contributed Papers

P3. Molecular Weight Measurements with the Magnetically Suspended Ultracentrifuge.* R. D. BOYLE, P. E. HEXNER, AND J. W. BEAMS, *University of Virginia.*—The magnetically supported vacuum type equilibrium ultracentrifuge previously described[1] has been improved and used for the measurement of the molecular weights of a number of substances. The rotor speed can be measured to at least one part in 10^6, the temperature of one part in 10^4, and the radial density ratio to about one part in 10^3. Molecular weight determinations in the range from about 50 to 10^8 can be carried out with roughly the same order of precision. The substances may be dissolved in any solvent which does not attack the quartz centrifuge cell windows. The maximum temperature is set only by the magnetic properties of the steel rotor so that the usable temperature range is comparatively large. A description will be given of the use of the centrifuge in the equilibrium method for the determination of the molecular weights of a number of different organic compounds dissolved in water and in benzine.

* Supported in part by the National Science Foundation.
[1] J. W. Beams, Proc. Am. Phil. Soc. **101**, 63 (1957).

P4. Ions and Ion-Molecule Reactions Produced by the Bombardment of Gases with Alpha Particles and Electrons. RUSSELL BALDOCK, *Oak Ridge National Laboratory.*—Ions induced in gases by alpha particles have been investigated as a function of the pressure in the reactor chamber of a research mass spectrometer. The relative proportion of various ions thus produced is significantly different from that produced by 75-ev electrons, and no multiply charged ions were observed. At pressures of the order of 0.1 mm of Hg in the chamber, higher mass ions are formed by ion-molecule collision processes, and these will be discussed.

P5. Charge Transfer Reactions Induced by Electrons and Alpha Particles. C. E. MELTON, *Oak Ridge National Laboratory.*—Charge transfer reactions of the type $XY^+ + Z \rightarrow XY + Z^+$ for low energy (0–0.15 ev) gaseous ions and various molecules have been studied in a research mass spectrometer. Some energetically possible reactions have high cross sections as expected, whereas other energetically possible reactions were not detected. The results are discussed in terms of excitation energy, W values, and competing chemical reactions.

P6. Crystallite Orientation and Spiral Structure of Cotton. LLOYD B. DELUCA AND ROLLIN S. ORR, *Southern Regional Research Laboratory.**—A method is demonstrated by which both crystallite orientation and spiral angle can be directly determined from the x-ray tracings of the 002 diffraction arcs of combed bundles of cotton fibers. Sisson[1] has shown, qualitatively, that the 002 arcs displayed by fibers with an oriented spiral structure can be explained by assuming two equal crystallite distributions separated by twice an average projected spiral angle. If this distribution of crystallites is assumed to be Gaussian, the experimental arc can be generated theoretically. This analysis is applied to several cottons of widely different orientations, and the calculated parameters are compared with those of the gross arcs.

* One of the laboratories of the Southern Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture.
[1] W. A. Sisson, Ind. Eng. Chem. **27**, 51–56 (1935).

P7. Effect of Subthreshold Captures on the Fast Fission Factor. G. ROBERT HOKE, *Mississippi State University.**—The fast fission factor is usually defined[1] as "the number of neutrons slowing down past the fission threshold of uranium-238 per primary fission neutron, that is, per neutron produced by thermal fission." The difficulty with this definition, as pointed out by Spinrad,[2] is that it is not consistent with the techniques customarily used in the measurement or calculation of the resonance escape probability. In particular, the neutron captures at energies between the fission threshold and the resonance energy region are not included in either p or ϵ. This difficulty is obviated by defining ϵ as the number of neutrons making first collision with the moderator per neutron arising arising from thermal fission. Based on this viewpoint a formula for ϵ has been derived. The values of $\epsilon-1$ for cylindrical rods of natural uranium calculated by use of this formula are approximately 20% lower than corresponding values using the older formula. Most of the difference is due to the subthreshold captures.

* Research Participant at Oak Ridge National Laboratory.
[1] S. Glasstone and M. C. Edlund, *The Elements of Nuclear Reactor Theory* (D. Van Nostrand Company, Inc., Princeton, New Jersey, 1952).
[2] B. I. Spinrad, Nuclear Science and Engineering **1**, 455 (1958).

P8. Measurement of Air-Borne Radioactivity. NEWTON UNDERWOOD, *North Carolina State College,* AND C. J. BRIDGMAN, *Wright-Patterson Air Force Base.*—An electrostatic precipitator operating at 170 cu ft per min, 10 000 v, and 4 M.A. was used to collect the dust from the air samples. Radioactive decay curves exhibit various stages of radioactive equilibrium. Gamma-ray spectra obtained at various times during the decay reveal the changing relative importance of the radon and thoron daughters. This information is useful in evaluating man-made air-borne radioactivity hazards.

P9. An Elementary Description of Pressure Diffusion. HAROLD L. WEISSBERG, *Oak Ridge Gaseous Diffusion Plant.*—Elementary considerations of the rate of momentum transfer among the gas molecules in a binary mixture of nonuniform composition are used to explain the physical significance of the terms which appear in the theoretical equation[1] which describes isothermal mutual diffusion. The purpose is to elucidate the effect of a gradient in the *total* as well as partial pressures. The pressure diffusion term in the equation represents the respective tendencies of lighter and heavier molecules to diffuse toward regions of lower and higher total pressure. This term as derived here corresponds to the situation where each species of molecules in the mixture contributes to the total pressure gradient in proportion to its own *mass* (as contrasted to, say, *number*) density. Hence, it cannot necessarily be associated with a flow in which a viscous shear exists. The method used is a generalization of the elementary treatment of mutual diffusion *without* a total pressure gradient as described by Present.[2]

[1] S. Chapman and T. G. Cowling, *Mathematical Theory of Non-Uniform Gases* (Cambridge University Press, New York, 1952), 2nd ed., p. 244.
[2] R. D. Present, *Kinetic Theory of Gases* (McGraw-Hill Book Company, Inc., New York, 1958), 1st ed., pp. 52–55.

Author Index to Papers Presented at the Gatlinburg Meeting of the Southeastern Section

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