SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION B, PHYSICS.

THE officers of this Section were: Vice-President, D. B. Brace; Secretary, John Zeleny; Member of Council, E. L. Nichols; Sectional Committee, D. B. Brace, John Zeleny, B. W. Snow, L. B. Spinney, E. L. Nichols; Member of General Committee, L. B. Spinney.

A large number of papers of unusual importance was presented before the Section, so that a keen interest was maintained in the meetings to the very end. The authors of a number of the papers were absent but had representatives who were familiar with the subjects they presented, so that beneficial discussions were possible even in these cases.

On Thursday forenoon, August 29, the Section met with the American Physical Society, and on the afternoon of the same day there was a joint meeting of Sections A and B.

The following are the abstracts of the papers that were presented:

1. 'A Spectrophotometric Comparison of the Relative Intensity of Light from Carbon at Different Temperatures': ERNEST BLAKER.

The instrument used in this work was a Lummer-Brodhun spectrophotometer, the comparison source being an acetylene flame.

The carbon studied was that of the filament of the ordinary incandescent lamp with treated surface, on the one hand, and a similar filament with smoked surface on the other. Temperatures were computed by means of the empirical relation between them and the ratio of the resistances of the hot and cold filament, established by Chatelier.*

Isochromatic curves showing the rise in intensity with the temperature were plotted for various wave lengths of the visible spectrum. These, taken separately, exhibit the form characteristic of bodies previously investigated, such as platinum and the artificially produced 'black body.'

The temperature or its reciprocal as demanded by the received equations for radiation is nearly proportional to the logarithm of the intensity.

The corresponding isothermal curves, however, show the existence of the remarkable peculiarity noted by Nichols† in a recent paper. The selective radiation in the yellow, described by that author, is even more strikingly developed at the higher temperatures covered in these experiments. It exists alike in the case of the gray-surfaced carbon and in lamp black and would lead us to classify carbon rather with the metallic oxides than with the black bodies, as regards the laws of radiation.

2. 'The Distribution of Energy in the Spectrum of the Acetylene Flame': George W. Stewart.

The great value of acetylene not only for illuminating purposes, but also in experimental research, makes the study of the distribution of energy in its spectrum of considerable importance. In the work to be described, a mirror spectrometer and fluorite prism were used to produce the spectrum, and the radiometer of Nichols to measure the radiant energy. The mirror-prism device of Wadsworth was utilized, the main advantage gained being that the radiometer could be kept stationary. The spectrum fell upon a slit mounted directly in front of the fluorite window of the radiometer, thus avoiding the use of any lens whatever.

The source of light used in the work upon the visible portion of the spectrum was a cylindrical acetylene flame from a single-tip burner. This type was used because the intensity per unit area was greater than in the flat flame. The results, plotted in the form of a curve, afford definite data concerning the distribution of energy in the visible spectrum of this flame.

Owing to the difference in the dispersion of the prism, a slight change in the relative positions of the spectrometer and radiometer was of greater consequence in the infra-red than in the visible portion of the spectrum.

The most striking characteristic of the curve of energy distribution is the set of elevations which are due to the emission bands of the gases of the flame. If the acetylene is pure, the gases to be expected are CO_2 and H_2O. According to Paschen, the maximum points of the emission bands of these gases are as follows:

H_2O Spectrum,
1.46μ, 1.90μ, 2.83μ.

CO_2 Spectrum,
2.71μ (2.68μ when CO_2 is not dry) and 4.40μ.

The energy curve shows elevations whose maxima agree very closely with these values. Observations of wave lengths longer than 6μ are useless, the error due to stray radiation being so great.

Similar measurements were made upon the flame of a bunsen burner adapted for the combustion of acetylene.

In this curve all five emission bands appear and the values of the wave length at the maximum points agree with the values

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* Chatelier, *Journal de Physique* (3), I., p. 203.

† Nichols, *Physical Review*, Vol. XIII., 1901.

quoted above. If we compare the bunsen and the single tip curves, we see that they do not agree in all respects. The elevations due to the emission of the H_2O gas have not the same relative values in the two cases, but this discrepancy disappears when corrections are made for slit widths. The band at 2.3μ does not appear in the bunsen flame and this fact makes its presence in the other somewhat in doubt.

The changes produced in the correction of the curves possess several points of interest. The maximum of intensity is shifted considerably toward the violet, appearing in the corrected curve at about 0.94μ.

Using Langley's method of finding the ratio of the area in the visible portion of the spectrum, to the area of the entire curve, the radiant efficiency was calculated. The value for the cylindrical flame is 0.100 and for the flat flame 0.131. The latter value is not very reliable, but there is not much doubt but that the radiant efficiency of the flat flame is the larger. Stewart and Hoxie, using a modification of the Melloni method, found the value 0.105 for the flat flame. (To be printed in the *Physical Review.*)

3. 'Experiments on a New Form of Standard High Electrical Resistance': H. C. Parker. (By title.)

4. 'Variation of Contact Resistance with Change of E. M. F.': H. C. Parker. (By title.)

5. 'On Flutings in a Sound Wave and the Forces due to a Flux of a Viscous Fluid around Spheres': S. R. Cook, Washburn College.

The author shows that the forces due to a perfect fluid are not sufficient to produce the laminæ and flutings in a sound wave, but that there are other forces which are probably due to the viscosity of the vibrating media. That there must be other forces was first manifest by a series of experiments with air, carbon dioxide, chlorine and hydrogen as media, using various materials to form the laminæ, including filings of coin silver and platinum.

The author also shows that flutings are not confined to a stationary sound wave but are capable of being produced by direct sound waves on an open surface.

A mica disk, threaded on a fine wire in a resonance tube, was caused to vibrate in unison with the prong of a large tuning fork, whose frequency was 32 per second. Koenig's equations for the forces due to a perfect fluid when reduced to their final form are:

$$X=\frac{3/2\pi\rho R^3 R_1{}^3 W_0{}^3}{r_0{}^4}$$

$$Z=-\frac{3\pi\rho R^3 R_1{}^3 W_0{}^3}{r_0{}^4}$$

$$M=\rho R_2{}^3 W_0 \sin 2\theta.$$

ρ = density of medium, R, R_1, R_2 are the radii of the sphere or disks, W_0 the velocity of the stream. This gives repulsion parallel and attraction perpendicular to the stream lines. The forces were studied by first allowing RR_1 to vary while ρ and W_0 remained constant. Then ρ was varied while all other factors were kept constant, and it was shown that

$$\frac{X_1}{X_2}=\frac{Z_1}{Z_2}=\frac{M_1}{M_2}>\frac{\rho_1}{\rho_2}$$

when ρ_1 was the density of carbon dioxide and ρ_2 that of air.

A further study of the forces was made with sealing-wax spheres and it was found that when the spheres, whose radii were less than 1 mm. were at a greater distance than one-half their diameter apart, they followed the perfect fluid forces, but when they were less than one-half their diameter they were repelled perpendicular, and attracted parallel, to the line of flow.

The author reaches the following conclusions:

1. The conditions for the formation of laminæ are found whenever there is a flux of a viscous fluid around solid particles.

2. There are forces exactly opposite to those of the perfect fluid.

3. These new forces are most probably due to the viscosity of the medium.

4. The new forces in conjunction with the forces of a perfect fluid make possible a complete and clear explanation of the laminæ and flutings produced in a sound wave. (To be printed in the *Phil. Mag.*)

6. 'Interferometer Curves': J. C. Shedd, Colorado College.

The general equation of the interference curves is found to be a conic and the conditions for obtaining the various forms are determined by considering the question of eccentricity.

The various cases are taken up in detail and the experimental manipulations necessary for obtaining them are explained.

7. 'On the Absorption Spectrum of Iodine in Solution': Edward L. Nichols and William W. Coblentz.

That iodine dissolved in carbon disulphide, although opaque to the visible spectrum, transmits the infra-red rays freely, has long been known, but no systematic studies of the spectrum of such solutions appear to have been made. In the study of the visible spectrum a horizontal slit spectrophotometer was used. Quantities of iodine varying from 3.3 mg. to 0.017 mg. per cubic centimeter were dissolved and their absorption spectra measured. A single broad band was found, having its maximum at $\lambda = .52\mu$, the transmission curve being steeper on the side towards the violet. For the solution containing 0.017 mg. per cc. the transmission in the center of the band was 80 per cent. With increasing concentration the band widens and becomes more dense. Solutions containing more than .25 mg. per cc. are opaque in the center of the band, and the region of opacity extends as the amount of iodine in solution is increased until the entire visible spectrum is obscured. Observations upon iodine dissolved in alcohol showed a very different absorption spectrum. Such solutions were opaque in the violet, the transmission increasing steadily towards the red. The form of the curves was such as to indicate an absorption band of which one side only lies in the visible spectrum, the center being in the ultra-violet. To extend these measurements to the infra-red spectrum a Nichols radiometer was employed. Readings of the transmission of various solutions were made out to 2.7μ, beyond which wave-length the solvent itself rapidly becomes opaque. It was found that all solutions rose rapidly in transmitting power with increasing wave-length and became completely transparent between 1.0μ and 1.1μ, between which region and 2.7μ, iodine appears to exert no absorbing power whatever.

7a. 'A Preliminary Communication on the Pressure of Light and Heat Radiation': E. F. Nichols and G. F. Hull.

The experiment consisted of two parts: (1) The determination of the light pressure by observing the deflection, either static or ballistic, of a torsion balance when one vane of the balance was exposed to light, and (2) the determination, in ergs per second, of the intensity of the light falling upon the vanes. The image of an aperture, upon which the rays from an arc lamp were concentrated by two condensing lenses, was focused in the plane of the glass vanes placed symmetrically with regard to a rotation axis held by a quartz fiber of known torsion coefficient. The torsion balance was covered by a bell jar connected to pressure gauges and a mercury pump. To eliminate the disturbing action due to the residual gas in the receiver, the following devices were used: (1) The vanes were silvered and highly polished, thus making the absorption small and the reflection percentage large. (2) The silver surface of one vane was turned towards, and of the other, from, the light, thus making the effect of the gas action and light pressure in the same direction on one vane, and in opposite directions on the other. (3) The pressure of the air in the bell jar was varied, and the pressures were chosen in the vicinity of that pressure at which the gas action was very small. (4) The length of exposure of light on the vane in most of the observations was short. The gas action, which begins at zero and increases with the length of exposure, was thus reduced in comparison with the instantaneous action of the radiation pressure. By means of an inclined glass plate placed in front of the aperture a portion of the incident light was thrown on a thermopile. The deflection of a galvanometer connected with the latter gave the *relative* light intensities.

Two methods of determining radiation pressure were used:

(1) The vane was exposed continuously to the light until the turning points of the vibration of the balance showed that static conditions had been reached. The other vane was then exposed. Finally the whole suspended system was turned through 180°, and the vanes were exposed in turn. The mean of the angles of deflection, multiplied by the torsion coefficient of the fiber and divided by the lever arm, gave the force in dynes acting on the vane. (2) The vanes were exposed for a quarter of the period of the suspended system. The period, damping coefficient, torsion coefficient and lever arm being known, the value of the radiation could be found. The two methods gave practically the same result except for the air pressures for which the gas action was large.

The energy falling upon the vanes was measured by means of a bolometer consisting of a thin disc of platinum, about the size of the vanes, covered with platinum black. The bolometer, occupying exactly the position which the glass vane had previously occupied, was made one of the arms of a Wheatstone bridge. The bridge was balanced, the bolometer exposed to the light, and the throw of the bridge galvanometer read. Later the disc was heated by an electric current which entered and left at two equipotential points on the bridge current and the galvanometer throw again was read. The current strength and the resistance of the disc being known, the activity of the disc is given by $i^2R \times 10^7$ ergs per second. The readings of the thermopile before mentioned made it possible to reduce all observations to a constant light intensity. If E = energy per second falling upon a surface, a = the percentage of the radiation reflected, v = the velocity of light, then, theoretically, the value of the radiation pressure is $\frac{(i + a)E}{v}$. The experimental value of the pressure as found by the authors was about 80 per cent. of the theoretical value.

8. 'The Absorption Spectrum of Ferric Hydrate': B. E. MOORE, University of Nebraska.

The author in a recent article upon 'A Spectrophotometric Study of the Hydrolysis of Ferric Chloride,' has pointed out that the final product is colloid ferric hydrate. This product can be formed by Graham's dialytic method. It would then be inferred that identical products would have identical absorption spectra.

It was found that the absorption of the two products was quite different in character. The addition of given quantities of chlorine or of hydrochloric acid, did not effect any transformation in the dialyzed colloid, *i. e.*, crystalloids, if present, were not changed by this treatment. If dialyzed ferric hydrate, or hydrolyzed ferric chloride were added to fresh dilute ferric chloride, the hydrolysis of the latter was accelerated. The greater acceleration was caused by the hydrolyzed ferric chloride. From this it is inferred that both solutions contain identical colloids, but that the Graham's colloid contains also considerable inactive crystalloid hydrate. The absorption curve then suggests that the crystalloid has an absorption curve lying between hydrolized ferric chloride and non-hydrolized ferric chloride. (To be printed in *Physical Review.*)

9. 'Note on the Transmission of Radiation by Thin Films of Asphalt': E. L. NICHOLS.

10. 'The Faraday Effect in Solutions of Hydrolyzed Ferric Chloride': FRED. J. BATES, University of Nebraska.

The rotation of the plane of polarization in optical transparent substances, when the light is transmitted along the lines of magnetic force, has been the subject of numerous experiments since the days of Faraday, and is known as the 'Faraday Effect.' There have been many determinations of the molecular rotation of substances in solution, but little effort to determine whether the effect in solution arises from a molecule or from an ion or from both. Observations have also frequently been limited to one color (and perhaps then a mixed color), or to a few colors. It seemed desirable to extend these observations to different parts of the spectrum. This is particularly true of colored solutions, whose colors correspond hypothetically to the free periods of their vibrations, affecting the dispersion and probably the rotation of the plane of polarization.

Ferric chloride solutions afford a good means of testing this phenomenon. Observers have noted that the molecular rotation of this substance decreases upon dilution of the solution. This suggests that the rotation arises from the molecules rather than from the ions. The writer tried a solution of sufficient concentration to give him a rather large rotation. The solution was then diluted enough to leave the effect slightly but certainly noticeable. If the rotation was proportional to the concentration, no effect was observed, which suggests that the ions are inactive or possess very small rotary power in comparison to that of the molecules. Observations by Goodwin and Moore show that dilute solutions of ferric chloride hydrolyze and finally form a new product, colloid ferric hydrate. It was thought that by restoring an iron molecule by this process there would possibly be a small rotation where previous ionization had made it unobservable. By this test it was found that the required dilution to obtain sufficient hydrolysis made the quantity of iron too small to give any further evidence by the usual method of observation. However, the use of a sunlight spectrum showed an effect as soon as one began to pass from the transparent spectral region into the absorption region. The half-shade polariscope could be read to 0.01°, and in the red the difference between a .01 normal solution (hydrolysis forced by heating the solution) and water was not more than 0.01°. The difference between an unhydrolyzed solution of this concentration and water was also unobservable. Upon examination of the hydrolyzed solution at a point in the green where the absorption is very marked, a rotation of .79° was observed, while at the same point the other two solutions showed no difference. That is, we have here an anomalous rotary polarization or 'Faraday Effect,' analogous to anomalous dispersion. It is clear that in this case the anomaly arises from molecules in the region of their absorption. It remains to be seen whether such an anomaly will also arise in solution where the absorption arises from ions.

11. 'Discharge of Electricity from Glowing Platinum and the Velocity of the Ions': E. RUTHERFORD.

A rectangular platinum plate 14 cm. long, 7.5 cm. wide and .002 cm. thick, was heated to incandescence by an electric current. The platinum plate was charged to a known potential by means of a battery and the current between the platinum plate and a parallel copper plate observed by means of a sensitive galvanometer. The rate of discharge of positive and negative electrification was examined under varying conditions of temperature, distance and P. D. between the plates, and compared with the theoretical results deduced from the ionization theory of gases.

At a temperature of a dull red heat positive ions are produced at surface of the platinum plate, which travel to the opposite plate through the gas, if the platinum is positively charged. The movement of the ions disturbs potential gradient between plates and at high temperatures the slope of potential near hot plate is extremely small.

Let $i =$ current per sq. cm. through the gas.
$n =$ number of ions per cc. at any point distant x from platinum plate.
$V =$ P. D. between the plates.
$K =$ velocity of positive ion for unit potential gradient.
$e =$ charge on ion.
$d =$ distance between the plates.

Assuming the potential gradient zero at the platinum surface, it can readily be shown that

$$i = \frac{9V^2K}{32\pi d^3}$$

The current is thus independent of number of ions produced, *i. e.*, the temperature of the plate, providing it exceeds a certain value. Experimentally it was found :

1. For a distance of 2 cm. and under, the current at first increased rapidly with rise of temperature up to a certain point, and then more slowly. For distances of from 3 to 8 cm. the current rose to a maximum, and then steadily decreased with rise of temperature.

2. The maximum current varied approximately as square of the P. D.

3. Current diminished more rapidly than $\frac{1}{d^3}$.

The differences observed in (1) and (3) between experiment and theory are due to (*a*) decrease of velocity of ions with distance from heated platinum plate, (*b*) presence of some very slow-moving carriers produced at platinum surface at high temperatures.

The velocity of the ions was measured by a direct method depending on the use of an alternating P. D. of known frequency. The method was similar to that used previously for determination of velocity of ions produced by ultra-violet light (*Proc. Roy. Soc.*, 1898). It was found that the velocity of ions was not a constant, but varied between wide limits.

This is probably due to difference in size of ions in consequence of their varying power of forming clusters of molecules round them.

The following table gives results obtained for different distances between plates. Under heading 'calculated velocity' are given values of K calculated from equation (1) by measuring maximum current i for given distance and voltage.

Distance between plates.	Velocity in cm. per sec. for 1 volt per cm.		
	Maximum.	Average.	Calculated.
2 cms.	13	7.8	5.5
3 "	7.9	5.8	3.2
5 "	—	4.7	2.2

12. 'On Conditions controlling the Drop of Potential at the Electrodes in Vacuum-Tube Discharge': CLARENCE A. SKINNER, University of Nebraska.

With the passage of electricity through rarefied gases, it requires, relatively, a very high P. D. to force the discharge directly across the space between the electrodes when these are brought within a certain small distance apart. To locate at what part of the path the potential increases was the primary object of this investigation.

The results led to a more general investigation of the drop of potential at the electrodes.

A cylindrical vacuum-tube, with disk electrodes (perpendicular to its axis) insulated so as to force the discharge directly across the space between them, and nitrogen were used. The potential of the gas at any position was obtained by a movable wire.

As the electrodes approach each other the drop at the anode remains constant so long as there is an extended positive column. With the anode passing through the Faraday dark space its 'drop' rises to a maximum and then falls to zero in the negative glow, but rises again *rapidly* as the anode moves into and through the cathode dark space. The cathode drop remaining constant until the anode reaches the cathode dark space begins then to increase with great rapidity. During these changes the conductivity of the gas does not vary.

These results are explained on the hypothesis that the impact velocity of the discharging ion tends to prevent charge from being transmitted to the electrode; that to give up its charge the ion must first come to rest.

Other Observations.—At the cathode the drop may be expressed by the equation

$$V = C + \frac{c}{p}(a + i)$$

where i is the current density; p, the gas pressure; C, a constant approximating in value the cathode drop, as measured by Warburg; c, a constant depending on the nature of the gas, but independent of the metal used as cathode; and a, a constant. At the anode the drop appears to vary according to a similar law, where c is about one thirty-fifth its magnitude at the cathode.

The great difference in magnitude of the drops at the two electrodes may be explained on the hypothesis that the positive ion is of much greater mass than the negative and hence (for the same impact velocity), its elastic reaction being greater, the greater resistance to its discharge.

The difference in the drop occasioned by the use of different metals may be explained by their contact-potentials. Of two metals, that possessing the greater attraction for negative electricity is found to possess the lower drop as anode, apparently by its attraction for the charge on the ion aiding in overcoming the elastic reaction of the impinging ion. The same applies to the cathode. (To be printed in the *Phil. Mag.*)

13. 'The Influence of Temperature upon the Photo-electric Effect': John Zeleny, University of Minnesota.

Ultra-violet light impinging upon negatively electrified bodies dissipates their charge. The electricity is supposed to be carried away by ions which are formed at the surface of the body by the rapid absorption of certain of the waves of the incident light. A study of the influence of temperature upon the effect was made to see if it would throw any light upon the question as to the relative parts played in the phenomenon by the material of the body and by the occluded gases. The charged body which was experimented upon was a platinum wire that could be heated by sending an electric current through it. The light used was obtained from an electric spark produced between two zinc rods by an induction coil. The results obtained are somewhat complicated. As the temperature was gradually increased to about 200° C., it was found that the rate at which the negative electricity was discharged diminished, but for still higher temperatures it increased again, so that at about 700° C., it was nearly three times its value at room temperature. The rate of discharge at certain temperatures depends considerably upon the immediate previous history of the wire, being much larger for a given temperature, although diminishing with time, if the wire has just been hotter than if it has just been colder. The conditions at the surface of the body at these temperatures reach their steady state but slowly, while for temperatures below 100° C. this is acquired much more rapidly. Changes in the molecular arrangement of the body, as well as the amount oft he occluded gas, may play a large part in the phenomenon. From an iron wire the rate of discharge while small at the lower temperatures became many times larger at the higher temperatures. It was also found that a positively charged body does not lose any charge due to the action of the light, even when its temperature is raised to that of red heat. To get an explanation for the unipolarity of the photo-electric effect, we need but consider that the intra-molecular impulses which are produced by the light, and which give rise to the discharge, are able to throw off from the body the negative ions or corpuscles, but are not able to disengage the much larger positive ions for which the forces of restitution are correspondingly greater.

14. 'The Diminution of the Potential Difference between the Electrodes of a Vacuum Tube produced by a Magnetic Field': JOHN E. ALMY.

15. 'Note on the Discharge Current from a Surface of Large Curvature': JOHN E. ALMY, University of Nebraska.

The discharge from a wire to a surrounding concentric cylinder, with reference to discharge current, especially, is studied. The law of discharge, under the conditions given below is found, $I = aV(V - b)L/R^3$, where

$I =$ the discharge current, passing from wire to cylinder.

$V =$ the potential difference between wire and cylinder.

$L =$ the length of the wire.

$R =$ the radius of the cylinder.

$b =$ a constant, with given apparatus and gas pressure, and is very approximately the 'minimum potential' of Röntgen.

$a =$ a constant.

The applicability to the discharge was shown with gas pressures, from 20 to 75 cm. of mercury, with cylinders, up to 10 cm. in diameter. The proportionality of current to wire length holds so long as the wire length is greater than the radius of the cylinder used. Finally, the proportionality of current to the inverse cube of the cylinder radius does not hold accurately. More strictly speaking it may be said that $I \propto \frac{1}{R^n}$ and $3.3 > n > 2.8$, in the experiments made.

16. 'The Radiant Efficiency of Vacuum Tubes': E. E. ROBERTS.

17. 'On the Spark Discharge during Rapid Oscillations': K. E. GUTHE. (By title.)

18. 'Results of Recent Magnetic Work of the U. S. Coast and Geodetic Survey': L. A. BAUER. (By title.)

19. 'The Physical Decomposition of the Earth's Permanent Magnetic Field': L. A. BAUER. (By title.)

20. 'On the Calorimetric Properties of the Ferro magnetic Substances, with special reference to Nickel-steel': B. V. HILL.

It is well known that the ferro-magnetic substances when heated through a certain range of temperature, depending on the nature of the substance, absorb latent heat and pass into an allotropic modification in which they are non-magnetic. Certain alloys (*e. g.*, nickel-steel) having been transformed into this state by heating, maintain it down to comparatively low temperatures, so that there are many so-called irreversible nickel-steel alloys to be obtained in both modifications within the same range of temperature (20° to 300° C.). This allows the properties of the alloys in the two states to be compared.

The latent heat of transformation for one sample of nickel-steel was found to be 2.783; that of another, 13.45; which, according to the theory of solutions, should have been 15.9—the application of the theory being, however, questionable. The specific heat of nickel-steel is greater in the non-magnetic state than in the magnetic (from 2 to 6 per cent., depending on the temperature interval through which it is obtained).

Six samples of iron differing in permeability showed that the greater the permeability of iron the smaller its specific heat. This supports the view that the difference in permeability is caused by a difference in composition of magnetic and non-magnetic iron.

21. 'On the Demagnetizing Effect of a Discharge in Iron when Electromagnetically Compensated': ZENO CROOK.

22. 'The Absorption Spectra of Solutions of Potassium Permanganate': B. E. MOORE, University of Nebraska.

The absorption spectra of solutions of the following concentrations, .25*n*, .025*n*, .0025*n*, .00025*n* and. 000025*n* (n = normal), were studied.

The observations, though they may need later some slight correction, show that upon dilution the solutions become relatively darker in the blue, *i. e.*, there is a displacement of the absorption band toward the blue upon dilution. The phenomenon is explained upon the theory of dissociation.

23. 'The Absorption and Dispersion of Fuchsin': W. B. CARTMEL. (By title.)

24. 'On the Determination of Dispersion by Means of Channeled Spectra with the Concave Grating': P. J. ANTES.

25. 'Accidental Double Refraction in Liquids': BRUCE V. HILL, University of Nebraska.

In a former paper upon this subject (*Phil. Mag.* (5), 48, p. 485) the writer gave results of a series of experiments upon gelatinizing solutions which became double refracting when subjected to a strain between rotating cylinders. The results indicated that we have in such solutions quasi-solids, and that there is a difference between colloid and crystalloid solutions not to be explained upon the assumption of a large molecular weight in the former.

The present experiments consist of an examination of water solutions of gelatine when subjected to a *static* strain. They vary in concentration from .1 per cent. to .5 per cent. and were too dilute to sustain their own weight. They were accordingly placed in thin-walled brass tubes 42.55 cm. in length and 2.77 cm. in diameter. Glass caps were fastened to the ends of these tubes by slipping short pieces of rubber hose over them. The tubes were strained, so that their cross-sections were elliptical, by means of clamps. The double refraction decreases so rapidly with rise in temperature that at room temperature—about 23° C.—no effect was visible in jellies of the above concentrations. The tubes were then surrounded by ice and the formation of dew upon the glass ends was obviated by slipping over the tube a second one, also having a glass cap and containing a little phosphoric anhydride. The amount of double refraction was measured as before by means of a half-shade polariscope. The seven sets of observations show that when a stress is applied, the strain increases to a certain point beyond which no further strain is produced. Further stress ruptures the solution, and the refraction diminishes or ceases. The amount a solution can be strained without rupturing depends upon the age of the solution. This point was sufficiently studied to show that the diluter jellies required much longer time to reach the point where they would sustain a maximum strain than the stronger jellies. Along with double refraction, depolarization also appears and then diminishes after standing some time.

These solutions are as fluid as water, but still behave optically as quasi-solids, capable of sustaining a static strain without a displacement of the mobile particles. This condition is reached very slowly and the depolarization early in the formation indicates that the progress of formation of the solid structure is not homogeneous, but that it later becomes so, as indicated by the disappearance of the depolarization.

26. 'Notes on Dielectric Strain': LOUIS TRENCHARD MORE, University of Cincinnati.

This paper—'Notes on Dielectric Strain'—is an answer to a paper by Dr. Paul Sacerdote (*Philosophical Magazine*, March, 1901), criticizing an article by me which appeared in the *Philosophical Magazine* for August, 1900. In attempting to extend the work of Quincke and others who found that glass, when electrified, elongated proportionally to the square of the difference of potential and inversely as the square of the thickness of the dielectric, I noticed that after errors were eliminated the effect vanished or was at least less than $\frac{\delta l}{l} = 10^{-13}$—a result much less than that found by former investigators. My work attracted the attention of Professor Cantone and Dr. Sacerdote, the latter of whom had recently published a theoretical discussion of the subject. This theory is based on a coefficient which expresses the relation between the potential and the elongation and so fails if the elongation is eliminated. Dr. Sacerdote's criticism showed, I thought, that he had not understood my results and had underestimated the delicacy of my apparatus which seems fully capable of recording the changes of length noticed by the most accurate of former investigators—Professor Cantone.

I have in these papers shown that my apparatus was capable of measuring the effect—that it did record an effect similar to that noted by other investigators, but that this effect was due to bending of the glass tube by electrostatic attraction—that this error being eliminated the effect vanished.

The sources of errors of former investigators are probably the following:

1. No adequate precautions were taken against lateral bending of the tube. The changes of length produced by an extremely small deflection would account for the entire amount of the effect.

2. The elongations are too close to limit of observation to establish a law when the effect itself is still questionable.

3. Changes of length on charge and discharge are not equal. This difference sometimes equals 40 per cent. of the entire change. An extraneous effect of such magnitude casts doubt on the cause of the elongation.

4. With each investigator, using improved and more delicate apparatus, the amount of the effect steadily decreases. This points either to a partial or entire influence of extraneous causes. (To be printed in the *Philosophical Magazine.*)

27. 'The Temperature Gradient of the Atmosphere, with Formula': S. R. COOK, Washburn College.

The author calls attention to the difficulty, in discussing the escape of gases from the atmosphere, of determining the temperature of the station in the upper atmosphere under consideration.

From the kite observations of the United States Weather Bureau and the recent balloon ascensions at Paris, it was shown that the rate of decrease of temperature with altitude was not constant.

From balloon ascensions made March 24, 1899, near Paris, an experimental formula $t_x = t_0 e^{-kx}$ was obtained for the temperature gradient when t_x and t_0 are the absolute temperatures at positions whose distances from the surface are x, and at the surface respectively, and when k is a constant obtained from the balloon ascensions.

The graph of the temperature gradient is given and compared with Ferrel's graph. A density graph computed from the pressure and temperature graphs is also given and compared with Cottier's density graph computed from the formula $\frac{p_0}{p_1} = \left(\frac{\rho_0}{\rho_1}\right)^v$ where v has the experimental value 1.2.

Attention is also called to the need of more accurate and systematic data for the determination of the temperature gradient at altitudes from 5,000 to 20,000 meters.

JOHN ZELENY,
Secretary.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION G, BOTANY.

THE Section met for organization on Monday, August 26, at 11.30 a. m., with the Vice-President, Mr. B. T. Galloway, in the chair. The following were the officers for the Denver meeting:

Vice-President, B. T. Galloway.

Secretary, E. A. Bessey (in absence of A. S. Hitchcock).

Sectional Committee, Wm. Trelease, Vice-President 1900; D. T. MacDougal, Secretary 1900; B. T. Galloway, Vice-President 1901; E. A. Bessey, Secretary 1901; C. E. Bessey, C. L. Shear, Miss C. E. Cummings.

Member of General Committee, W. J. Beal.

Member of Council, D. H. Campbell and L. M. Underwood.*

On Wednesday, August 28, in accordance with the custom established at the last New York meeting, Section G held a joint session with the Botanical Society of America, the officers of the latter taking charge of the meeting.

On Thursday evening the following were chosen by the General Committee as Vice-President and Secretary, respectively, for the Pittsburg meeting, June, 1902: D. H. Campbell, Leland Stanford University, and Hermann von Schrenk, Shaw School of Botany.

The following is a complete list of the papers presented. Abstracts are given where furnished by the authors, except for the papers presented at the joint meeting with the Botanical Society of America, abstracts of which will be published elsewhere by the Secretary of that Society.

1. 'Thermal Relations of Plants': D. T. MACDOUGAL. (No abstract furnished.)

2. 'Experiments with Lime and Solutions of Formaldehyde in the Prevention of Onion Smut': A. D. SELBY.

Onion Smut, *Urocystis cepulæ* Frost, a soil-infesting fungus, has become introduced into soils devoted to the growing of onion sets near Chillicothe, Ohio, and into those devoted to the growing of market onions about Berea, Ohio. Certain results of experiments made in 1900 at Chillicothe were published in a bulletin (No. 122) of the Ohio Experiment Station. These showed decided advantages of quicklime applied to the soil before seeding and of dilute solutions of formaldehyde in water sprinkled upon the seeds in contact with the soil, as compared with flowers of sulphur, sulphur and lime (in small quantities), and other substances heretofore proposed for the prevention of onion smut. More extended experiments along these lines were conducted both at Chillicothe and Berea during 1901. The results from Chillicothe are now at hand and show very gratifying smut prevention and corresponding increase in the yield of onion sets. All plots herein considered are 760 square feet in area; results are stated in actual and calculated yields.

Plot.	Treatment.	Actual yield, lbs. per plot.	Calculated yield per acre, bushels.
I.	Lime, 34 bu. per A.	121.6	174.
II.	" 70 " " "	152.0	217.5
III.	Formalin, .375% sol.	196.0	280.8
IV.	Nothing	92. (large sets)	131.8
V.	Formalin, .75% sol.	202.	289.4
VI.	Lime, 125 bu. per A.	203.	290.8
VII.	" 70 " " " and Formalin, .375% sol.	214.	306.5

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* Chosen to succeed D. H. Campbell after the latter's early departure.