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Program of Research Papers
at the
Annual Meeting of the Southeastern Section
of the
American Physical Society

UNIVERSITY OF ALABAMA, TUSCALOOSA, ALABAMA

April 1 and 2, 1938

Newly elected officers of the Southeastern Section of the American Physical Society are:

OTTO STUHLMAN, JR.	—*Chairman*
B. A. WOOTEN	—*Vice Chairman*
PHILIP RUDNICK	—*Secretary*
W. S. NELMS	—*Treasurer*

INVITED PAPERS

1. **Radioactivity.** KARL K. DARROW, *Bell Telephone Laboratories.*
2. **Thermodynamical Viewpoints in the Study of Nuclear Reactions.** L. W. NORDHEIM, *Duke University.*
3. **Twenty-Five Years of Wilson Cloud Chamber Research; an Illustrated Survey of the More Important Discoveries Made with the Cloud Chamber.** ARTHUR E. RUARK, *University of North Carolina.*

ABSTRACTS OF CONTRIBUTED PAPERS

1. Measurement at High Frequencies of the Diamagnetic Faraday Effect in Liquids. G. C. COMSTOCK, *The Citadel.*—Direct measurements of the Verdet constants of four diamagnetic liquids: carbon disulfide, glycerine, isopropyl and amyl alcohols, for optical frequencies far removed from their absorption regions, have been made in the comparatively high radiofrequency range from 1 to 1.7×10^7 c.p.s. by the modification of a method due to Bretscher,[1] in which a photo-cell coupled to a tuned radiofrequency amplifier was used as the detector of the rotations of the plane of polarization. The variations of the plate current in the output circuit were calibrated in terms of the peak Faraday rotations. The radiofrequency values of the Verdet constants were compared with those obtained by measurement at 60 cycles and with direct current using a.f. and d.c. photoelectric amplifiers. The Verdet constants were found to be independent of the frequency of the field up to 1.7×10^7 c.p.s. within the experimental accuracy of about 5 percent. These measurements are in agreement with the theoretical predictions of Persico[2] of the constancy of the Faraday rotation with variable magnetic field frequency for optical frequencies far removed from the absorption frequencies of the liquids. No anomalous effects were found at radiofrequencies for which these liquids show strong absorption of the radio waves.

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[1] E. Bretscher, Helv. Phys. Acta **9**, 42 (1936).
[2] E. Persico, Rend. Linc. **3**, 561, 603 (1926).

2. Optical Activity of Nickel Sulfate, α-Hexahydrate. EDWARD B. NELSON, *Vanderbilt University.*—Nickel sulfate crystals of the α-hexahydrate form have been examined to determine the relative number of laevo- and dextrorotatory crystals, the activity of their solutions, and the rotatory dispersion of the crystals. The relative abundance of the laevo- and dextrorotatory crystals is a one to one ratio. The crystals are found to be mirror-image crystals, since sections of equal thickness give numerically equal rotations for any particular wave-length. Aqueous solutions of only laevo-, and of only dextrorotatory crystals were separately examined throughout the visible spectrum, but no optical activity was observed. Visual observations with a Lippich half-shade polarimeter and photographic observations with an adaptation of the method of Fizeau and Foucault were made of the rotatory dispersion of the crystals which was found to be of an anomalous nature. The rotation is zero for light of wave-length 5030A. Above this point the rotation increases gradually in magnitude to about 6200A where it begins to increase rapidly. Below 5030A the rotation increases gradually in magnitude to about 4600A where it begins to increase rapidly. The sign of the rotation of each crystal changes on passing the zero point. The rotation for the D line of sodium is approximately 1.55° per mm.

3. The Effect of Humidity and Irradiation on the 2.0 cm Sphere Gap. ARTHUR B. LEWIS, *University of Mississippi.*—Quantitative data are presented showing the effects of humidity and irradiation on the 2.0 cm sphere-gap voltmeter in the lower voltage ranges. Preliminary work has been confined to a single gap setting, 4.0 mm (about 10 kv peak). Irradiating this gap with a 500-watt cored-carbon arc lowers the sparking voltage by 2.0 percent from the value obtained when the gap is completely dark, and decreases the probable error of a single observation from about ±0.7 percent with the gap dark to about ±0.1–0.2 percent with the gap irradiated. A sixfold increase in the intensity of this irradiation causes no further significant decrease in either the sparking voltage or the scattering of individual observations. The presence of water vapor in the gap causes a roughly linear increase in the sparking voltage of +0.1 percent in voltage per mm (of Hg) increase in vapor pressure. The control of these two variables permits the reproduction of the sparking voltage of this particular gap to ±0.3 percent. This increased accuracy of indication, however, reveals the presence of other variables which affect the indications of the sphere-gap voltmeter and which must be isolated and controlled if the full accuracy of the instrument is to be realized. These are being investigated.

4. A Sensitive Differential Barometer. WILLIAM HURST, *Duke University.* (*Introduced by W. M. Nielsen.*)—A sensitive differential barometer has been designed and constructed for application in clinical medicine. Its sensitivity, small cost, and other characteristics suggest that it may have a wider range of usefulness. In place of the more conventional metal bellows, a drum with light weight rubber stretched over it is used. Motion of the rubber due to differential pressure is applied through a train of gears from a small jeweled wrist watch to an indicating arm attached to the last gear. The device is sensitive to pressure changes equivalent to 0.002 cm of mercury and is capable of indicating pressure changes as rapidly as 10 pulses per second. Because of the design and character of the component parts, the instrument is quite stable. It should be of particular usefulness in the measurement of pressure variations in systems of small volume.

5. Separation of Solutions by the Tubular Centrifuge.* J. W. BEAMS, *University of Virginia.*—The tubular vacuum type air-driven centrifuge[1] has been modified and applied to the separation of solutions. The centrifuge "bowl" consists of an alloy steel tube which is spun in a vacuum chamber. The solution enters the spinning tube at the top continuously through a stainless steel tube, gauge 14. The lighter and heavier fractions are collected at the axis and periphery respectively by channels in the bottom of the spinning tube. These fractions are led to the outside through coaxial tubes, gauges 15 and 12, which support the rotor. Vacuum tight oil glands seal the vacuum chamber and separate the chambers in which the two fractions are collected. The ratio of the quantities of light to heavy fractions collected can be varied over wide ranges. The oil glands or bearings are maintained at approximately the same temperature as the rotor by circulating water or oil. Possible stirring where the solution enters the centrifuge and where the fractions are drawn off is prevented by baffles. Experiments also show that the remixing caused by comparatively wide variations in rotational speed could be prevented by a coil of screen wire which filled the centrifuge. The observed separation was in rough accord with the calculations of Archibald.[2]

6. Practical Applications of Electronic Control Principles to the Operation of a Wilson Cloud Chamber. I. I. HOPKINS, R. T. DICKERSON AND W. M. NIELSEN, *Duke University.*—A circuit for the complete electronic control of a Wilson cloud chamber has been designed by one of us (R.T.D.), constructed, and put into operation. The general idea is based on the maximum possible use of gaseous discharge valves and typical resistance capacitance time circuits. Tracks are illuminated by two capillary helium-mercury discharge lamps, each operating from a five microfarad condenser charged to about five thousand volts.

7. Probable Errors in Counts from Geiger-Müller Counters. ERIC RODGERS, *University of Alabama.*—When a large number N of random events are counted with a Geiger-Müller counter, the result is usually written as $N\pm(N)^{\frac{1}{2}}$. This is based on the assumption that the events being counted follow a Poisson distribution, in which case the standard deviation equals the square root of the average. If x is assumed to represent the "true" average count for a given time interval, the probability that a single trial does not deviate from x by more than $(x)^{\frac{1}{2}}$ lies between $(2/\pi e)^{\frac{1}{2}}$ and $(2/\pi)^{\frac{1}{2}}$ if x is sufficiently large. Thus $(x)^{\frac{1}{2}}$ is perhaps not a bad approximation to the probable error, which is that deviation from x for which the chances are equal that a single trial yield a result within or without the range. However, when a single observation is made, the result may differ widely from the "true" average for that interval. It therefore seems that not much faith can be put in the practice of taking the square root of the number of counts obtained in an interval and calling it the probable error even if the interval is of such length that many counts are obtained.

8. Construction and Use of Lissajous Figures. F. H. MITCHELL, *University of Alabama.*—Beginning with space models of Lissajous figures, their equations may be deduced and the component sine waves analyzed without their being in phase. The results are checked by the actual figures as produced by the oscillograph.

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* Supported by a grant from the Division of Natural Sciences of the Rockefeller Foundation.

[1] Beams, Linke and Skarstrom, Science **86**, 293 (1937).

[2] In press.

9. Hysteresis Testing with Cathode Rays. C. T. RAZOR, *The Citadel.*—Application of the conventional type of cathode-ray oscillograph with electrostatic deflection plates to draw hysteresis loops of magnetic specimens. No modification of the instrument is needed. Hysteresis tests may also be made on the cores of completed machines without damage or dismantling. The method is applicable either to quantitative measurements or to quick and easy demonstration. The necessary accessories are found in most laboratories.

10. A Device for Controlling the Temperature of Absorption Cells. DUDLEY WILLIAMS AND RICHARD TASCHEK, *University of Florida.*—A device for controlling the temperature of small absorption cells is described. The arrangement involves a thermocouple, a galvanometer, a photronic cell, and a miniature relay. A light beam reflected from the galvanometer mirror falls upon the photronic cell when the temperature of the absorption cell increases to a certain value. The photronic cell operates a miniature relay which serves to increase the resistance in series with the heating coil, thus reducing the heater current. By proper adjustment of resistances the temperature of the absorption cell can be kept within a certain range. In the arrangement used at present it is possible to control the temperature of the absorption cell to 0.1 degree C at any point between 25 degrees C and 160 degrees C. By the use of a more sensitive galvanometer it should be possible to reduce the range of variation. This arrangement may prove useful in other experimental work where the geometry of the apparatus precludes the possibility of using ordinary forms of thermostatic controls.

11. A Spectroscopic Study of Deuterium Bonds. WALTER GORDY, *Mary Hardin-Baylor College.*—Mixtures of deuterium oxide with dioxane and with acetone have been studied in the region 3 μ to 12 μ. The effect of dioxane and of acetone on the spectrum of the deuterium oxide was to shift the intense 4 μ band to the shorter wave-lengths by about 0.2 μ. In the most dilute solutions, however, the position of the band appeared at wave-lengths appreciably longer than that of the corresponding band of deuterium oxide vapor. In the change from the liquid to the solution state, the shift to the shorter wave-lengths probably indicates the breaking of deuterium bonds between the deuterium oxide molecules. The appearance of the band at longer wave-lengths in the solution than in the vapor state may be a result of the formation of deuterium bonds between the solute and the solvent; variation of certain bands of the solvent provide additional evidence for this interpretation.

12. Calibration Wave-Lengths for Infra-Red Spectrometers. P. E. SHEARIN AND E. K. PLYLER, *University of North Carolina.*—About 20 wave-lengths which have been measured on grating spectrometers have been given for the calibration of prism spectrometers in region from about 2 μ to 24 μ. A number of lines due to H_2O and CO_2 can be normally observed due to atmospheric absorption. Since not many sharp bands have been measured on grating spectrometers from 7 μ to 13 μ, several sharp bands in ethyl alcohol and amyl alcohol in the liquid state have been measured in this region. The values found in the present work check well with those previously found by Weniger except those in the 9 μ and 10 μ region. Here some of the bands differ by about 0.2 μ from those found in this work. This difference is probably due to the fact that Weniger did not have the more accurate values of the index of refraction of rocksalt due to Paschen at his disposal.

13. A Portable Eagle Mounting for a 3 m Grating.* HERTHA SPONER AND WILLIAM HURST, *Duke University.*—Confronted with the necessity of building a grating spectrograph which would take little room and could be easily moved, we have tried the following construction of an Eagle mounting of relatively light weight. The instrument consists of two independent parts. One is the actual spectrograph having an I beam chassis, supporting an optical bench for movement of the grating, and the plate holder. This mechanism is surrounded by a double wall insulating box. The second part is a steel carrier on which the instrument rests on three points, at a convenient height above the floor. The carrier has three rubber tired wheels which may be removed and easily replaced for moving the instrument around the building. Mr. F. B. Key adjusted the instrument. Results have proven so far to be satisfactory with no broadening of the lines even when the instrument was subjected to light blows in short exposure experiments. It should be added that the floor of the room where the instrument is now set up is floated. Another important feature of this apparatus is that the construction was relatively inexpensive.

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* Read by title.

14. X-Ray Crystal Structure Study of Tetramethyl Ammonium Tri-Iodide. R. C. L. MOONEY, *Newcomb College, Tulane University.*—Tetramethyl ammonium tri-iodide was prepared by a method analogous to that used for ammonium tri-iodide; crystals of suitable size and perfection were obtained from slow cooling of an alcoholic solution. They were definitely identified as the tri-iodide by quantitative chemical analysis. X-ray diffraction data were obtained by means of the single crystal oscillation method. The complete set consisted of six overlapping fifteen degree oscillations about each axis. The Patterson modification of the Fourier series method was used to locate atomic positions. The cell size of the crystal is 10.43A, 8.60A, 14.62A along the *a*, *b*, and *c* directions, respectively. The class is orthorhombic bypyramidal, with the space group symmetry of Q_h^{12} (*Pnmn*). All of the iodines are in special positions, lying in the reflection plane perpendicular to the *y* axis. The six parameters necessary to locate them in the plane were found by consideration of observed diffraction intensities. Some assumptions of reasonable interatomic distances were required to decide the positions of the cations. Three iodines are associated to form a monovalent complex anion group. The group is linear, with an iodine to iodine distance of 2.75A. A comparison of the details of this structure with those of ammonium tri-iodide previously examined demonstrates the effects of the relative sizes of anion and cation.

15. Infra-Red Absorption Spectrum of a Liquid Crystal. RICHARD TASCHEK AND DUDLEY WILLIAMS, *University of Florida.*—The infra-red spectrum of the anisotropic liquid peri- (peri-ethoxy-benzalamino) cinnamate has been studied at temperatures from 20°C to 160°C, in the region between 2μ and 12μ. Intense characteristic absorption is found at 3.3μ, 5.85μ, 6.25μ, 7.7μ, 8.0μ, 8.6μ, 9.7μ, and 11.6μ. All but the 8.0μ and 8.6μ bands can be assigned to known inner vibrations of the groups occurring in the molecule. In the anisotropic liquid phase the 3.3μ and 7.7μ bands are found to be shifted to slightly longer wave-lengths than in the solid or isotropic liquid. At constant wave-length, the transmission as a function of temperature remains constant while the compound is solid. Between the melting point and clearing point the transmission increases, the rate and continuity of increase depending upon the wave-length. The transmission remains constant beyond the clearing point and shows a marked hysteresis on cooling the compound. For most wave-lengths one or more "arrests" are observed at definite temperatures in the temperature-transmission curves. The increase in transmission with temperature is attributed to lessened scattering from the constituent "swarms" of the anisotropic phase as it passes to the clear liquid.

16. The Infra-Red Spectra of Nitrate Solutions. DUDLEY WILLIAMS AND LORAINE DECHERD, *University of Florida.*—The absorption of several nitrate solutions has been measured in the region between 2μ and 16μ. The results are compared with earlier measurements of nitrate absorption. In the solutions the nitrate bands near 7.5μ and 15.5μ are intense, while the bands near 3μ, 4.8μ, and 12μ, are comparatively weak. It is found that the characteristic frequencies of the NO_3 group in solution are slightly lower than those of the NO_3 group in crystals, a result in accord with Pfund's early reflection measurements.

17. Design and Calibration of an Infra-Red Spectrometer with a Fluorite Prism. E. S. BARR, *Tulane University.*—An infra-red spectrometer of the Wadsworth type, with an aperture of 0.218, has been built for use with a 60° fluorite prism (sides 45 by 75 mm.). Arrangements have been made for observing prism settings by means of a calibrated dial, or directly to 10″ from a circle. There is provision for interchanging prisms to vary the range of the instrument. Using the index of refraction values of fluorite given by Coblentz,[1] tables have been prepared for circle readings of angles of incidence and for effective slit widths as functions of the wave-length and are shown in the form of curves. By the use of a secondary prism, the fluorite prism is set at minimum deviation for sodium light. The Wadsworth mirror was set visually for sodium light from a sodium arc lamp. For finer adjustment of the mirror and for calibration, atmospheric absorption bands due to CO_2 and H_2O were used. Other well-established points from spectra measured by grating instruments serve as a check on the correctness of the calibration.

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[1] W. W. Coblentz, J. Opt. Soc. Am. 4, 432 (1910).

18. The Refractive Index of Air in the Visible and Photographic Infra-Red. DAVID BENDER, *California Institute of Technology.*—The refractive index of dry CO_2-free air has been measured from 5300A to 11,200A by means of a Fabry-Perot interferometer with invar separating posts. The following dispersion curve was obtained for standard conditions (0°C and 760 mm):

$$(n_0-1)10^7=2885.59+\frac{15.77}{\lambda^2}+\frac{0.421}{\lambda^4}$$

where λ is expressed in μ. A comparison of the present result with those of other observers shows that this curve lies above the others by about 10 parts in 10^7, and that all curves are nearly parallel. This suggests that the discrepancies are due to systematic errors, providing, as seems to be the case, that the constitution of air remains sufficiently constant. In the present experiments systematic errors due to phase change at reflection, methods of purification of the air, and bulk modulus of the invar posts were considered. A calculation concerning the oxygen absorption band at 7600A indicates that this band has no measurable effect on the dispersion of air.

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* Now at Louisiana State University.

19. The Polar Moment of Cellosolves. W. H. BYERS AND A. A. BLESS, *University of Florida.*—The polar moment of 2-methoxy ethanol and of 2-ethoxy ethanol was determined using the heterodyne beat method for finding the dielectric constant. With benzene as a solvent the moment is 2.05×10^{-18} e.s.u. for the first compound and 2.13×10^{-18} e.s.u. for the second. The relation between these values and the values of the moment of the related alcohols is discussed. Work is now in progress on the other members of the series.

20. A Sensitive Method of Detecting Magnetic Impurities. F. W. CONSTANT AND J. M. FORMWALT, *Duke University.*—The presence of ferromagnetic impurities in any small solid specimen may be detected and magnetic moments per cc as small as 10^{-7} (compared with 10^3 for pure iron), measured by the following method. The specimen is first placed in a strong magnetic field which serves to magnetize all the magnetic impurities in the same direction. Their residual magnetism is then measured by suspending the specimen by a delicate quartz fiber at right angles to a weak field supplied by Helmholtz coils. By noting the deflection and calibrating the fiber the residual magnetic moment is determined. It was found to range from 7×10^{-2} per cc for brass, to 3×10^{-7} per cc for Pyrex, all materials tested showing some ferromagnetic impurity. It is of interest that such small impurities are still ferromagnetic; further study of their magnetic properties is being made.

21. A Displacement Polarimeter. NEWTON UNDERWOOD, *Vanderbilt University.*—The device is based on a deformation of the fringe system seen when a uniaxial crystal cut with its faces perpendicular to its optic axis is observed in convergent elliptically polarized light. The polarimeter is constructed using Polaroid, quartz and Cellophane, arranged in the following order; the polarizer, the specimen, the wave plate which covers one-half of the field, the converging lens, the quartz, and finally the analyzer Polaroid. The field of the instrument consists of the rings due to the quartz and is bisected by the edge of the Cellophane wave plate. The rings form continuous smooth curves when the axis of the wave plate is parallel to either the analyzer or polarizer. A rotation of the plane of polarization produced by inserting a specimen immediately in front of the polarizer causes a break to appear in the curves at the edge of the wave plate. Rotation of the polarizer or analyzer to compensate for the rotation introduced by the specimen causes the curves to line up again and thus affords a measurement of the rotation due to the specimen. The measurements are accurate to 0.1°.

22. Collision Relations. ARTHUR E. RUARK AND CREIGHTON JONES, *University of North Carolina.*—Braunbek[1] has published formulas dealing with energy and momentum relations in the collision of two unequal relativistic particles. His results cover both radiative and nonradiative collisions. We have worked out more formulas, with a view to cloud-chamber applications, and will present a systematic summary of those which appear most useful.

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[1] Zeits. f. Physik **96**, 600 and **104**, 619.

Organization Meeting of the New York State Section of the American Physical Society

UNION COLLEGE, SCHENECTADY

April 2, 1938

FINAL steps were taken in the organization of the New York State Section of the American Physical Society at a meeting held at Union College, Schenectady on Saturday, April 2. One hundred seventy-five persons attended, representing institutions in all parts of the state (exclusive of the metropolitan area) and including a large group of High School physics teachers as well as physicists in college and industrial work. After the constitution and by-laws were adopted 83 persons enrolled as charter members and paid their annual dues.

The following officers were elected for a two year term:

Chairman,	P. I. WOLD, Union College
Vice Chairman,	W. B. RAYTON, Bausch & Lomb Optical Co.
Secretary,	P. R. GLEASON, Colgate University
Treasurer,	G. H. CAMERON, Hamilton College
Members of Executive Committee:	
Terms expiring in 1942:	
	MRS. ANNA W. PEARSALL, Hamilton High School
	R. E. BURROUGHS, Eastman Kodak Co.
Terms expiring in 1940:	
	R. C. GIBBS, Cornell University
	C. A. MOOSE, Milne High School, Albany

At the dinner meeting Professor Gibbs brought official greetings to the new organization as President of the Optical Society of America; Dr. Irving Langmuir brought similar greetings from the American Chemical Society.