

of the alloy which should have the least coefficient of expansion. The results are given in the following table:

Percentage.		Coefficient.	Mean Temp.
Nickel.	Cast Iron.		
33½	66⅔	.00000543	31.5
35	65	.00000410	31.5
36	64	.00000397	31.0
36½	63½	.00000403	32.0

*Sulphur Dioxide and the Binary-Vapor Engine:* R. H. THURSTON, Cornell University.

*A New Apparatus for Demonstrating Wave Motion:* FRED. J. HILLIG, St. John's College.

The instrument is used to demonstrate the theory of radiation, particularly the different wave-forms (longitudinal and transversal), polarization and diffraction. The apparatus consists of a network of rubber strings, at the intersection of which lead balls are suspended.

*Demonstration of a Portable High Tension Coil and Ozone Generator:* G. LENOX CURTIS, New York city.

For several years I have been experimenting with a high tension coil which is attached to the street main of 110 or more volts. The current is multiplied to one million volts, while the ampèreage is reduced to a fraction of one ampère. The object of the apparatus is to produce ozone for therapeutical purposes. It apparently has but a single pole, the atmosphere being the negative pole.

To the coil are attached ozone generators, inhalers, Geisler and X-ray tubes. The apparatus is portable and can be used wherever there is an incandescent current, or the current may be supplied from a battery; it is, therefore, adapted to sick-room practice. The current and ozone, by this device, may be carried into and through the body, oxidizing pathogenic

conditions, reestablishing nutrition, and restoring the blood to normal. There is no shock nor unpleasant feeling to the patient. This method as demonstrated by five years' active practice, in which many diseases have been treated, is probably the most effective of any now in vogue. It appears to be equally advantageous in the treatment of acute and chronic cases. It quickly reduces fevers, controls pneumonia and diseases of suppurative character, and increases vitality. By passing the electrode over the body, superficial and deep-seated congestions may be located, and within an unusually short period normal circulation is reestablished. This fact has been demonstrated in the treatment of meningitis, pneumonia, tuberculosis, neuritis, etc., and the long chain of affections arising from autointoxication is virtually controlled. Sufficient ozone can be generated by this device to quickly disinfect the sickroom or hospital ward.

DAYTON C. MILLER,  
*Secretary of Section B.*

MEETING OF THE AMERICAN PHYSICAL SOCIETY.

ON Wednesday, December 31, a joint meeting of Section B and the American Physical Society was held, at which Professor A. G. Webster, vice-president of the society, presided. The annual election resulted in the choice of the following officers for the current year:

*President*—Arthur G. Webster.

*Vice-President*—Elihu Thomson.

*Secretary*—Ernest Merritt.

*Treasurer*—William Hallock.

*Members of the Council*—W. F. Magie and E. H. Hall.

The first paper on the program was by Dr. L. A. Bauer, 'On the Results of Comparisons of Magnetic Instruments.' These comparisons had been made by the magnetic survey and showed a very satisfactory agreement among the different instru-

ments used, which represented types from all parts of the world. Mr. Bauer referred especially to the satisfactory performance of certain earth inductors, which were able to give dip determinations with such accuracy as to readily show the diurnal variations. Mr. Bauer also gave a report of the observations made at the time of the solar eclipse in 1901 to detect the presence of magnetic disturbances accompanying it. Observations had been made at thirty different points distributed all over the world. Unmistakable evidences of magnetic disturbances were shown by the curves exhibited, the maximum of the disturbance occurring at the time of totality. Since the time of totality was widely different at different points, the effect observed could not be due to disturbances of the ordinary kind.

Professor E. F. Nichols and G. F. Hull presented a very interesting paper giving the final results of their work on the 'Pressure Due to Radiation.' Since their first work on this subject alterations in the apparatus had been made which permitted of much greater accuracy in the results. The pressure as computed from the observed energy of the radiation used was found to agree with the pressure actually observed to within 1 per cent., the greatest variation being 1.1 per cent. and the more usual variation being about 0.6 per cent. The effect of wave-length on the pressure was tested by using light which had been filtered through a water cell or through red glass. In each case the pressure was found to depend upon the energy only, and no indication of any dependence upon wave-length was observed. This is in accordance with theory.

In connection with this work the authors also described an experiment by which something greatly resembling a comet's tail was obtained under conditions approximating those of nature. A powder con-

sisting of a mixture of emery and puff-ball spores was placed in a vacuum tube constructed somewhat like an hour-glass. The vacuum was made as perfect as could be obtained, precautions being also used to get rid of mercury vapor. Upon pouring the powder from one part of the tube to the other, and at the same time concentrating upon it the rays from an arc, the lighter portions of the powder were seen to be blown out as though repelled by the light, and presented an appearance quite similar to that of a comet's tail. The effect was of the same order of magnitude as would be expected from the authors' values for light pressure. The authors considered it quite possible that the phenomena might in part be due to other causes; but even if this is true the experiment reproduces the behavior of a comet's tail with great accuracy. The apparatus used in measuring light pressure and with the tube showing the laboratory comet's tail were exhibited.

Professor E. H. Hall gave a historical account of the various experiments that have been made to detect a southerly deviation of a falling body, and described recent experiments by himself on the same subject. With suitable precautions to avoid disturbances, nearly 1,000 balls had been dropped through a distance of about 23 meters. The average deviation toward the south was 0.05 mm. The results are especially interesting, since the theory of the subject as developed by Gauss and others does not indicate that any deviation should be expected, while most previous experiments, like those of Professor Hall, indicate a slight effect.

The papers by J. R. Benton, viz., 'The Elasticity of Copper and Iron at  $-186^{\circ}$  C.,' 'Thermodynamic Formulæ for Isotropic Solids Subject to Tension' and 'Experiments in Connection with Friction Between Solids and Liquids,' will have been

published in full\* before the appearance of this account.

The first results of a determination of the Heat of Vaporization of Oxygen were reported by Dr. J. S. Shearer. The method used was an electrical one similar to that already used by the author with liquid air. The value obtained was 58.9. Experiments to determine the heat of vaporization of nitrogen were in progress, but not yet completed.

Professor R. W. Wood described and exhibited a screen which was transparent to ultra-violet light, while being opaque to the rest of the spectrum. Such a screen is very useful in photographing ultra-violet spectra, since it enables the overlapping spectra of other orders to be eliminated. The author showed an interesting lecture experiment in which the rays of the lantern, after passing through such a screen, were concentrated to an invisible focus where a suitable fluorescent substance was excited. The screen was made by combining a gelatine film containing nitroso-dimethyl-aniline with copper oxide and cobalt glass.

A group of papers dealing with radio-activity occupied the first half of the Wednesday afternoon session and aroused much interest. It is a subject for congratulation that work along these lines is increasing on this side of the Atlantic, and that so many important papers dealing with the subject should be presented to the Physical Society. In a paper on the 'Magnetic and Electrical Deviation of the Easily Absorbed Rays from Radium' Professor Rutherford described experiments showing that these non-penetrating '*a*-rays' are slightly deviated in passing through a magnetic field. The deviation is opposite in sense to that of the cathode rays. The deviation of the *a*-rays in an electric field

is also opposite to that of cathode rays. It would, therefore, appear that these rays are in all likelihood *positively* charged particles. Both the magnetic and the electric deviations were very small. In order to get results it was necessary to use intensely active radium and strong fields. The author's measurements indicate for the velocity a value of about  $2.5 \times 10^4$  cm./sec., and for the ratio of charge to mass the value  $6 \times 10^3$ . It would thus appear that the *a*-rays are similar in character to the 'canal rays' of the vacuum tube, the size of the particles constituting the rays being comparable to the size of atoms. The author pointed out that this result is in harmony with the fact previously observed that the coefficient of absorption of a substance for such rays depends upon the thickness of the absorbing layer already traversed and increases rapidly with this thickness.

An article by Professor Rutherford and Mr. H. L. Cook, on a 'Penetrating Radiation from the Earth's Surface,' gave the results of experiments which indicate that part at least of the so-called spontaneous ionization of air in a closed place is due to radiation from outside. It was found that in a closed vessel surrounded by a screen of lead one inch thick the ionization was reduced to 68 per cent. of the value obtained without the lead. The results indicated that the rays, which were in part absorbed by the lead, proceeded from all directions and originated at or near the surface of all bodies in the neighborhood. The authors were of the opinion that the ionization upon the interior of a closed vessel was due in part also to a radiation proceeding from the surface of the surrounding vessel. This was made probable by the fact that a screen of iron seemed to be more effective in reducing the ionization than one of lead, while if the vessel containing the air was

\* *Physical Review*, January, 1903.

sunk in a tank of water the action could be reduced still further. The assumption that iron and water radiate less strongly than lead would explain these results. In the case of lead the presumably more complete absorption of the rays from outside is more than balanced by the increased radiation from the metal itself.

Professor McLennan, of Toronto University, reported the results of experiments made at the foot of Niagara Falls to determine the induced radioactivity at that point. An insulated wire mounted immediately at the foot of the falls on the American side and maintained at a negative potential was found to acquire a much less induced activity than would be acquired by the same wire under similar circumstances at Toronto. It was found unnecessary actually to charge the wire when at the foot of the falls, since it received a negative charge from the air or spray, the potential being about that needed for the experiment. The activity acquired at the foot of the falls was found to be only about one sixth of that obtained at Toronto. The author also described experiments made in the neighborhood of a static machine in operation. It was found that the activity acquired by a metal disk when placed near the machine and negatively charged was much less than when the same disk was placed at a greater distance. It was also found that the activity acquired by a body placed in a closed room diminished with time.

A paper by Professor McLennan and Mr. E. F. Burton on the 'Electrical Conductivity of Air' dealt with experiments somewhat similar in character to those described in the paper by Rutherford and Cook mentioned above. It was found that air placed in a closed vessel showed at first a rapid diminution in conductivity, but that later its conductivity increased again.

The effect was more marked at greater pressures. The general form of the curve showing the variation of conductivity was the same for vessels made of different materials, but the initial diminution and subsequent increase of conductivity were much more marked in some than in others. The authors think that the result is due to an emanation or radiation issuing from the walls of the containing vessel. The rapid decrease in conductivity at first is due to the dying out of the conductivity originally possessed by the air, while the subsequent increase is the result of the emanation or radiation from the walls. It will be noticed that this conclusion is practically the same as that reached by Rutherford and Cook. The fact that the results of these entirely independent experiments should be announced at the same meeting of the Physical Society presents an unusual and interesting coincidence.

A paper on the 'Radioactivity of Freshly Fallen Snow,' by Mr. S. J. Allen, showed that snow, like rain, possesses marked radioactivity, which, however, is rapidly lost. The activity of snow was found to fall to one half its initial value in thirty minutes. If the snow is melted and the resulting water evaporated something possessing radioactivity is left behind. The radiation from snow consists chiefly of the easily absorbed rays. In the discussion of this paper Professor McLennan stated that he had found that after a fall of snow a negatively charged wire acquired less activity than before the snow-storm. It would seem as though the active constituent of the atmosphere had been removed by the snow.

In a paper 'On the Double Refraction of Dielectrics in a Magnetic Field in a Direction at Right Angles to the Lines of Force,' by D. B. Brace, the author called attention to the fact that the existence of double circular refraction along the magnetic

lines of force has been definitely established from theoretical considerations. Voigt has obtained equations which indicate not only this result, but also double refraction at right angles to the lines of force. The experimental results of Voigt apparently confirm this conclusion for glass and sodium vapor. The author calls attention to the fact that the results obtained by Voigt might be due to the Faraday effect. He finds this to be the case with glass, but confirms Voigt's conclusion for sodium vapor.

The next paper was by Professor A. Wilmer Duff, on the 'Viscosity of Liquids at Low Rates of Shear.' According to ideas developed by Poisson, Maxwell, and others, a liquid differs from a solid in having either a low modulus of rigidity or a high rate of relaxation under shearing stress, and the coefficient of viscosity contains a term that varies inversely as the rate of shear. Experiments by Professor Duff, made at a rate of shear about 1,000 times lower than the lowest in Poiseuille's experiments, seem to show that, while the coefficient of viscosity of kerosene is the same within rates of shear that vary as 50,000 to 1, that of water is slightly larger at the low rates of shear than at the high rates used in Poiseuille's experiments. This might be interpreted as indicating a definite, although very narrow, limit of perfect elasticity for water under shearing stresses.

'Results of Determinations of the Mechanical Efficiency of Musical Instruments,' were presented by Professor A. G. Webster. The determinations were made with the help of the apparatus designed by the author for sound measurements, which was described at the April, 1902, meeting of the Society. The efficiencies obtained were extremely small, indicating that sound-producing machines are even more

inefficient than those used in producing light.

A paper by Dr. Herschel C. Parker on 'Experiments with Very Brief Electrical Contacts' gave an account of tests of a gravity contact key devised by Dr. Charles Forbes. The apparatus itself had been exhibited at a former meeting. Dr. Parker finds that reliable contacts can be obtained ranging in duration from 0.1 sec. to about 0.00001 sec.

Brief papers by Professor W. J. Humphreys, on 'A Comprehensive Boyle's Law Apparatus' and 'A Lecture-room Method of Analyzing Irregular Electric Currents,' dealt with these subjects from the pedagogical standpoint.

The last paper on the program was by Dr. C. A. Skinner, on the 'Critical Current Density and Cathode Drop in Vacuum Tubes.' The author referred to the difference in the formulæ obtained by Stark and himself giving a relation between cathode drop, current density, and pressure. Dr. Skinner explains the difference as due to the fact that wire electrodes were used in the experiments of Stark, while in the case of his own experiments disk electrodes had been used.

As one day proved too short a time to complete the program of the society, the joint meeting with Section B was continued on Thursday, January 1, a number of the above-mentioned papers being presented on that day. The meeting may properly be regarded as one of the most interesting and successful which the society has ever held.

ERNEST MERRITT,  
Secretary.

SCIENTIFIC BOOKS.

*A Nature Wooing at Ormond by the Sea.* By W. S. BLATCHLEY, author of 'Gleanings from Nature.' Indianapolis, The Nature Publishing Company. 1902. 12mo. Pp. 245.

The author went to Florida in the early