I have ventured into a field without even a decent equipment of knowledge, and that I have altogether failed to understand the real meaning and bearing of the accepted teachings of modern science." We beg to state gently but firmly that this indictment is strictly correct in all particulars. The author of this screed on gravitation demonstrates conclusively: first, that he does not understand the fundamental concept of Newton's law of attraction; secondly, that he does not know enough of elementary mathematics to apply this law to the simple case of a homogeneous sphere; and, thirdly, that he possesses little of the caution which is born of a knowledge of things physical. He illustrates well the colossal impudence of those pseudo-scientists whose equipment consists of formal logic and a facile pen. W.

SCIENTIFIC JOURNALS.

PHYSICAL REVIEW, VOL. IV., NO. 4, JANUARY–FEBRUARY, 1897.

The Freezing Points of Dilute Aqueous Solutions, III.: By E. H. LOOMIS. This paper is devoted to a continuation of Dr. Loomis' experiments on the lowering of the freezing point by dissolved substances. The method is the same as that previously employed. In the present series of experiments the substances tested were chiefly chlorides and phosphates, though several of the more important organic acids were also used.

Since the substances employed were electrolytes, Dr. Loomis' results afford a check upon the theory of electrolytic dissociation, osmotic pressure, etc. As in the case of his earlier measurements, the agreement is entirely satisfactory only in few cases. It is well known, however, that the ordinary formula for the lowing of the freezing point depends upon several assumptions and approximations of a very doubtful character. So that it seems not improbable that the apparent discrepancies that are brought out by Dr. Loomis' measurements may lead to an improvement in the whole theory.

A Method for Energy Measurements in the Infra-red, and the Properties of the Ordinary Ray in Quartz for Waves of Great Wave-Length: By E. F. NICHOLS. This article contains two important features: first, the description of a new type of instrument for the measurement of infra-red radiation; and second, the account of measurements made with it by which the optical properties of quartz were investigated in the extreme infra-red.

The instrument used by Professor Nichols is a modified form of the Crookes radiometer. It consists essentially of two excessively small vanes mounted upon a fine quartz fibre and suspended in vacuo. The rays to be measured are allowed to fall upon one of the vanes, and a deflection of the system results. The deflection is measured by means of a light mirror. This form of instrument is found to be much more sensitive than any bolometer heretofore used. More important than its increased sensitiveness is, however, its freedom from the various disturbances to which a sensitive bolometer is subject. The radiometer does not depend in its action upon any electric or magnetic forces, and is therefore free from the irregularities which are always present when a sensitive galvanometer is used. The instrument is also capable of being more thoroughly protected against outside temperature disturbances. It can hardly be questioned that this instrument will make a considerable advance in our knowledge of infra-red spectra.

This new type of radiometer was employed in connection with a mirror spectrometer to investigate the reflection and absorption of quartz. For wave-lengths in excess of $4\,\mu$ quartz becomes practically opaque with layers of ordinary thickness. To investigate the absorption a very thin layer was prepared, the thickness being not more than $18\,\mu$. Sufficient energy was transmitted through this film of quartz to be detected, and measurements of absorption were extended to about $8\,\mu$. At that point even this extremely thin layer failed to transmit a measurable amount. Numerous well-defined absorption bands were detected between $4\,\mu$ and $8\,\mu$. The reflecting power of quartz was measured throughout the same range of wave-lengths by comparison with silver. Making use of the Cauchy formula, the index of refraction was then computed from the observed values of the

reflection and absorption. The results indicate distinctly the presence of anomalous dispersion, the critical wave-length being that where the absorption of the quartz becomes complete. The article is an important one in its bearing upon the theories of dispersion and absorption.

Heat Rays of Great Wave-Length: By H. Rubens and E. F. Nichols. Experiments are described in this paper by which infra-red rays were detected of greater wave-length than any heretofore observed. The longest wave-lengths in the infra-red which had previously been measured were those studied by Paschen in connection with the dispersion of fluorite. These rays had a wave-length of a little less than 10 μ. Messrs. Rubens and Nichols have succeeded in obtaining and measuring rays whose length is 25 μ, these rays being obtained by successive reflection from fluorite. It appears that this substance possesses an absorption band in the neighborhood of 25 μ, which is so intense as to suggest metallic absorption. There results a great increase in the reflecting power of the material in the neighborhood of this wave-length, so that after successive reflection from three surfaces of fluorite the rays that remain are found to consist almost wholly of waves corresponding to this absorption band. The wave-length was determined by means of a wire grating. Similar experiments with quartz led to the detection of waves of about 6.5 μ. Experiments were also tried with rock salt, but the bolometer was not sufficiently sensitive to enable the resulting waves to be measured. The authors intend to continue this work, using the improved radiometer described by Professor Nichols in the previous paper.

On the Formation of Lead Sulphate in Alternating Current Electrolysis with Lead Electrodes: By S. Sheldon and M. B. Waterman. The work described in this paper is in part a continuation of the authors' experiments on the capacity of electrolytic condensers (*Physical Review*, II., p. 401). Attempts to find condensers of this type which should be efficient and free from 'hysteresis' led to the trial of lead electrodes in sulphuric acid. As a condenser this form of cell was no improvement over those first used. But when placed in an alternating current circuit a curious instance of alternating current electrolysis was observed, namely, the development of insoluble lead sulphate at both electrodes. Experiments were then made to determine the dependence of the amount of electrolytic action upon current density, frequency of alternation, temperature, etc. The results, both in tabular and graphic form, are contained in the present article.

Polarization and Internal Resistance of a Galvanic Cell: By B. E. Moore and H. V. Carpenter. This article is devoted to an experimental study of the 'diamond' carbon cell, the object of the authors being to localize the changes in polarization and resistance which occur on opening and closing the circuit. Their chief conclusions are: (1) that polarization occurs at both electrodes, but is more marked at the carbon electrode; (2) on closing the circuit the rapid fall of E. M. F. is due principally to the polarization at the carbon electrode; (3) the rapid rise in E. M. F., when a cell is first thrown upon open circuit, is largely due to recovery from polarization at the zinc electrode.

The Trace of the Gyroscopic Pendulum: By Ernest Merritt. In this article the motion of the gyroscopic pendulum is first briefly discussed from a theoretical standpoint. A number of photographic traces are then shown, which were made by reflecting a beam of light from a mirror attached to the lower end of the pendulum. Several different types of curves are represented corresponding to different starting conditions and to different lengths of pendulum. These curves are of interest in affording a concrete illustration and confirmation of the theory of gyroscopic motion. They also bring out a curious effect due to friction, which is exactly opposite in its result to what would be at first expected.

Note on Different Forms of the Entropy Function: By W. F. Durand. Professor Durand discusses, in this article, the general form of the integrating factor which must be used in order that the integral of dQ shall vanish for any reversible cycle. It has generally been recognized for some time that the absolute temperature represents only one of the infinite number of possible integrating factors. If some other of these factors

were used we might get something analogous to entropy, and which, nevertheless, would possess different and possibly interesting properties. Professor Durand has discussed two special forms which the integrating factor might take for a perfect gas. One of these is where it is a function of the pressure only, and the other in which it is a function of the volume only.

Books Reviewed: Frick, Physikalische Technik; Wilkinson, Submarine Cable Laying; Griesbach, Physikalische Propadeutik; Weldon, Physical Measurements.

SOCIETIES AND ACADEMIES.

ELEVENTH ANNUAL SESSION OF THE IOWA ACADEMY OF SCIENCES.

THE Iowa Academy of Sciences held its eleventh annual session in Des Moines December 29 and 30, 1896. In the absence of the President, Professor T. P. Hall, Professor W. S. Franklin, First Vice-President, occupied the chair. The following papers were presented:

'The State Quarry Limestone,' by Professor S. Calvin, describes a series of limestone ledges of Devonian age consisting of comminuted parts of brachiopods, crinoids, etc., some of which deserve to rank as a brachiopod coquina. As now known, limited to a few local deposits in Johnson county. It appears to be unconformable on the Cedar Valley limestone and laid down after an erosion period of considerable length. No such erosion period in the Devonian has hitherto been suspected. The fauna, in some respects unique, contains a remarkable fish bed including the common Devonian type Ptyctodus, but also the Carboniferous Psephodus. Some of the brachiopods also have Carboniferous affinities. It is probable the beds represent the closing stage of the Devonian.

'Stages of the Des Moines, or chief Coal-bearing Series of Kansas and Southwest Missouri and their equivalents in Iowa,' by C. R. Keyes.

'Natural Gas in the Drift of Iowa,' by A. G. Leonard, enumerates the different localities where natural gas has been noted and relation of these to drift sheets. The gas has two possible sources, the underlying coal-measure shales and the vegetable accumulations in the drift. The latter are supposed to be the source of the natural gas in Iowa.

'Results of Recent Geological Work in Madison County,' by J. L. Tilton, included discussion of the geological formations of the county, distribution of the loess, drift and alluvium, relation of present to preglacial drainage, and other features.

'A Drift Section at Oelwein,' by G. E. Finch; 'Evidence of a sub-Aftonian Drift in Northeastern Iowa,' by S. W. Beyer, and 'The Botany of a Pre-Kansan Peat-Bed,' by T. H MacBride, all dealt with some exposures recently studied in the northeastern part of the State which are of special interest as showing very clearly a distinct separation of glacial periods, at least five of which are now known to be well marked by deposits in Iowa.

'Additional Observations on the Surface Deposits of Iowa,' by B. Shimek, detailed results of a series of borings and evidence in support of the author's view that the loess deposits in western Iowa are of æolian origin.

'The Flora of the Sioux Quartzite,' in Iowa, by B. Shimek, included an annotated list of the plants observed by the author on the quartzite exposure in Iowa, with a discussion of its relation to the remaining flora of the State.

'Notes on the Aquatic Plants of Northern Iowa,' by the same author, included mention particularly of the flowering plants occurring in lakes and ponds.

'Spermaphyta of the Fayette, Iowa, Flora,' by Bruce Fink; a list including about 700 species of plants collected at or near Fayette.

'Notes on the Flora of Iowa,' by T. Z. Fitzpatrick; a short list of species new or little known to Iowa flora.

'The Mechanism for Securing Cross-fertilization in *Salvia lanceolata*,' by G. W. Newton; a description of the structure of blossom and means of pollination.

'Notes on some Introduced Plants in Iowa,' by L. H. Pammel; covering introduction, distribution and economic importance of a number of species.

'A Study of the Leaf Anatomy of some Species of the Genus Bromus,' by Emma Sirrine; giving details of the epidermis, especially the bulliform cells, stereome and mestome.