Proceedings of the American Physical Society

MINUTES OF THE DENVER MEETING, JUNE 25 AND 26, 1937

THE 215th regular meeting of the American Physical Society was held in the Y. W. C. A. auditorium at Denver, Colorado on Friday and Saturday, June 25 and 26, 1937.

Morning sessions were devoted to symposia, and the afternoons to the presentation of the twenty-six contributed papers. Papers 5, 6, 7, 11, 17, 22 and 26 were read by title.

The symposium of Friday morning, held jointly with the Astronomical Society of the Pacific and the Section on Astronomy (D) of the A.A.A.S., was concerned with *Astrophysical Problems of the Ionosphere.* Speakers were:

N. E. BRADBURY, *Stanford University*
A. G. MCNISH, *Carnegie Institution of Washington*
J. H. DELLINGER, *National Bureau of Standards*
R. S. RICHARDSON, *Mount Wilson Observatory*

On Saturday morning a symposium on *Cosmic Physics and High Altitude Effects* was conducted as a joint session with the Section on Physics (B) of the A.A.A.S. The speakers were:

JOYCE C. STEARNS, *University of Denver*
THOMAS H. JOHNSON, *Bartol Research Foundation*
HURD C. WILLETT, *Massachusetts Institute of Technology*
J. C. STREET, *Harvard University*

Maximum attendance at the sessions ranged from 60 to 75 persons.

Abstracts of the contributed papers are given in the following pages. An Author Index will be found at the end.

PAUL KIRKPATRICK, *Local Secretary for the Pacific Coast*

ABSTRACTS

1. High-Pressure Ionization Currents at High and Low Temperatures. JAMES W. BROXON AND GEORGE T. MERIDETH, *University of Colorado.*—The investigation of weak gamma-ray ionization currents in air, discussed in an earlier paper,[1] has been extended to nearly 200 atmospheres. Measurements have also been made in the neighborhood of 96°C and −76°C. Under no conditions have saturation currents been obtained at the highest gradients employed. At room temperature, the ionization-pressure curves appear to pass through maxima within the new pressure range. At 96°C the high-gradient ionization currents continue to increase with pressure at the highest pressures. At −76°C, the ionization-pressure curves have decided maxima in the neighborhood of 60 atmospheres. At the new temperatures the negative ionization currents continue to exceed the positive under the same conditions.

[1] James W. Broxon and George T. Merideth, Phys. Rev. **49**, 415 (1936).

2. Preliminary Report on Recombination of Ions in Air at High Pressures. GEORGE T. MERIDETH AND JAMES W. BROXON, *University of Colorado.*—In conjunction with the measurements of ionization currents induced by weak gamma-rays in air at high pressures (see preceding abstract), determinations of the charge density of ions of one sign have been made also. Analysis of the growth curves obtained from these data by means of the customary equation, $dn/dt = q - \alpha n^2$, and also the equation suggested by the experience of Power,[1] $dn/dt = q - \beta n$, has been begun.

At present it appears that the data conform more closely to the latter equation, although there are indications that the equation proposed by Schweidler[2] would represent the results still more closely.

The values of the ordinary recombination coefficient, α, computed by a method of approximations are in fair agreement with those determined by Lea[3] by a somewhat similar method.

[1] A. D. Power, J. Frank. Inst. **196**, 327 (1923).
[2] Schweidler, Akad. Wiss. Wien. Ber. **127** (2a), 953 (1918).
[3] D. E. Lea. Proc. Camb. Phil. Soc. **30**, 80 (1933).

3. The Recombination of Ions in Pure Oxygen as a Function of Pressure and Temperature. M. E. GARDNER, *University of California. (Introduced by Leonard B. Loeb.)*—The coefficient of recombination, α, for the pure oxygen (no free electrons) showed α to be a constant independent of the age of the ion from 10^{-2} sec. to 1 sec. The value of α

for pure oxygen at room temperature and atmospheric pressure was $(2.0\pm0.1)\times10^{-6}$. The value of α as a function of pressure and temperature was in agreement with the theoretical values of J. J. Thomson (molecular weight of ions 64, mean free path $\frac{1}{5}$ that for molecules) and completely incompatible with the theory of Langevin. The pressure variation was in good agreement from 10 cm to 76 cm pressure. Below 10 cm the high diffusion rate and the presence of free electrons vitiated the results obtained. The temperature variation was in good agreement from -40°C to 100°C. At -78°C the experimental values deviated from the theoretical value but could be made to agree if it were assumed that the molecular weight of the ions increased to 96. These experiments show that initial and preferential recombination is occurring to some extent even at 0.1 second. This indicates diffusion coefficient for the ions from a paired configuration of the order of 100 times the normal coefficient. A similar conclusion was drawn by Loeb.[1]

[1] Loeb, Phys. Rev. **51**, June 15 (1937).

4. Ionization in Cosmic Ray Tracks. MERLE A. STARR, *University of California. (Introduced by Robert B. Brode.)*—According to the theory of Bethe and Heitler, the ionization produced by electrons should be a function of energy with a minimum at 10^6 ev and having a value at 10^5 and 10^6 ev twice as great as the minimum. An attempt has been made to observe such a function by counting drops in diffuse tracks about one second old, photographed in a counter controlled cloud chamber. Measurements show that on the average, particles of near 5×10^3 Hρ do not ionize as heavily as those of lower and of higher energies, but tracks above the limit of energy measurement, 2×10^6 Hρ, show a wide fluctuation of from 20 to 60 drops per cm path. A few straight tracks with approximately twice the average ionization have been observed in small showers. These may be produced by very high energy electrons or by particles of greater mass. Since the low drop count has not been traced to faulty expansion of the cloud chamber, it appears likely that such tracks were produced by electrons, and the most dense by protons of high energy. A more detailed study of recombination of ions will make it possible to determine whether the effect is real.

5. The Townsend Coefficient in Pure Nitrogen. WOOLFORD E. BOWLS, *University of California. (Introduced by L. B. Loeb.)*—An investigation of the effect of cathode material on β, the second Townsend coefficient of ionization, has led to surprising results with Pt and Na cathodes. The values of α, the first Townsend coefficient of ionization, obtained in an outgassed, mercury free chamber were 20 percent less and 5 percent greater for Pt and Na cathodes, respectively, than values obtained by Townsend in the presence of Hg vapor. For the Pt cathode, and $X/p<400$, the values of β/p were larger than those found by previous investigators using mercury coated surfaces. The values of β/p rose sharply from zero at $X/p=65$ until a plateau was reached extending from $X/p=140$ to $X/p=240$ where $\beta=0.05$. The curve then rose into the Townsend curve at about $X/p=400$. For the Na cathode, the β/p curve lay entirely below the Pt curve, starting at an $X/p=140$ and rising slowly to a less pronounced plateau at an $X/p\sim325$. For higher X/p the curve essentially parallels the Pt curve. Plots of β/α as a function of X/p showed a sharp peak in each curve, possibly due to photoelectric phenomena in the low X/p range, followed by a gradual rise, resulting from secondary emission due to positive ion bombardment.

6. The Volta Potential between Barium and Magnesium. An Experimental Test of the Relation between Work Functions and Volta Potential. PAUL A. ANDERSON, *State College of Washington.*—Recent photoelectric determinations of the work functions of barium[1] and of magnesium[2] in which the technique of preparation of the metal surfaces has been similar to that used by the author in measurements of contact differences of potential[3] have suggested the possibility of checking the Sommerfeld-Eckart relation under unusually favorable experimental conditions. A first measurement on fractionally and multiply distilled surfaces of Ba and Mg deposited on glass at room temperature has yielded the value 1.08 v for the contact difference of potential between these metals. The difference of 1.08 ev between the work functions predicted by the Sommerfeld-Eckart relation agrees to within 0.01 ev with the results of Jamison and Cashman, $\phi_{Ba}=2.51$–2.52 ev, and Cashman and Huxford, $\phi_{Mg}=3.60$ ev. While the exactness of this agreement is, no doubt, fortuitous to some degree it indicates that the results of independent photoelectric and contact potential measurements which are obtained under adequate experimental conditions may be used interchangeably in work function calculations.

[1] Jamison and Cashman, Phys. Rev. **50**, 624 (1936).
[2] Cashman and Huxford, Phys. Rev. **48**, 734 (1935); Mann and DuBridge, Phys. Rev. **51**, 120 (1937).
[3] P. A. Anderson, Phys. Rev. **47**, 958 (1935); 320 (1936).

7. Some Applications of Spectroscopy to Agriculture. STANLEY S. BALLARD, *University of Hawaii.*—A satisfactory technic for the qualitative analysis of various agricultural specimens has been developed. Although developed primarily for the analysis of soils, fertilizers and plant materials, the technic doubtless has a much wider field of application. Samples to be analyzed are burned in a carbon or copper arc, and their spectra are produced and photographed by a large quartz spectrograph. The photographic plates may be analyzed rapidly to establish the presence or absence in the sample of some fifty of the elements. Features of the technic concern the care exercised in the preparation of electrodes and samples to prevent the inadvertent introduction of any impurities. The procedure developed is at present being applied with success to the analysis of various commercial fertilizers for the presence of the rarer metallic elements, the so-called less essential plant nutrients. This program is being carried on in the spectroscopic laboratory of the Experiment Station of the Hawaiian Sugar Planters' Association with the assistance of P. E. Chu and P. L. Gow, Assistant Chemists at the Experiment Station. An article describing the experi-

mental procedure and some of its applications is being prepared for publication in an appropriate journal.

8. The Design and Performance of Quantity Heads for the Air-Driven Ultracentrifuge. RALPH W. G. WYCKOFF AND J. B. LAGSDIN, *Rockefeller Institute for Medical Research, Princeton, N. J.*—The ultracentrifugal sedimentation of antibodies and the similar isolation of virus proteins have demonstrated that many biologically important substances too unstable for chemical purification can be prepared by physical procedures based on the ultracentrifuge. The need that has accordingly arisen for handling comparatively large volumes of liquid has led to the design of rotors holding 100 to 200 cc. Studies have been made to determine the maximum speeds at which such rotors of several shapes and materials can be operated and to ascertain the variation with tube angle of the efficiency of sedimentation in ultracentrifugal fields. The information thus gained has been utilized in the construction of light metal alloy heads that can be employed for quantity centrifugation at fields up to 250,000 to 300,000 times gravity. These will be described and a discussion will be given of their performance when operated by the current design of air-turbine.

9. The Theory of Optical Activity. E. U. CONDON, WILLIAM ALTAR AND HENRY EYRING, *Princeton University.*—It is shown that a single electron moving quantum-mechanically in a field of suitable dissymmetry suffices to make a medium containing such molecules show optical activity. This is in striking contrast to the models studied by Born, Kuhn and others in which the rotatory dispersion is related to the hypothetical existence of coupled oscillators in the molecule. Here the absorption bands are associated with one-electron jumps in the molecule, the rotatory power arising from the fact that the electrons move in a dissymmetric field.

It turns out that to account for the presence of such a field one merely has to consider the presence of electrostatic charges in the vicinity of the optically active electron, in accordance with standard dipole data. This is confirmed by calculations of the rotatory dispersion in specific examples, using the following expression for the potential energy function:

$$V=\tfrac{1}{2}(k_1x^2+k_2y^2+k_3z^2)+Axyz,$$

where the constants k_1, k_2, k_3 and A may be calculated from the dipole moments. The numerical agreement with the experimental curves is very satisfactory.

10. Luminescence and Color Excited by Radium in Zinc Borate Glasses Which Contain Manganese. BYRON E. COHN, *University of Denver*, AND S. C. LIND, *University of Minnesota.*—A series of synthetic zinc borate glasses were made up to contain known concentrations of manganese between zero and five percent. These glasses were exposed to radium.

The thermoluminescence of the samples was determined. Manganese was found to act as an activator; the optimum concentration was at 0.05 percent manganese. The luminescence emission was in the form of a band with a maximum around 6000A.

The change in absorption of light due to the exposure of such glasses to radium was determined quantitatively for both the visible and ultraviolet regions. The violet color developed in these glasses by exposure to radium was found to be due to a preferential increase in the absorption for wave-lengths longer than 5000A. Exposure to radium produced an increased absorption in the ultraviolet region. The change in absorption depended both upon the wavelength and the concentration of manganese. At 2537A the greatest change in absorption was at 0.05 percent manganese and appeared related to the thermoluminescence emission.

11. The Structure of the Arc Spectrum of Tungsten, WI. J. E. MACK, *University of Wisconsin*, AND OTTO LAPORTE, *University of Michigan.*—The analysis of the spectrum of WI, begun by one of us,[1] has been brought to a certain stage of completion by the classification of all stronger and of many of the weaker lines into a diagram of 42 even and 195 odd levels. Although for the latter no quantum number other than J can be and should be assigned, this is possible in numerous cases for the even levels under either one of the following conditions: (a) An extreme J value identifies a level independently of coupling; (b) disturbing terms are absent. A check is obtained on the completeness of the level diagram found in this work by counting the levels of a definite J value and comparing these numbers with the theoretically expected ones.

[1] O. Laporte, Naturwiss. **13**, 627 (1925).

12. The Preparation of Auroral Afterglow Tubes. JOSEPH KAPLAN, *University of California at Los Angeles.*—The failure of Cario and Stille to reproduce some of the results obtained in our auroral afterglow experiments has led to a repetition of some of our former studies, and in particular to a more detailed study of the preparation of the tubes which show these glows. A series of spectrograms is shown which shows the cleanup of impurities during the preparation of several tubes. These afterglow spectra illustrate clearly three distinct, successive stages of the afterglow as the N_2 becomes purer, namely, the cyanogen stage; the cyanogen-nitrogen-molecule-ion stage; and the afterglow in pure nitrogen, which may be called the auroral stage. Following the auroral stage the tube cleans up the nitrogen itself, and a series of spectrograms of the afterglow is obtained which illustrates the remarkable variation in the auroral afterglow with pressure. In the cyanogen stage under certain conditions the afterglow and discharge are so distinct that an objective proof of the accuracy of our technique for photographing the afterglow has been obtained.

13. The Frequency of Cosmic-Ray Showers Produced in Different Metals. J. C. STEARNS, *University of Denver*, AND D. K. FROMAN, *MacDonald College, McGill University.*—A study of the frequency of shower production in lead, tin, copper, iron, zinc, and aluminium is being made. Three Geiger counters arranged in the form of a triangle and connected to a circuit which records triple coincidences are

being used to detect showers originating in blocks equal in mass and cross-sectional area. The counter voltage and temperature is kept constant. The number of coincidences was taken with shower producing blocks used above the counters in the following order: Al, air, X, X, air, Al, etc. X is any element except Al. The ratio (X-air) to (Al-air) was determined and from this the showers per atom (N) for each element determined. N varies approximately as the square of the atomic number.

14. The Vertical Cosmic-Ray Intensity up to 43.5 mm Hg. THOMAS H. JOHNSON, *Bartol Research Foundation of the Franklin Institute.*—A balloon flight on May 21 carried a double coincidence counter apparatus with radio transmitter to a height corresponding to barometric pressure 43.5 mm and down again. The radio signals reporting coincidences, barometric height and temperature were distinct throughout the entire flight to the ceiling and down to within a mile of sea level, a total time of two hours and forty-one minutes. Signals were received from a fire lookout tower of the Pennsylvania Department of Forests where interference noise is at a low level. Records of the signals were made automatically on photographic film and manually, from the audible sounds, on a telegraphic register. Details of the results will be ready at the time of presentation.

15. The Effects of Time and Meteorological Factors on the Intensities of Cosmic-Ray Primaries and Showers. DAROL K. FROMAN, *MacDonald College, McGill University,* AND J. C. STEARNS, *University of Denver.*—The hourly counting rate of a set of triple-coincidence Geiger-Müller counters has been observed for about 3000 hours in counting about 190,000 showers from lead, and for about 1500 hours in counting about 160,000 vertical primary rays. The counting rates, Y, have been fitted separately by the least-square method, to an equation of the form

$$Y=A_1\sin(2\pi/24)t_1+A_2\cos(2\pi/24)t_1+A_3\sin(2\pi/24)t_2 +A_4\cos(2\pi/24)t_2+A_5p+A_6T+A_7w+A_8H+A_9n,$$

where the symbols have the following significance: t_1, local solar hour; t_2, local sidereal hour; p, atmospheric pressure in cm of Hg; T, atmospheric temperature in °C; w, atmospheric humidity in g per cu. meter; H, horizontal component of the earth's magnetic field in gammas; n, serial number of the observation. The following table gives the partial regression coefficients, expressed as a percentage of mean counting rate, and their probable errors. The values marked with an asterisk differ significantly from zero.

	For Showers	For Primaries
A_1	+3.8 ±2.5	+3.1 ±3.0
A_2	+0.2 ±2.5	+2.1 ±2.4
A_3	−3.2 ±2.7	−5.1 ±3.1
A_4	−1.3 ±2.2	−3.9 ±2.3
A_5	*−5.45 ±0.44	*−1.73 ±0.56
A_6	*+0.83 ±0.10	*+0.29 ±0.088
A_7	−0.068 ±0.13	*−0.60 ±0.12
A_8	+0.018 ±0.011	+0.0049 ±0.014
A_9	*−0.033 ±0.0025	+0.0014 ±0.0030

16. Alpha-Particle Counting and Geologic Ages. ROBLEY D. EVANS AND CLARK GOODMAN, *Massachusetts Institute of Technology.*—The complete theory of alpha-particle counting for thin and thick sources has been developed and experimentally confirmed by the method of internal standardization.[1] The uncertainty in the correction for internal absorption of alpha-rays within the source is large in the case of thick sources but becomes negligible for a thin source having a thickness of the order of one air-cm. For thin sources the alpha-ray counting rate becomes a direct measure of the rate of production of helium. Representative portions of geologic samples, ground to an average particle size of only a few microns, are temporarily suspended in ethyl alcohol and evaporated in an atmosphere of radioactive-free nitrogen onto a previously weighed aluminium disc. The alpha-ray emission of the resulting uniform compact deposit is then determined with a photographic recording vacuum-tube electrometer. The counting rate for ordinary rock sources is from 0.3 to 4.0 alphas per mg per hour. The large effective area (150 cm²) of the ionization chamber allows up to 200 mg of sample to be used. The helium content (determined by the direct-fusion method[2]) divided by the rate of production of helium gives a direct measure of the geologic age that is independent of the decay constants of the radioactive series. Age determinations on several rocks have been made.

[1] G. D. Finney and R. D. Evans, Phys. Rev. **48**, 503–511 (1935).
[2] R. D. Evans, R. S. I. **6**, 99–112 (1935); R. D. Evans and C. Goodman, Phys. Rev. **51**, 595 (1937).

17. Focusing X-Ray Ionization Spectrometer. S. T. STEPHENSON, *State College of Washington.*—The ionization method is here applied to the curved crystal x-ray spectrograph. Focusing x-ray spectrographs of the type developed by Cauchois and others are being used in several laboratories. The general method involves transmission through a curved crystal and registration on a photographic plate placed on the focal circle. In the present investigation, an optical spectroscope is used as a base. The curved crystal holder, having a radius of curvature of 2 feet, is mounted in place of the collimator 1 foot from the central axis of the spectroscope. A slit is mounted in place of the telescope at a distance of one foot from the central axis and thus is capable of rotation in the focal circle. The ionization chamber is mounted behind the slit. The slit is moved in small angular steps through the region to be investigated and the ionization currents are recorded for each slit position. Tests on the Mo $K\alpha_1\alpha_2$ doublet indicate better intensity than that obtainable with the usual type Bragg spectrometer for a given resolving power. The mica crystal used has given line widths which are about four times greater than those obtained with a double crystal spectrometer.

18. Liquid *vs.* Vapor Temperature. EDWARD M. LITTLE, *Montana State University.*—It is usually assumed that when a liquid and vapor are in equilibrium, their temperatures are the same. This paper proposes to show they are not, if temperature is defined as proportional to the average kinetic energy of translation of the molecules, and not by its effect on a thermometer. There are two opposing things

that tend to give the vapor a different temperature: (1) only the faster molecules can penetrate the meniscus, (2) the surface tension forces reduce the kinetic energy of the molecules vaporizing. These raise and lower the temperature respectively. Assuming a Maxwell distribution of velocities in the liquid and a definite potential difference (or molecular work function) between vapor and liquid, the average kinetic energy of the molecules before and after they leave the liquid can be found. A thermometer will never detect this temperature difference; it must be tested by methods (such as spectroscopic) which do not change the molecular energy appreciably. We show that vapor temperature may be 2/3 the liquid temperature.

19. Electron Asymmetry in the Atoms of Zinc Crystals. G. E. M. JAUNCEY AND E. M. MCNATT, *Washington University.*—The diffuse scattering of x-rays from single crystals of zinc at room temperature has been measured at scattering angles ϕ from 15° to 40° and at orientation angles ψ of 14° and 90°. Using our S values and Miller's F values obtained from the reflections of Mo $K\alpha$ x-rays from powdered zinc, we have been able to calculate the true atomic structure factors (from which the effect of thermal vibration has been removed) for orientation angles $\psi=0°$ and $\psi=90°$. When these f values are plotted against $(\sin\phi/2)/\lambda$, two curves—one for $\psi=0°$ and the other for $\psi=90°$—are obtained. The two curves coincide for values of $(\sin\phi/2)/\lambda$ greater than 0.6, with the fork occurring at this place. The difference of the f values is due to electron asymmetry and gives a measure of this asymmetry. The method of diffuse scattering is unusually powerful in this type of problem.

20. The Use of Twin Sources in Experimental Studies of Thermal Neutrons. G. J. THIESSEN AND E. L. HARRINGTON, *University of Saskatchewan.*—If using but a single radon-beryllium source in the central portion of a body of a hydrogenous material, the plan generally followed, one obtains thermal neutron radiation which varies greatly with the distance from the source. This variation makes it difficult to obtain consistent results whatever the detector used. By employing two such sources placed at the optimum distance apart the authors were able to obtain a region of nearly uniform neutronic radiation, the scheme being analogous to that employed in magnetism to obtain a uniform field through the use of Helmholtz coils. Certain experimental studies, using such a region, have been carried out.

21. A Deuteron Source for Nuclear Research. N. E. BRADBURY AND F. BLOCH.—A modification of the usual low voltage arc in deuterium for the production of deuterons is described which appears to have several advantages over the ordinary types. A relatively high deuteron yield is obtained by using pressures of 0.1 mm to 0.4 mm and an auxiliary cathode as described by Luhr and Lamar. To avoid excessive gas consumption and high pumping speeds, an electrostatic focusing system is incorporated in the arc which permits currents of the order of 0.4 ma to pass through an aperture of 1 mm². The arc chamber is water cooled. The arc is easy to start and stable in operation with a gas consumption of 20 cc/hour under ordinary operating conditions. The total power required for operation of the arc is 250 watts which may be supplied at high potential by means of an insulation transformer.

22. The Effect of Containing Tubes on Ultrasonic Velocities in Benzene. W. H. HULSWIT, JR. AND B. J. SPENCE, *Northwestern University.*—Field and Boyle[1] have shown that for frequencies up to 110 kilocycles the measured velocity of sound in a liquid is a function of the frequency. A radial resonance phenomenon associated with the containing tube was shown by Field[2] to furnish an explanation.

In carrying this investigation to higher frequencies two interferometers, having tubes of 1 inch and 1½ inches, were employed at frequencies from 400 to 700 kilocycles using toluene free C.P. benzene as the liquid. At these frequencies it was found that the measured velocity of sound was not a constant but passed through definite maxima and minima, with a maximum variation of about 5 percent. The change was cyclic and occurred about every 80 kilocycles with the 1-inch tube and every 50 kilocycles with the 1½-inch tube. The locations of the maxima are in agreement with Field's theory if an "effective" diameter somewhat smaller than the real diameter of the tube is employed in calculations.

[1] Field and Boyle, Can. J. Research **6**, 192 (1932).
[2] Field, Can. J. Research **5**, 131 (1931).

23. A Multiple Camera for Lightning Studies. E. J. WORKMAN AND R. E. HOLZER, *University of New Mexico.*—An improved lightning camera designed to obtain relatively complete photographic records of the flashes in a single storm will be described and exhibited. The instrument consists of three rotating drum units and one still camera unit mounted in a single case in such a way as to provide rapid film changing. The camera is driven by a constant speed six volt motor and film changing on all units is accomplished in about two seconds while the drums are in motion. Standard moving picture film is placed in magazines within the rotating drums in such a way that thirty to forty pictures may be taken without reloading the magazines. The only manual operation necessary in taking a picture and preparing for the next picture consists of closing a single electrical contact. Two of the drums rotate about vertical axes and one about a horizontal axis. A simple and very satisfactory method has been developed for analyzing complicated discharges through photographs taken in this way.

24. Fringe Systems Produced by Passage of X-Rays Through Plane Slits. A. E. SMICK AND PAUL KIRKPATRICK, *Stanford University.*—X-rays emerging from a plane slit system such as that formed by parallel glass plates in contact diverge in a fringe system having maxima and minima parallel to the slit plane, as in ordinary slit diffraction. The principal features of these patterns can not be explained by diffraction, however, as the width and separation of fringes is too great. The role of multiple total reflection has been investigated and been shown to be chiefly responsible for the observed effects.

25. The Production of Ions in the Auroral Glow. J. KAPLAN, *University of California at Los Angeles.*—Studies of the discharges which produce the auroral afterglow, as well as of the afterglows, are brought together in an attempt to construct a hypothesis regarding the production of ions in these glows. The answer to this problem will have an important bearing on the production and decay of ions in the earth's upper atmosphere. The hypothesis is based chiefly on the observation that at high pressures the $v'=1$ level of the initial electronic state of the Goldstein-Kaplan bands (G-K level) is enhanced at the expense of metastable molecules in the $A^3\Sigma$ state. There exists almost an exact two to one ratio between the energies of these states. Collisions between two molecules in the G-K state, or between one in the G-K and one in the $A^3\Sigma$ state, involve enough energy to yield N_2^+. Such properties of the glow as the violent enhancement of the green members of the first-positive bands and the intensity distribution in the second-positive system are ascribed to collisions between molecule-ions and metastable molecules or normal molecules. This hypothesis leaves us with many predictions regarding the variation of intensity in auroral spectra with pressure as well as predictions of hitherto unobserved bands in auroral afterglows. These will be studied.

26. A New Charcoal Trap for Oil Vapors. PAUL A. ANDERSON, *State College of Washington.*—The limitation of preliminary outgassing temperatures to 500°C in glass-contained charcoal traps heated by external furnaces and the non-uniform heating with rapid element deterioration characteristic of immersion heating with wire-wound units have been avoided by making the charcoal mass act as its own heating unit in the manner of the granular carbon resistance furnace. The charcoal is packed in a reentry tube between graphite rods which cap molybdenum current lead wires welded to a conventional tungsten-in-Pyrex press. A charcoal column 2.5 cm in diameter and 10 cm long is brought to incandescence (800–900°C) in a few minutes by currents which do not overload 60 mil tungsten leads. The prolonged preliminary outgassing periods required in conventional traps for adequate clean-up are reduced from days to hours and the vacuum attainable with the charcoal hot is improved markedly.

AUTHOR INDEX TO ABSTRACTS OF DENVER MEETING