Proceedings of the American Physical Society

MEETING AT STATE COLLEGE, PENNSYLVANIA, JUNE 26–27, 1942

THE 249th meeting of the American Physical Society was held in the buildings of The Pennsylvania State College at State College, Pennsylvania, on Friday and Saturday the twenty-sixth and twenty-seventh of June, 1942. The fourth of our meetings since Pearl Harbor, it showed the now-familiar pattern of a marked decline in the number of contributed papers as compared with the summer meeting of the previous year. This, however, was amply compensated by several distinguished physicists and chemists who acceded to requests that they give invited papers. The attendance was higher than in the previous year (there were about 120 at the dinner) but this happy event must be credited in part to our sister societies which were holding meetings on the Thursday and part of the Friday. These were the American Association of Physics Teachers and the Society for the Promotion of Engineering Education, of which the joint symposium "The War and Problems of Physics Teaching" attracted much attention, and will presumably be reported in another journal.

The circumstances of the meeting were remarkably pleasant, and it was evident that the members of the physics staff and even some of the chemistry staff of State College had expended time and pains without stint in making the arrangements for the sessions, while their wives had labored equally in preparing entertainment for visiting ladies. It is difficult to guess whom to single out for special mention, but it should be recalled that Professor D. C. Duncan was Chairman of the Local Committee and that Dean F. C. Whitmore gave a reception on the Thursday evening for all members and guests of the three societies. Special mention should assuredly be made of the enlightened liberality of the local gasoline-rationing board (Chairman, Mr. Maurice Baum) who allowed to all visiting members sufficient gasoline to get to their homes or to the boundary of the rationed area, and was even willing to allow gasoline enough for the round trip. This was a highly valued tribute to the singular importance of physics and of the teaching thereof to the war effort.

The dinner was held on the Friday evening at the Nittany Lion Inn. President Bridgman presided; the three societies were welcomed to State College in the name of its President by Mr. Morse; officials of the other two societies spoke briefly; but the major feature of the after-dinner programme was the brilliant speech of Dean Whitmore, deviating somewhat but not too much from the subject indicated by the title quoted below, and pertaining largely to the problem of synthetic rubber. Another outstanding event was the description of the cryogenic laboratory and the demonstration of liquid hydrogen by J. G. Aston on the following day, which may be described as matchless.

The invited speakers and the titles of their papers were the following, speakers not otherwise designated being of the Pennsylvania State College:

J. G. ASTON AND M. SAGENKAHN: **Production of Low Temperatures at Pennsylvania State College (with demonstrations of liquid hydrogen)**
J. G. ASTON AND S. C. SCHUMANN: **Thermochemical and Thermodynamical Research on Organic Compounds at Pennsylvania State College**
P. DEBYE (*Cornell University*): **Coagulation of Colloids**
J. E. MAYER (*Columbia University*): **Electron Affinity**
D. H. RANK AND R. J. PFISTER: **Direct Photoelectric Method of Measuring Wave-Lengths and Intensities in Raman Spectra**
J. H. SIMONS AND H. T. FRANCIS: **Measurement of the Scattering of Low Velocity Ions in Gases at Low Pressures**
J. A. VAN HORN AND D. H. RANK: **Isotopic Fine Structure in Raman Spectra**
F. C. WHITMORE: **Organic Chemistry for Physicists**

The contributed papers are listed below with the abstracts submitted for them; number 10 was read by title.

At the Council meeting which was held on the Friday, one Member of the Society was advanced to Fellowship, and 27 candidates were elected to Membership; their names are the following:

Elected to Fellowship: J. R. Hirsh.

Elected to Membership: Abraham, George; Atlee, Zed J.; Booge, James Eliot; Boyer, Keith; Burns, Loren V.; Debeau, David Edmund; De Pangher, John; Drake, William Robert; Ekstein, Hans; Fagen, Morton D.; Greenwood, Ivan A., Jr.; Herscher, Leonard O. W.; Lavatelli, Leo Silvio; Linder, Benedict M.; Longini, Richard L.; Maltby, Frederick Lathrop; Peterson, E. L.; Pinkham, Raymond A.; Saby, John S.; Salisbury, W. W.; Spangenberg, Karl; Spatz, Wilber D. B.; Sprengnether, W. F., Jr.; Weinstock, Robert; Weltin, Hans; Winkler, Stanley; Wong, Ming S.

Only one death in the Society has to be reported by the Secretary, that of M. F. Manning, known for his work on the theory of electrons in metals.

The Treasurer and Secretary recall with gratitude the seventeen years of skilful, loyal, and laborious service of Margaret Herod Tilton (now Mrs. Bernard Titche) as secretary in general charge of all routines of the office of the Society at Columbia University.

Karl K. Darrow
Secretary, American Physical Society
Columbia University

Abstracts of Contributed Papers

1. The Method of Thin Films. Howard S. Coleman and Henry L. Yeagley, *The Pennsylvania State College.*—A simple method for observing intermetallic diffusion rates has been devised. This method involves the deposition from the vapor phase first of one metal than another on top of it. A microscope slide is used as a film base. The diffusion rates are then observed at various temperatures. This is done by noting the change in reflectivity at one surface as the metals diffuse. The apparatus consists essentially of an automobile headlight source maintained at constant voltage, the bi-metallic reflecting film, and a photronic cell connected to a recording microammeter. The recorder draws a record of the change in reflectivity automatically as the diffusion progresses. This new method makes possible the study of diffusion rates of metals through metals and, in some cases, gases through metals at temperatures as low as 50°C and in lengths of time as little as 5 minutes, depending upon the metals involved, the thickness of the metals, and the temperatures. The activation energies determined by the method of thin films are in agreement with values obtained by others. For example the activation energy for the diffusion of gold into lead has been found to be $-13{,}700\pm 300$ cal.

2. The Surface Layer of Sheet Glass. F. L. Bishop, Jr., *American Window Glass Company.*—There has been considerable speculation as to the nature of the fire polish layer on sheet drawn glass. Drude gave equations for determining the thickness of a surface layer when deviations from Fresnel's equations are found. In this research plane polarized light with its plane of polarization 45° from the plane of incidence was reflected from glass at Brewster's angle. Due to the surface layer, the reflected light was found to be slightly elliptically polarized. A new method of photographic recording, using a Polaroid split field analyzer was used to measure this ellipticity. The result showed the probable existence of a crystalline quartz layer on freshly drawn sheet glass. The extreme difficulty of drying the surface once it had been wet was also confirmed; the existence of a high index layer on glass polished with rouge was verified.

3. Stray Magnetic Fields from Cobalt. L. H. Germer, *Bell Telephone Laboratories.*—Electrons passing near the surface of a demagnetized cobalt single crystal are deflected by the stray fields from the individual magnetic domains. Iron and nickel single crystals show no similar phenomenon; because these metals are cubic they have more than one direction of easy magnetization and external fields are therefore very weak. 40-kv electrons scattered from a hexagonal face of a cobalt crystal produce on a photographic plate an exceedingly complex pattern made up of curves or arcs interlaced in elaborate fashion but all concave toward the primary beam position. The pattern is decreased in size, but not altered in character, if the hexagonal face is covered by a thin layer of electrodeposited copper. By studying crystals covered by different known thicknesses of copper, it has been discovered that the magnetic fields extend to about 0.01 mm above the surface and that the maximum field intensity just at the surface is of the order of 10^4 gauss. In general, hexagonal faces of demagnetized cobalt crystals do not adhere when pressed together, but if they have been flattened with exceptional care, the magnetic attraction can be very great, 4.9 kg weight/cm^2 in one case.

4. Transitions in Cobalt-Nickel and Iron-Nickel Alloys Determined by Hydrogen Diffusion. F. D. Bennett, J. R. Doig, and W. R. Ham, *The Pennsylvania State College.*—The measurement of the rate of hydrogen diffusion through metals provides a sensitive and accurate method of detecting transition points in the metal lattice. For a homogeneous metal or alloy the diffusion rate is given by

$$R=\text{const. } p^z e^{-b/T},$$

where z is usually $\frac{1}{2}$. An examination of two Ni-Co alloys shows that while the physical magnetic change occurs at 600° and 910°, respectively, the Curie point break for Ni is still present in the diffusion curve. Two Fe-Ni alloys in which the magnetic transformations occur at 340° and 561° both show a marked discontinuity at 769°, the Curie temperature for pure Fe. A Co-Fe alloy shows a transformation at 1112°C regardless of the length of time it has been heat treated in hydrogen and this is the magnetic transformation temperature for pure cobalt. The presence of an alloying element with Fe, Co, or Ni changes the temperature of the magnetic transformation, but appears always to leave unchanged a transformation at the Curie transformation temperature of pure Fe, Co or Ni. These data might be interpreted as indicating that fundamental electronic transitions occur in ferromagnetic alloys at the Curie temperatures of the elements that are not necessarily associated with any magnetic changes in the alloys. An alternate explanation of the unexpected transitions is that a segregation of one of the elements exists but this appears to the authors very unlikely, considering the heat treatment.

5. The Use of Secondary Electron Emission to Obtain Trigger or Relay Action. A. M. SKELLETT, *Bell Telephone Laboratories.*—The use of secondary electrons to obtain trigger action similar to that of a thyratron is described. An experimental tube and the necessary circuits by which this action is achieved are discussed. This combination gives the features of a triode with a relay or on and off feature, resulting in an amplifier, oscillator, modulator or other vacuum tube device which may be turned on or off abruptly at high or low frequencies. In addition, it can be used to replace thyratrons in many of their circuits where very low impedance is not necessary and is capable of much greater speeds of operation in such applications.

6. An Automatic X-Ray Diffraction Apparatus. S. W. HARDING, F. R. SMITH, AND W. P. DAVEY, *Pennsylvania State College.*—The use of balanced ZrO_2 and SrO filters in x-ray diffraction work with Mo x-rays is well known. When Geiger-Mueller quantum counters are used to detect the diffracted lines, it is possible, by means of a four-pole synchronous motor operating a disk, to insert into the path of the x-ray beam, first a ZrO_2 filter, then a SrO filter. The impulses from the quantum counter are then amplified and passed through a pulse-leveler in the usual way. After further amplification, the impulses are then led to a mechanical double pole-double throw switch on the shaft of the four-pole synchronous motor. This switch feeds the impulse from the Zr-filtered beam into a "tank condenser" with one polarity, and feeds the impulse from the Sr-filtered beam into the same tank condenser with the opposite polarity. A suitable bleeder-leak in series with a recording microammeter is placed across the tank condenser. The recording meter then registers the difference between the counts made through the two filters. A proper choice of circuit constants gives a useable and reasonably accurate measurement of x-ray intensities provided the original x-ray beam is strong enough.

7. Diffraction of X-Rays by Argon in the Liquid, Vapor and Critical Regions. A. EISENSTEIN AND N. S. GINGRICH, *University of Missouri.*—Rocksalt reflected Mo $K\alpha$ radiation was used to obtain diffraction patterns of argon at twenty-six different conditions of pressure and temperature. Argon gas was compressed in a flat beryllium window cell under pressures of from 0.8 to 51.1 atmospheres and its temperature was held constant at values between 84.35°K and 168°K. The diffracted x-ray intensity was measured by means of a Geiger-Mueller counter. The liquid pattern at 84.35°K (triple point 83.99°K) is considerably sharper than those at any higher temperature, including, particularly, that at 91.8°K. Series of patterns were obtained at temperatures of 126.7°K, 144.1°K and 154°K covering both the vapor and liquid phases in each case. One series was obtained at a pressure of 51.1 atmospheres, somewhat above the critical pressure. The general characteristics of the patterns are largely dependent on the density of the argon, although increase of temperature alone tends to shift the main peak to smaller angle while for the vapor, increase of pressure alone tends to shift it to larger angle. When these curves are fitted to structure factor curves, it is found that at high pressure and temperature and near the vapor-liquid line, considerable excess scattering occurs at small angle.

8. A Diffraction Adapter for the Electron Microscope. J. HILLIER, R. F. BAKER, AND V. K. ZWORYKIN, *RCA Manufacturing Company.*—As part of a program to extend the usefulness of the electron microscope as a scientific tool, an adapter has been developed which allows a conventional electron microscope to be used interchangeably as an electron diffraction camera or an electron microscope. The adapter comprises a unit which takes the place of the projection lens unit of the microscope, and includes a newly designed microscope projection lens, a specimen holder, and a focusing lens. To transform the instrument from a microscope to a diffraction camera (or vice versa) it is only necessary to transfer the specimen from the adapter to the regular object chamber. Diffraction patterns may be obtained by either reflection or transmission. As a result of the excellent reproducibility of voltages and currents from the regulated power supplies used in the electron microscope, the diffraction camera holds its calibration to within 0.1 percent over long periods. Using a calibration determined by measurements of gold patterns, lattice spacings of a number of common materials were determined and found to agree with x-ray values to within 0.5 percent. A number of such transmission-diffraction patterns have been made during the testing of the equipment.

9. The Direct Measurement of the Ionization Potentials of the Free Radicals, Methyl and Ethyl. JOHN A. HIPPLE AND D. P. STEVENSON,[1, 2] *Westinghouse Research Laboratories.*—The lead tetra-alkyls, $Pb(CH_3)_4$ and $Pb(C_2H_5)_4$, were decomposed to yield free methyl and ethyl radicals in a specially designed furnace built into the ionization chamber of a 180° mass-spectrometer tube. From the initial breaks of the ionization efficiency curves of the ions, CH_3^+ and $C_2H_5^+$, we have found the ionization potentials of the methyl and ethyl radicals to be $I_{\text{vert}}(CH_3) = 10.0 \pm 0.1$ ev and $I_{\text{vert}}(C_2H_5) = 8.6_0 \pm 0.1$ ev. These values are in excellent agreement with those found by indirect calculations from other electron impact data. Fraser and Jewitt,[3] by a molecular beam technique, obtained 11.2 ± 0.8 volts and 10.6 ± 0.8 volts for the corresponding ionization potentials.

The reason for this difference will be discussed. An energy diagram is constructed which represents the present states of combination of a carbon and four hydrogen atoms. It has been found that the thermal decomposition of these lead compounds, even at these low pressures ($\sim 10^{-5}$ mm) yields predominantly stable molecules rather than free radicals. The yield of methyl radicals relative to other decomposition products is critically dependent on the furnace temperature, passing through a sharp maximum.

[1] Westinghouse Research Fellow.

[2] Present Address—Shell Development Company, Emeryville, California.

[3] Fraser and Jewitt, Proc. Roy. Soc. **160A**, 563 (1937).

10. Sensitized Fluorescence of Iron Vapor. J. G. Winans and Stanley Breen, *University of Wisconsin.*—The sensitized fluorescence of iron vapor in mercury vapor has been obtained by using the simplified form of apparatus.[1] A fused quartz tube containing electrolytic iron dust and mercury was heated at one point to 1100°C with a hydrogen-air flame. This point was illuminated by light of wave-length 2536 from a SC 2537 discharge tube using a focal isolator. The spectrum of the fluorescence showed thirty iron lines at low mercury pressure (about 0.5 cm) and approximately ten iron lines at high mercury pressure (about 10 cm). At medium mercury pressure, a low voltage Tesla discharge showed the same iron lines as the fluorescence at medium pressure, but at low mercury pressure the Tesla discharge showed many more iron lines than appeared in fluorescence at the same pressure.

[1] J. G. Winans and R. W. Williams, Phys. Rev. **52**, 930 (1937).

11. Radioactive Tellurium from Antimony. C. V. Kent and J. M. Cork, *University of Michigan.*—Antimony exists in nature as isotopes of mass 121 (56 percent) and 123 (44 percent). On bombarding antimony with deuterons, tellurium isotopes of mass 122, 124, 121, and 123 might be produced; the first two by the (d, n) reaction and the latter two by the less probable $(d, 2n)$ process. The separated tellurium fraction has been found to yield several radiations. A positron radiation probably due to Te (121) has been observed. An activity of half-life thirty days consists of several gamma-rays. On the beta-spectrometer the resolution is sufficient to show clearly the K, L, and M peaks for two of the converted gamma-radiations of energy 82.0 kev and 88.3 kev. Both have K-L-M differences characteristic of tellurium and hence must be associated with excited states in the similar stable isotopes of mass 122 and 124. Other gamma-rays have energies of 136, 157.3, 210.8, and 615 kev.

12. The Solution of Maxwell's Equations for Certain Diffraction Problems. Robert A. Woodson, *University of Rochester.**—Particular solutions of Maxwell's electromagnetic field equations are obtained which approximately satisfy the boundary conditions for the diffraction of plane waves normally incident upon an aperture in a plane opaque screen situated in an isotropic transparent medium. The following cases of Fraunhofer diffraction are solved: the infinite plane grating, the single slit, multiple slits, and the rectangular aperture. The problem is solved by an original application of Fourier analysis. Plane waves are combined by pairs into "corrugated waves." Such corrugated waves are periodic both in the direction of propagation and also in the wave front. Coplanar corrugated waves are superimposed in the plane of the aperture in such a way that the Fourier series of their amplitudes gives the amplitude of the incident wave in the plane of the aperture. Thus the boundary conditions are satisfied. This theory is based directly upon Maxwell's equations, and does not depend upon Huygens' principle. The phenomenon of diffraction is shown to be a natural result of limiting the extent of the wave front. Perhaps the most valuable contribution of the corrugated wave theory is its simplicity, by which it readily explains phenomena predicted by much more complicated theories.

* Work done at Rensselaer Polytechnic Institute.

13. Departures from Ohm's Law in Solids. H. Osterberg, *Spencer Lens Company (Introduced by A. H. Bennett).*—The writer has attempted to ascertain whether there exists in crystalline or isotropic solids a volume effect which obeys Neumann's hypothesis and in which the resistance varies as a power series in the components of the applied electrical field. Crystals of 21 classes allow linear terms different from zero and may exhibit rectification. Quadratic terms are allowed by all crystal classes. Higher terms of the above tensor were not studied. Parallel crystal plates of carborundum, zincite and galena with evaporated metal electrodes were immersed in constant temperature baths and found to exhibit current-voltage characteristics consistent with the above linear and quadratic tensors when the applied electrical fields were small. At higher fields the behavior, especially of galena, became complicated. With repeated grinding and resurfacing the direction of rectification in single crystals of carborundum and zincite remained the same. Consistent with the above volume effect, the resistance changes in isotropic resistors varied quadratically with the field over wide ranges in the applied voltage. These observations together with those made by other observers provide good but not yet indisputable evidence for the above volume effect and indicate that rectification effects in crystals are due only in part to surface effects.

14. The Kinetic Energy Correction in Viscosity Measurements. M. R. Cannon and Edward Nadro,* *The Pennsylvania State College (Introduced by W. P. Davey).*—The kinetic energy correction in viscosity measurements appears in the C' term in the equation: $\mathrm{K.V.} = Ct - C'/t$ where K.V. is the kinematic viscosity, t efflux time in seconds, C a constant dependent upon the dimensions of the viscometer and C' an alleged constant which depends upon the kinetic energy coefficient "m" and the dimensions of the viscometer. In this paper extensive data are presented and indicate that C' is not a constant for a given viscometer but is a variable. Therefore, the common practice of assuming C' to be a constant may introduce appreciable errors in viscosity measurements. For example, in some types of viscometers C' changes by 60 percent over a sixfold range in Reynolds number. Eleven different types of viscometers were used in this investigation. Some of them were designed to make the kinetic energy correction high (20 percent or more) and, therefore, accurately measurable over a wide range of Reynolds numbers. It is apparent that it is necessary to maintain the term C'/t very small in relation to Ct in accurate viscosity measurements. This can be done by proper selection of viscometer dimensions and the C'/t term may be reduced to 0.1 percent or less of the Ct term. The equation then reduces to: K.V. = Ct.

* Present address: Socony-Vacuum Oil Company, Paulsboro, New Jersey.

15. An Ultraviolet Recording Photoelectric Spectrophotometer. R. J. Pfister and D. H. Rank, *The Pennsylvania State College.*—A large F-4 plane grating monochromator has been built to feed light from a water-cooled hydrogen discharge to a split beam photometer. The photocurrents from two F.J.-405 (General Electric) tubes are separately amplified by two RH-507 (Westinghouse) electrometer tubes and the currents are supplied to a pair of galvanometers whose deflections are continuously recorded while the monochromator moves through the spectrum. The monochromator employs two 8-inch parabolic mirrors used 11 degrees off the axis in such a way that the astigmatism produced by the collimating mirror is partially corrected by the focusing mirror. An 8-inch plane grating containing 26 square inches of ruling with 15,000 lines per inch on aluminum is used in the second-order ultraviolet. The grating is motor driven so that the spectrum moves at a rate of approximately 47A per minute across the exit slit. The source is a π type hydrogen tube with large aluminum electrodes. The complete assembly yields records showing a resolving power of about 5A and sufficient intensity down to about 2350A.

16. Impurities in Certain Arc Carbons Sold for Spectrographic Work. R. H. Cotton, *Pennsylvania State College* (*Introduced by W. P. Davey*).—Arc carbons can be bought from the manufacturers in various degrees of purity. The two most commonly used brands (*A* and *B*) of the less pure type have been examined spectrographically. In some cases chemical methods have been tried to improve the purity. Both *A* and *B* were found to contain Ca, Si, Ti, and B. Ca was removed from brand *A* by Soxhlet extraction with either HCl or HNO_3. Calcium is materially reduced from brand *B* by Soxhlet extraction with HNO_3. As might have been expected, Si was present and did not yield to chemical treatment. Ti was removed from brand *A* by Soxhlet extraction with HCl, but was not completely removed from brand *B* by Soxhlet extraction with HNO_3. B was not removed from either brand by Soxhlet extraction with HCl or HNO_3 or by three one-hour boilings with 29 percent NH_4OH. The following elements were looked for in both *A* and *B* but were not found:

Al
Bi
Cb
Co
Cr
Fe
K
Li
Mg (doubtful trace)
Mn
Mo
Na
Ni
P
Pb
Pt
Tl
V
W
Zn.

17. Near Infra-Red Absorpton by Water Vapor. C. C Haworth, Jr. and F. C. Todd, *The Pennsylvania State College.*—The radiation of 1.87 microns absorbed by water vapor has been measured by employing a carefully jacketed, absorption cell. Adsorption on the windows is found negligible by use of a removable glass plate.[1] The absorption cell is filled by saturating it at the temperature of the thermostat. Measurements show that the integrated absorption per unit mass of water is constant for saturated water vapor at 35, 25 and 15°C, but perhaps increases for 0°C. The absorption at atmospheric pressure of air varies from 1.7 to 2.6 times that of water vapor alone, increasing with decreasing temperature. The variation of the integrated absorption with the pressure was measured at 25°C for the 1.4 and the 1.87 micron band. The increased absorption by the pure water at 0°C and the decrease in absorption with increasing temperature at atmospheric pressure, indicates that the Lorentz boradening may not be the sole effect.[2] Association is known to increase the absorption[3] and is indicated here.

[1] F. C. Todd and A. W. Gauger, Proc. A. S. T. M. p. 1134 (1941).
[2] H. Margenau and W. W. Watson, Rev. Mod. Phys. **8**, 40 (1936).
[3] J. J. Fox and A. E. Martin, Proc. Roy. Soc. **A174**, 234 (1940).

18. The Long Wave-Length Absorption of Saturated Carboxylic Acids and Esters. Henry L. McMurry, *Rensselaer Polytechnic Institute.*—Electron configurations for the COOR group (R denotes an alkyl group or an H atom) expressed in terms of localized MO's are like those for the carbonyl group[1] with, however, the inclusion of MO's representing electrons in the added $R-O$ and $C-O$ bonds. A pair of nonbonding electrons are localized on each oxygen atom. Excitation of one of these electrons to the lowest excited MO which has a node in the OCO plane should produce the longest wave-length absorption. This excited MO is largely localized in the $C=O$ part of the COOR group but must cover all three atoms in the COO^- ion. The calculated intensity for these transitions is low except when the excited electron starts from an MO having a node in the OCO plane. This occurs in the ion where a large intensity is predicted. When it occurs in the COOR group the intensity may be very low. The longest wave-length absorptions near $\lambda 2100$ in the unionized COOR group is weak but becomes very strong and appears at somewhat shorter wave-lengths in the ionized salts of the acids. This agrees with predictions.

[1] H. L. McMurry, J. Chem. Phys. **9**, 231 (1941).

19. Effect of Mass on the Shift in Absorption Regions in Conjugated Organic Molecules. Gladys A. Anslow and Evans Vaughan, *Smith College.*—Attempts to correlate the position of absorption bands in the spectra of conjugated hydrocarbons with the number of conjugated groups have met with considerable success, although the cause of the shift of the bands toward higher wave-lengths with additional groups is not immediately apparent. The increase in the intensity of the bands with the number of groups is undoubtedly the result of the increase in the number of absorbing centers in the molecule. If it be assumed that the energy absorbed in these groups is transferred to the central member of the conjugated groups, causing vibration of the molecule about the center of gravity of this member and resulting in dissociation, the energy of the exciting photon must be proportional to the inverse square root of the reduced mass of the molecule about this center. This hypothesis is tested from data in the literature. The symmetrically formed molecules such as diphenyl-polyenes, bixin and lycopin form a group of molecules with the same force constant; the metyl- and furyl-carboxylic acids and aldehydes form other groups. Hence the spectral shift occurring in conjugated organic molecules must result from the stretching of the bonds in the conjugated groups by the increased weight of the molecule.

20. Fluctuations of Cosmic-Ray Ionization Data Obtained with Proportional Geiger Counters. PAUL WEISZ AND W. F. G. SWANN, *Bartol Research Foundation of The Franklin Institute.*—Two identically built proportional Geiger counters were operated in such a way that any ray passing through the same length of path in both counters, as defined by an additional coincidence arrangement, would yield a record of the pulse size supplied by each proportional counter. The counters were surrounded by 10 cm of lead on all sides to prevent simultaneous rays from producing disturbing records. The six hundred dual records so far obtained have been analyzed as to the relative fluctuations between the two data of each pair. The analysis shows that the probability for obtaining two data identical within 10 percent is greatest, as should be expected. If the frequency of such identical pairs be F, pairs of data differing from each other by 50 percent are obtained in about $1/2$ F cases, differences of 100 percent in $1/10$ F cases. One of us[1] has pointed out that such fluctuations should be expected, since the ionization does not occur in individual pairs of ions only, but in form of ionization blobs of different sizes, some of which may contain great numbers of ions. Their number is infrequent enough to be subject to appreciable fluctuations.

---

[1] W. F. G. Swann, Paper No. 15, Am. Phys. Soc. Meeting at Baltimore, Maryland, May, 1942.

AUTHOR INDEX TO ABSTRACTS OF PAPERS PRESENTED AT THE STATE COLLEGE MEETING