Proceedings of the Southeastern Section of the American Physical Society

Minutes of the University of Georgia Meeting, March 31 and April 1, 1939

THE fifth annual meeting of the Southeastern Section of the American Physical Society was held at the University of Georgia, Athens, Georgia, on March 31 and April 1, 1939. Local arrangements for the meeting were in charge of a committee consisting of: L. L. Hendren, chairman, E. H. Dixon, R. G. Henry, and R. H. Snyder. Approximately 150 members and guests were registered. The following officers were elected for the year 1939–40:

Chairman,	B. A. Wooten
Vice-chairman,	R. C. Williamson
Secretary,	P. Rudnick
Treasurer,	W. S. Nelms

Charleston, S. C., was selected as the place for the annual meeting in 1940, at the invitation of The Citadel.

Dr. Detlev W. Bronk, Director of the Johnson Foundation for Medical Physics at the University of Pennsylvania, was the guest of the Section and principal speaker in a symposium on biophysics, for which the program is printed below, together with abstracts of research papers presented at the meeting. The total number of papers on the program was 52; abstracts of those related to the teaching of physics are published in the August issue of the American Physics Teacher.

Philip Rudnick
Secretary, Southeastern Section

Program of Symposium on Biophysics

The Physical Basis of Biological Organization.—Detlev W. Bronk, *Johnson Foundation for Medical Physics.*

Applications of Nuclear Physics to Biology.—J. B. Fisk, *University of North Carolina.*

The Present Status of the Electron Microscope.—Otto Stuhlman, Jr., *University of North Carolina.*

Applications of Photography to Medical and Biophysical Problems.—G. G. Quarles, *University of Alabama.*

Purification of Biological Materials by Centrifuging.—J. W. Beams, *University of Virginia.*

A Recording Sensitive Differential Manometer.—William Hurst, *Duke University.* (See abstract 18)

The Lethal Effect of 2537A Radiation on Bacteria.—D. Gordon Sharp, *Duke University.* (See abstract 19)

Abstracts

1. A Method of Measuring Electrolytic Conductivity at High Frequencies. Gordon Stipe, Jr., and J. H. Purks, Jr., *Emory University.*—The rate of energy absorption by different solutions of hydrochloric acid in a cylindrical glass cell placed in a coil carrying several amperes at frequencies of the order of ten magacycles has been measured. This rate of energy absorption was found to be a function of the specific electrical conductivity σ, the volume v of the solution, the area a of the solution normal to the field, the frequency f of the current i in the coil, and a factor k which depends only on the dimensions of the coil and is defined by $H=ki$. An empirical relation was found which is expressed by the equation $\Delta u/\Delta t=\rho vs\Delta T/\Delta t=[1.449\times10^{-16}]av\sigma k^2i^2f^2$, where $\Delta u/\Delta t$ is the rate of energy absorption. A theoretical equation for the rate of energy absorption was derived. This equation is $\varphi u/\varphi t=[\pi/2\times10^{-16}]av\sigma k^2i^2f^2$ which agrees closely with the empirical equation. Since all factors in this equation other than the conductivity may be measured independently, the above relation may be used to determine the high

frequency electrical conductivity of electrolytic solutions from the rate of energy absorption by the solution in a high frequency magnetic field.

2. The Determination of Melting Points by Transmitted Light. DUDLEY WILLIAMS AND BENJAMIN HINTON, *University of Florida.*—An arrangement for the determination of melting points is described. A sample of the compound being studied is placed on a thin glass plate mounted inside a temperature-control bath. Light from a linear filament passes through the sample and is focused on a narrow slit behind which is mounted a photo-cell. At the melting point the intensity of the transmitted radiation increases and causes a rapid rise in the photo-current. Temperatures are determined by means of a thermocouple mounted in the control bath close to the sample. Typical photo-current *vs.* temperature plots are shown. Results obtained by the present method are compared with those obtained by visual observation and cooling-curve measurements.

3. An Apparatus for the Excitation of Raman Spectra of Gases. J. S. KIRBY-SMITH, *Duke University.*—An apparatus designed primarily for the excitation of Raman spectra of gases at low pressures has been constructed and put into operation. The light source consists of 16 low voltage direct-current Pyrex mercury arc lamps. Each lamp is 60 cm long and dissipates, normally, about 500 watts. A specially designed lamp housing, cooled with compressed air, permits reflectors, arcs, and scattering tube to be mounted in close contact without overheating. Appropriate filter solutions for isolating the various exciting lines, usually either Hg4047 or Hg4358, are circulated through a jacket surrounding the Raman tube. The entire apparatus operates in a vertical position, and the scattered light is reflected, by means of a right angle prism, into a Zeiss 3-prism spectrograph with an effective camera aperture of f: 2.3. Initial measurements have been made on a series of gaseous amines at about two atmospheres pressure. Good Raman plates have been obtained after exposures of from 3 to 6 hours.

4. Spectrographic Differentiation of Thallium Toxicity and Frenching of Tobacco Plants. G. M. SHEAR AND H. D. USSERY, *Virginia Polytechnic Institute.*—It is known that certain elements in minute amounts produce marked results on the growth of plants, some producing toxic effects, and the absence of certain others causing deficiency diseases. Frenching, one of the most important tobacco diseases, has remained confused with thallium toxicity, primarily because it has not been possible by ordinary chemical analysis to detect and measure the very small amounts of thallium required to produce toxic effects. In this investigation, ashed samples of leaves from tobacco plants grown in water cultures, and on frenching and nonfrenching soils were arced on copper electrodes, the spectrum from $\lambda = 2200$A to $\lambda = 4400$A being photographed with a grating spectrograph. Estimations of the thallium content for certain samples was made by comparing the intensity of the thallium line $\lambda = 3775.73$A in these samples with the intensity of the same line in samples of ash to which known amounts of thallium were added. The results of this work show that thallium toxicity and frenching are not the same, because no thallium was detected in the ash of the frenched tobacco, whereas thallium was found in measurable amounts in the ash of plants receiving thallium in amounts too small to produce thallium toxicity.

5. The Physical Factors Involved in Blood Volume Determination. JOHN C. BURCH, E. T. ELLISON AND N. UNDERWOOD, *Vanderbilt University.*—A brief outline of the method of measurement is presented. Measurements of the index of refraction, the density, and the hematocrit are made at the same time the blood volume is measured. Thus the changes in the quality of the blood that accompany changes in volume are indicated in these experiments.

6. Skin Temperature Measurements. M. A. PITTMAN, *Madison College.*—A study of the skin temperatures of various types of individuals was made using very simple apparatus. Radiation leaving the subjects passed through a hole in the end of a box housing a vacuum thermocouple with rocksalt window. The thermocouple was connected to a 10-ohm galvanometer and temperatures were measured by comparing deflections of the mirror with those produced by a blackbody of known temperature.

7. Dental Fluoroscope and Shield. C. R. FOUNTAIN, *George Peabody College for Teachers.*—The present form of dental fluoroscope, consisting of a small fluorescent screen clipped at an angle of about 30° to a regular dental mirror, is very similar to that designed by the author several years ago. The original design was not as satisfactory as desired and was not made public because the fluorescent screens available at the time did not show quite enough contrast when exposed to the type of x-rays regularly used for photographic work. The new fluorescent screens (Type B) are much more sensitive and give ample contrast, especially when exposed to the softer x-rays available with modern x-ray machines. The x-ray image on the screen, within the mouth, is viewed in the mirror by an observer entirely outside the path of the small beam of x-rays. When used with a lead shield designed to limit the direct beam and concentrate most of the secondary radiations upon the same small area, the operator of this dental fluorescope is not exposed to harmful radiations. The screen is protected from action upon it by saliva and sterilizing agents.

8. Graphical Evaluation of the Statistical Significance of Rate Differences. F. T. HOLMES, *University of Virginia.*—Workers in the general field of biology frequently must interpret rate differences. This is often done qualitatively rather than on a sound quantitative statistical basis. The work presented here was begun in the belief that the above-described condition was caused and fixed as a habit in many individuals by fear of the square root sign. It has been found possible to exhibit graphically on log-log scales certain curves which are sufficient to determine the presence or absence of a statistically significant difference between two rates. The graphs cover explicitly a wide

range of these four parameters: 2σ, p_2, N_2, and N_1/N_2 where $2\sigma = p_1 - p_2 =$ twice the standard error for the numerical data given by p_1 and the remaining parameters, the p's and N's representing, respectively, the rates to be compared and the totals of the numbers of events from which the rates were computed. It is believed that the use of these graphs will occasionally save time for persons who are mathematically skilled and both time and effort for those who are not.

9. A Statistical Treatment of the Ultracentrifugation of a Bacteriophage. THOMAS DAVIS, *Virginia Polytechnic Institute.*—The formulae for the statistical treatment of the errors of sedimentation constants and their influence upon subsequent calculations are set forth. Emphasis is placed upon the special advantage of statistical methods to biological data. The sedimentation constant, density, diameter and apparent "molecular weight" of an anti-colibacteriophage are given along with their mean errors, based on many independent determinations.

10. Mileage of Gasoline at Different Speeds, and of Different Grades. J. B. DERIEUX, *North Carolina State College.*—The miles per gallon of gasoline were determined at speeds from five to sixty miles per hour, and the grades tested were "high-test," "regular," and "traffic." Graphs of mileage against speed were smooth curves rising rapidly as speed increased to twenty-five miles per hour, where the maximum was reached, then falling away more slowly beyond. Data on different cars were obtained and they all had approximately the same values. There was very little difference in the mileage of different grades. Gasolines of different companies all gave approximately the same value. The tests were made without adjusting the octane selector for the different grades, just as the average motorist usually does in trying out the different grades. In the apparatus arrangement, the fuel pump was disconnected from the pipe leading to the car's gasoline tank, and connected to a tube leading to a two-way stopcock, one of the ways of the cock was connected by a tube into a graduate where the volume used was measured, the other way of the cock was connected into a large bottle of the gasoline under test, and was switched to it while initiating a run.

11. Remarks on the Study of Structural Viscosity and an Example of the Technique for a Cellulosic "Solution." FRANCIS BREAZEALE, *American Enka Corporation.*—The problem of determining the flow properties of imperfect viscous fluids, is discussed. It is shown how the data from capillary and Couette viscometers may be correlated with that from other experimental procedures to give good information about the fluid in regard to: (1) the existence (and magnitude) of yield value; (2) the existence (and extent) of creep; (3) the form of the viscosity rate of shear function. The differences between, and factors governing Ostwald and Bingham systems are emphasized. It is indicated how the expressions for the flux of such fluids through a cylindrical pipe may be derived. As an example, photographs of the movement of a cellulosic solution through a tube are shown. They indicate: no creep; no yield value; but structural viscosity. Measurement of this liquid in capillary and Couette viscometers confirm this. An approximate expression for the flux of the fluid is derived *in extenso.*

12. Infra-Red Absorption of Mixtures Containing D_2O. P. E. SHEARIN AND E. K. PLYLER, *University of North Carolina.*—The purpose of the present study was to determine if the nature of the solvent affected the association of D_2O molecules. The investigation included mixtures of heavy water and acetone, isopropyl ether, ethyl alcohol, and isoamyl alcohol. One absorption band of heavy liquid water is at 4μ and the corresponding band of heavy water vapor occurs at 3.6μ. Mixtures of heavy water with the two alcohols showed the water absorption band at 4μ. Practically no change was observed in this band as concentrations were varied from 2 percent to 20 percent. This indicated that the association between D_2O and the alcohols produces about the same effect as the association of D_2O with itself. In the case of a 5-percent solution of D_2O in isopropyl ether a broad band was observed with a minimum at approximately 3.95μ. This showed that the binding between the ether molecules and the water molecules is different from the association of D_2O and alcohol. The acetone-water mixtures showed a further shift in the D_2O band to 3.8μ. The concentrations varied from 5 percent to 20 percent of D_2O. The D_2O molecules are nearer to the vapor state in the acetone-water mixtures than in the other mixtures.

13. Near Infra-Red Absorption Spectra of Some Sugars. E. S. BARR AND C. H. CHRISMAN, *Tulane University.*—By use of a fluorite prism spectrometer, infra-red spectra have been observed in the region between 1.7μ and 5.0μ for nine monosaccharides (*d*-arabinose, *l*-arabinose, *d*-xylose, *l*-rhamnose, *d*-mannose, *d*-galactose, *d*-levulose, *d*-glucose, and β-*d*-glucose) and four disaccharides (sucrose, maltose, *d*-lactose and β-*d*-lactose). Saturated solutions in water were used for some of these materials, but for most of them it was found that slow evaporation made it possible to prepare cells with the water content highly reduced, without crystallization setting in. This procedure reduces the error involved in correcting for the absorption of the solvent. Characteristic absorptions were observed at 2.16μ and 2.35μ. The strong general absorption in the region of 3.3μ was partially resolved into the component bands.

14. The Influence of Discharge Chamber Geometry upon the Striking Potential of the H.F. Discharge. SHERWOOD GITHENS, JR., *University of North Carolina and Wake Forest College.*—In a paper on the striking potential of the h.f. discharge in hydrogen given at an earlier meeting (February 20, 1937), the relations of striking potential to pressure at 6 frequencies between 5 and 10.5 megacycles were shown. These curves possessed three minima instead of the usual Paschen law single minimum. A corresponding set of curves, obtained with the latest of a series of specially-designed discharge chambers, will be presented. A comparison of curves and discharge chambers verifies that the

lowest-pressure minimum in the older chamber is produced by a discharge initiating between either electrode and the walls of the chamber; and leads to the conclusion that at most frequencies, there are two modes, rather than one, in which a discharge may initiate between the electrodes.

15. The Effect of Humidity and Sphere Material on the Sparkover Voltage of the 2-Centimeter Sphere Gap. ARTHUR B. LEWIS, *University of Mississippi.*—Data are presented showing that: (1) The effect of humidity on the irridiated 2-centimeter sphere gap, set at a gap of 4 mm, is to increase the sparkover voltage by +0.13 percent per mm (of mercury) increase in vapor pressure of the water in the atmosphere. This effect is apparently independent of the sphere material for the metals aluminum, brass, chromium, nickel and steel. (2) There seems to be no choice between these metals so far as the repetition of the results is concerned, the probable error of a day's results averaging ±0.28 percent. This error can be largely if not wholly accounted for in terms of known sources of uncertainty. (3) Even when corrected for all known variables, including humidity, the final sparkover voltages for the spheres of various metals differ from each other by far more than can be accounted for by any definitely recognized source of uncertainty.

16. Apparatus for Nuclear Physics. J. C. MOUZON, *Duke University.*—A description of an inexpensive half-million volt a.c. transformer set made up of discarded x-ray transformers, its associated equipment, and its application to specific nuclear problems will be given.

17. Emission of Electrons from "Cold" Metallic Targets under High Energy Positive Ion Bombardment.* J. B. FISK, *University of North Carolina.*—A small electrostatic generator at the Massachusetts Institute of Technology has been used to accelerate protons, (hydrogen molecular ions, and singly charged helium ions), to energies between 50 and 450 kv. The ions then struck a cold metallic target. The number of electrons emitted per incident ion was measured as a function of incident energy for a number of different metals. For protons, the "yield" of electrons varied smoothly from about 4 at low energies to about 2 at high energies, nearly independent of target material. The yield for hydrogen molecular ions was about seven; for helium ions about 13, there being little variation with energy. For targets of Mo, Cu, Pb, Al prepared in a given manner the yield was very nearly proportional to the mass of the bombarding particle. However, the yield depends very markedly on the condition of the surface of the target.

* Hill, Buechner, Clark and Fisk, Phys. Rev., in press.

18. A Recording Sensitive Differential Manometer. WILLIAM HURST, *Duke University.*—A modification of the differential manometer recently described in the literature[1] has been made which possesses several advantages over the former instrument. A drum with light weight rubber stretched over it actuates a mirror which pivots on a glass shaft. The manometer is sensitive to pressure changes equivalent to 0.00005 cm of mercury and responds to pressure variations occurring as rapidly as 25 per second. Pressure variations are recorded on moving sensitized paper. While the instrument has been developed for use in clinical medicine, it has already been applied to problems in zoology, such as the study of the respiration of small insects.

[1] William Hurst, "A Sensitive Differential Manometer," Rev. Sci. Inst. **10**, 27 (1939).

19. The Lethal Effect of 2537A Radiation on Bacteria. D. GORDON SHARP, *Duke University.*—In order to measure the lethal effect of 2537A radiation on bacteria an apparatus[1] was used in which the organisms were carried in a stream of compressed air through a region of high intensity rays. Measurements made on intensity of radiation and speed of the air stream were used to calculate the energy incident per unit area of each bacterium. By taking samples of the air beyond the exposure chamber and counting the number of survivors, quantitative data were obtained on several species. *Bacillus subtilis* was killed with an incident energy of 62,225±7.2 percent ergs/cm² while *Pseudomonas aeruginosa* required 16,100±5.4 percent for complete killing. All other organisms tested were in this region. In the case of *Escherischia coli* the survivor curve was plotted. It was found that this curve showed considerable deviation from the one predicted by existing theory. This deviation was especially apparent for survival ratios less than one percent. These low survival ratios have not been examined by the plate method because of its physical limitations not inherent in the present method. The explanation of these results necessitates an alteration in the proposed theories of lethal action of ultraviolet rays, and it is suggested that more weight be given to the variation in individual cell resistance.

[1] D. Gordon Sharp, J. Bacteriol. **35**, 589 (1938).

20. Surface Effects in Testing for Ferromagnetic Impurities. F. W. CONSTANT AND J. M. FORMWALT, *Duke University.*—As described in previous papers, a method has been developed whereby a permanent magnetic moment as small as 10^{-7} per cc may be measured in any small solid specimen—less than 10^{-7} percent of that found for Armco iron. For the various metals tested, magnetic moments per cc of 2×10^{-7} to 8×10^{-2} were found. In such measurements the elimination of surface impurities is of prime importance. The effectiveness of various methods of cleaning has been investigated with several metals. In most cases the cleaning fluid used made little difference, and a series of tests on the same specimen would show a linear relationship between the total magnetic moment and the volume, or a constant magnetic moment per cc. In testing aluminum, however, it was found that some solvents appear to leave the ferromagnetic impurity in the form of a film adhering to the surface, so that the magnetic moment per cc increases with successive cleanings.

21. Linearity of Wide Range Galvanometer Response in a Photoelectric Spectrophotometer Utilizing a Balanced Amplifier Circuit. WALTER C. BOSCH AND BARREMORE B. BROWN, *Tulane University.*—Photo-cell conductances, *C*, for a large range of spectral intensities in the visible and

ultraviolet are measured by a null method and for each intensity the deflection, d, of the plate galvanometer in a DuBridge-Brown amplifier is read. An equation, $d=AEC/(1+CR)k$ is experimentally investigated. E, the potential across the photo-cell and series resistance, R, is kept constant at 90 v. A 3.5-meter mirror to scale distance reduces the galvanometer constant, k, and increases the voltage sensitivity of the amplifier. The factor $(1+CR)$ equals 1.005 for the greatest deflection used. The current amplification factor, A, quickly deviates from constancy unless proper bias conditions are established and a method for determining correct bias is given. Experimental data and curves for $R=10^9$ and 10^{10} ohms show that, with correct bias, conductance/cm for any given value of R is a constant within ± 1 percent of a mean value for deflections up to 1500 cm. The incident light flux in this deflection range, both values of R considered, is estimated to vary between 10^{-5} and 10^{-8} lumen.

22. Effective Rotation Temperatures of CO in the Electrodeless Discharge. MYRON S. MCCAY, *Virginia Polytechnic Institute*, AND HAROLD P. KNAUSS AND BRUCE ARCHDEACON, *Ohio State University*.—The effective rotation temperatures of carbon monoxide in the electrodeless discharge heated by an electric furnace have been determined by the method of band intensity maxima, and from the intersection of the intensity envelopes of the branches composing the band.[1] The temperatures were found from the line intensities of the (0,1), (0,2), and (0,3) bands of the Angstrom system of CO for furnace temperatures ranging from 300°K to 600°K. Comparison with readings of an air thermometer placed within the discharge indicates a consistently higher spectroscopic temperature, in contrast with the observed convergence of furnace temperature and rotation temperature at high values for the low-voltage arc.[2]

[1] Phys. Rev. **52**, 1143 (1937).
[2] Proc. Phys. Soc. **47**, 413 (1935).

23. The 7.5μ Fundamental Vibration of CH_3Cl. ALVIN H. NIELSEN* AND HARALD H. NIELSEN, *Ohio State University*.—Because of the small separation of the rotation lines in the parallel bands of CH_3Cl they were not at first[1] resolved. Somewhat later Barker and Plyler[2] partially resolved the band ν_5 at 13.7μ giving the spacing as 1.1 cm^{-1} and computing the moment of inertia A to be 50×10^{-40} g cm^2. Nielsen and Barker[3] remeasured ν_3 at 7.5μ and with poor resolution found $\Delta\nu_r$ to be 1.3 cm^{-1}. The writers have made a new attempt to resolve ν_3 with fair success. The spectrometer used was of prism-grating design equipped with a 2000-line-per-inch grating. The slits included a spectral interval of 0.6 cm^{-1} and galvanometer readings were taken at intervals of 0.2 cm^{-1}. The lines in the P branch are resolved much better than the lines in the R branch because of the isotope shift, but on averaging the best line spacings over the whole band, the value appears to be about 0.96 cm^{-1} which gives a value of A equal to 57.9×10^{-40} g cm^2.

* University of Tennessee, Department of Physics.
[1] W. H. Bennett and C. F. Meyer, Phys. Rev. **32**, 888 (1928).
[2] E. F. Barker and E. K. Plyler, J. Chem. Phys. **3**, 367 (1935).
[3] A. H. Nielsen and E. F. Barker, Phys. Rev. **46**, 970 (1934).

24. Force Constants of NO_2 Groups. DUDLEY WILLIAMS AND LORAINE DECHERD, *University of Florida*.—The infrared spectra of inorganic nitrite solutions have been studied. From the fundamental frequencies it was possible to determine the force constants and angles involved in the group. The values obtained for the angles are in fair agreement with x-ray data. The force constants of the nitrite group are compared with those of the nitro groups in organic compounds and with those of nitrogen dioxide.

25. Change of the Viscosity of Liquids Produced by an Electric Field. A. A. DIXON, *North Carolina State College*.—The work of Alcock[1] showed that for polar liquids, the viscosity was changed by an electric field but for nonpolar liquids the effect was zero. A rotating cylinder type of viscosimeter has been used during the past year to measure the effect of an electric field on the viscosity of several liquids. A potential difference which could be varied, was applied between the two cylinders. Some of the liquids tested were the same as those reported by Alcock and the results were similar to those contained in his report. Measurements on a few additional liquids have been made. In all the polar liquids tested the viscosity was found to increase with the electric field strength.

[1] E. D. Alcock, Physics **7**, 126 (1936).

26. The Unit Cell and Space Group of Potassium Bicarbonate. RICHARD C. KEEN, *Louisiana State University*.—Small needle-shaped crystals of potassium bicarbonate were prepared by passing carbon dioxide gas through a solution of potassium carbonate. X-ray rotation photographs about all three coordinate axes were taken. The planes producing the diffraction spots were indexed using the Benal reciprocal lattice method. According to data given by Groth the crystal should have axial ratios of $a:b:c=2.677:1:1.311$. This was found to be incorrect and axial ratios are actually $a:b:c=2.667:1:0.655$. The length of a unit cell along Z axis is only one-half of the value given by crystallographic measurements. Planes having indices hOO and OkO were missing when h and k were odd. Calculations from density, molecular weight of potassium bicarbonate and the dimensions of unit cell, obtained from measurements of photographs, show that there are four molecules of this compound in each unit cell. These measurements and missing planes would suggest the compound should belong to space group C_{2h}^4. Characteristics of this space group together with preliminary calculations show this to be an impossible arrangement. A space group, retaining the glide plane along X axis and having much lower symmetry, C_s^2, is suggested. This space group accounts for absence of hOO planes when h is odd. There is also no physical reason why the computed intensity of OkO planes should not be zero when k is odd. Then this space group, C_s^2, having only two molecules per unit cell enables one to apply its parameters twice to obtain the four molecules and to overcome the impossible difficulty of concentrating atoms at one-fourth, one-half, and three-fourths the distance along X axis, which led to the impossible atomic distances inherent in the C_{2h}^4 space group arrangement.

27. An Analytical Centrifuge.* J. W. BEAMS AND R. E. FOX, *University of Virginia.*—A new design of a vacuum type analytical centrifuge is described which requires no optical system. The driving and supporting mechanism has been previously described,[1] the only changes being in the large rotor or "centrifuge." The centrifuge contains a number of identical sector-shaped cells spaced symmetrically with respect to the axis of rotation and equidistant from it. These cells are connected by small channels near their periphery so that each is filled to the same radial distance when the centrifuge is spinning. If the cells "overflow," the material is collected in a chamber situated above them. The centrifuge is first accelerated to the desired speed and the material to be centrifuged is injected through the hollow supporting shaft into the cells. The centrifuge is maintained at constant angular speed until the desired separation has taken place. A sufficient amount of heavy nonmiscible liquid is then injected into the cells at their periphery, to force about half of the solution (by volume) being centrifuged into the upper chamber. The machine is then stopped. From a determination of the cencentration of the material in the upper chamber and of the original material, the dimensions of the centrifuge, time of centrifuging, and angular speed, molecular weights and sizes can be found. This apparatus may be used either for sedimentation equilibrium measurements or rate of sedimentation measurements.

* Supported by a grant from the Research Corporation.
[1] Beams, J. App. Phys. **8**, 795 (1937).

28. Measurement of Radiation of the Sky. C. M. HECK, *North Carolina State College.*—The radiation of the sky toward the earth has been recorded throughout 1938 by means of thermometers and thermocouples placed in the bottom of a small hemispherical aluminum mirror, which mirror was placed confocally within an enclosing mirror of double the diameter. In turn, the larger mirror was enclosed by a still larger mirror and this by one still larger, making a confocal nest of four mirrors, the function of each being: (a) to protect the mirror enclosed from the radiation of the earth and convectional currents of the air; (b) to direct radiation to the enclosed mirror only from the sky. With such devices the radiation has been continuously studied at Raleigh and for a short time from the top of Mount Mitchell and from the top of the Empire State Building. Curves of the variation in radiation show: (a) a sudden fall in radiated heat around sunset that allows the temperature within the radiometer to fall as much as 35° below that of the surrounding atmosphere, which great differential tends to remain constant thereafter throughout the night. (b) the differential appears dependent on the absolute humidity and its relative distribution in the atmosphere whereby upper gulf air masses or passing invisible clouds of higher absolute humidity are recorded with precision. (c) the average point of thermic control of such insulated and radiation environed points at the earth's surface can thus be carried to heights of two or more miles.

29. The Light Plane Hypothesis. J. L. TALLEY, *Junior College of Augusta.*

30. Displacements of Raman Frequencies of Some Aliphatic Molecules in Water Solution. R. C. WILLIAMSON, *University of Florida.*—The substances studied were methanol, ethanol, acetone, dioxane, formic, and acetic acids. Curves are presented showing the displacements (plus or minus) of the following Raman frequencies as functions of the ratio of the number of molecules of water to one of the solute: $C-H^{(\nu)}$ (+methanol, +dioxane); $C-O$ (−methanol, −ethanol, −dioxane); $C=O$ (−acetone); $C-C$ (−ethanol, +acetone, −dioxane). The curves indicate approximate saturation, the greater part of the shift being attained below a molar ratio of four of water to one of solute. The frequencies are usually displaced with no broadening of the lines. Except that in the case of formic and acetic acids (as noted by previous observers), the $C=O$ line at 1666 cm^{-1} gradually fades and a new one develops with a frequency increase of 52 cm^{-1} (formic) and 42 cm^{-1} (acetic). Microphotometer records show that the original line and the new one are about equal intensity at a molar ratio of approximately one of water to two or three of acid. The shifts observed for dioxane in water agreed to within approximately 2 cm^{-1} with those reported by Simon and Feher. Dioxane shows well marked $C-H^{(\nu)}$ shifts, reaching +14 cm^{-1} at ratios of six to one. No measurable shifts were observed for the flexural $C-H^{(\delta)}$ frequencies. The $C=O$ acetone line at 1712 cm^{-1} was decreased by 11 cm^{-1} at a molar ratio of 6 to 1, contrary to Edsall who reported no observable shift.

31. A Study of Dielectric Absorption. J. W. SIMMONS, *Virginia Polytechnic Institute.*—An extensive study of absorption in waxed paper used as a dielectric has been made to determine empirical equations expressing the relation of absorbed current to times of change, discharge, and recovery after discharge. High capacity and low direct-current potential were used to avoid leakage and other losses. Results have been as expected, residual charge increasing rapidly with time of charge, for fixed times of discharge and recovery after discharge, until maximum charge is approached, then increasing very slowly. The inverse effect is true for variation of residual charge with discharge time, charge time and time of recovery being fixed. Curves of residual charge plotted against time of recovery after discharge show a marked increase in slope for the higher values of charge time, but are almost flat for small charge times. Increase in time of discharge tends to flatten the curves, even those of large charge time values. It is hoped that a connection between the curve equations and alternating-current dielectric losses may be shown.