speaker's giving a method by which any one can measure the size of the pupil of his own eye, all the apparatus needed being easily constructed from a half-sheet of writing-paper. Mr. Brashear exhibited a new form of comet-seeker, very conveniently arranged, consisting of a Newtonian reflector of six and one-half inches clear aperture, mounted with an altazimuth motion, the eye-piece being placed in the horizontal axis, so that the observer has no need to change his position while sweeping the sky. He also showed a modification of the Merz-Young polarizing helioscope, less liable to breakage than the old form; and in a third paper he advocated the adoption of standard sizes for screws and draw-tubes for astronomical instruments, so that the parts may be interchangeable, — an improvement whose utility seems self-evident, especially if combined with the adoption of metric units for the standards.

Professor Boss presented a list of over twelve hundred stars with large proper motions, whose data, collected from various sources, will, however, need to be verified before detailed publication.

The last paper of the day had been postponed from the first place on the list, and was by Prof. F. N. Willson. He presented a systematized nomenclature for the roulettes, or trochoidal curves, in which he recognizes the fact that the same curve may be generated in two ways by varying the relative size of the circles and the position of the tracing-point.

On Friday morning only seven papers were assigned to Section A, and two of these failed to appear. Mr. Woodward's paper on a method of computing the secular contraction of the earth, and Professor Stone's on the perturbations of the orbit of Hyperion, were of a technical character, consisting of a discussion of the differential equations involved in the problems. The interest of the morning, however, centred about the papers of Professors Mendenhall and Webb. The former was upon the eccentricities of guessing. The circumstances which gave rise to it were these: a number of persons having recorded their guess of the number of nails contained in a glass carboy, the nails being of various sizes, large and small, these guesses were given over to the professor for discussion. The results were plotted with amount of guess and number of guessers as abscissa and ordinate, and were found to agree pretty well with the probability curve; but the maximum of the curve did not coincide with the actual number of nails, showing that the average guess was considerably below the truth in this case, reasons for which were easily suggested. Mr. Farquhar suggested that the use of the logarithm of the number guessed for abscissa would bring the two curves into closer agreement. The author rather objected to his own title, and thought this was not really a case of guessing (which should be entirely without the bias of any reason), but rather a series of estimates. It is no doubt true, that, while some of the numbers were careful estimates, others were the most random guesses, made without ever seeing the carboy. The guesses numbered over seven thousand, and varied from forty-three to over three million, both extremes being seriously given. The true number was 2,551, as ascertained later by actual count. Professor Webb advocated the introduction of the idea of mass into the definition and formula for the moment of inertia, defining it as the summation of the mass into the square of the distance from the axis, or the mass which at unit's distance will have the same energy at the same speed of rotation. The discussion which followed, participated in by a number of those present, brought to light the fact that a good many persons object to the use of the term 'inertia' at all, some preferring 'moment of mass,' while others were content to retain the term because used in so many valuable memoirs already in print.

There was no session of Section A on Friday afternoon nor on Saturday; and on Monday, no papers being assigned to the section except the two which failed through absence on Friday, and their author still being absent, the section adjourned finally, so far as reading of papers is concerned.

Section B.

THE address of Vice-Pres. W. A. Anthony before the Physical Section, at its opening on Wednesday, was on the importance to the advancement of physical science of the teaching of physics in the public schools. Professor Anthony took the ground, that, since there is a strong re-action by which the applications of science stimulated the development of the science itself by awaking more general interest and by bringing out phenomena that call for explanation, the cause of pure science will be advanced by giving inventors and all concerned with the application of physics a more thorough training in the principles of that science.

This training must be given by the public schools, and should begin early, and be prolonged over several years of the course, so that such a principle as the conservation of energy shall not be to the student something which he learned in cramming, during one year or a part of a year, a very difficult subject called physics, but it shall be as familiar and well understood a fact as that water will not flow up hill. When this is the case, the labors of inventors may be expected to be more fruitful, because more intelligently directed, and science itself will be advanced.

The most important paper of the session was presented by Professors Michaelson and Morley, and was on a method of making the wave-length of sodium light the actual and practical standard of length. The methods that have heretofore been advanced for this purpose all depend on the use of the diffraction grating, and do not afford a sufficient degree of accuracy in the comparison; for, as was remarked by Professor Rogers, before the wave-length of sodium light can be taken as the standard of length, it must be possible to lay off a distance on a scale which shall represent a given number of wave-lengths, at least as accurately as it is possible to compare two standard scales. Messrs. Michaelson and Morley allow sodium light to fall on a piece of plane parallel glass, where it is divided into two beams at right angles to each other, which are reflected back by two mirrors, and again brought together into one beam, which falls upon the observing telescope. Interference bands are seen, which depend on the difference between the distances which the two beams traverse. One of the two mirrors is provided with a screw motion, by which it can be moved back or forth in the direction of the beam of light which falls upon it. If, now, it is moved, the observer at the telescope, by counting the number of interference bands which cross the field of view, can determine the exact number of wave-lengths of sodium light corresponding to that distance. By this arrangement a distance of one decimetre can be directly determined; and by successively measuring off ten decimetres, and by having the marking diamond rigidly attached to the mirror which is moved, Professors Michaelson and Morley believe that they will be able to lay off a length of one metre, in terms of a given number of wave-lengths of sodium light, with an accuracy of about one part in a million, which is at least twice as accurately as two metres can be compared; but, in finding the number of wave-lengths that correspond to a metre, they will of course be limited by the accuracy with which the microscope can be set on the graduations of the standard.

A second paper of great interest was by these same investigators, and was an account of some experiments by which it was sought to measure the velocity of the luminiferous ether relative to the earth, by the interference between two beams of light, which were reflected back and forth a number of times, one being in the direction in which the ether was supposed to be moving, and the other at right angles to that direction. No effect was found, so that it was concluded that the ether must be very nearly at rest with respect to the earth; but this result leads to serious difficulty in explaining aberration, and should be carefully scrutinized.

Prof. William A. Rogers, to whose enthusiasm and skill in a very arduous field of research American investigators are so greatly indebted, presented a number of papers to the association, in one of which points of great importance in the exact measurement of lengths were brought out; in particular, that, in comparing standard scales, a time when the temperature is slowly changing is the worst possible, and that such comparisons should be made either with constant temperature, or at a certain critical time in the day when the temperature is changing quite rapidly, the time depending on the relative masses of the bars and on other circumstances. In the case cited this critical time was about 6 A.M., and measurements a half-hour before that time showed errors about equal in amount and opposite in direction to those made a half-hour after it.

Prof. W. F. Magie, in a study of capillarity, showed reasons for believing that the contact angle of water and glass is not zero.

It is striking evidence of the great velocity attained in tornadoes that straws and bits of hay are often driven like darts into pine boards, and even into the dense bark of hickory-trees. Professor Mees found, that, to obtain similar results by shooting straws from an air-gun, velocities of from one hundred and fifty to one hundred and seventy-five miles per hour were necessary.

Professor Mendenhall read a paper giving an account of the changes in the electrical condition of the atmosphere that are observed during thunder-storms, and referred to the excellent work done by the New England Meteorological Society in the study of these most interesting phenomena.

Prof. E. S. Nichols gave an account of a battery-cell on which he and Mr. W. S. Franklin had been experimenting, in which both electrodes were iron; but one was in a magnetic field, and the other not. The magnetized electrode was found to be sometimes electro-positive to the other, and sometimes electro-negative, depending on whether its magnetic poles were exposed to the liquid, or whether the neutral part alone was so exposed. A difference was also found between those liquids tending to produce ferric salts and those forming ferrous compounds.

Professor Barker presented two papers on behalf of Mr. Edison, in one of which a magnetic balance similar in principle to Wheatstone's bridge was described, by which the relative magnetic permeabilities of different samples of iron can be rapidly tested. In the other paper, Mr. Edison described an ingenious form of apparatus, which he calls a 'pyro-electric dynamo,' in which an electric current is obtained directly from heat-energy through the induction produced by alternately heating and cooling an iron core placed in a strong magnetic field and surrounded by an insulated coil.

Mr. C. E. Monroe presented to the section the results of some curious experiments in which blocks of gun-cotton, after having been stamped with certain letters, were exploded on flat plates of wrought iron. The gun-cotton blocks were placed with the lettered side down, and it was found, that, when the letters were stamped in relief, they appeared in relief on the iron after the explosion, and, on the other hand, when the letters were depressed in the gun-cotton, they were also depressed on the iron plate.

The session this year has been of considerable interest, and the number of communications presented to the section unusually large.

Section C.

[*Report not received in time for this issue.*]

Section D.

NINETEEN papers or subjects were presented during the sessions of this section by twelve gentlemen, as follows: on Nicaraguan woods, and friction of engines, by R. H. Thurston; on the American system of water-purification, by Albert R. Leeds; a new method of finding an equivalent uniform load, producing bending moments approximately equal to the maximum moments under a moving train, the deflection of girders and trusses, and re-action polygons and their properties (a new general class of graphical polygons suitable for the comparison of the bending moments and shearing stresses in simple girders and single intersection trusses, due to a moving train of wheel weights), by H. T. Eddy; on an improved method for testing metals, by Charles E. Monroe; on the effect upon the strength of iron by subjecting it to a pull while hot, Rankine's solution of the problem of turbines, and downward draught device for a furnace, by DeVolson Wood; on a new high-speed steam-engine indicator, by J. Burkitt Webb; on errors of approximate calculations of the effect of the inertia of the moving parts of a steam-engine, by D. S. Jacobus; on the theoretical effect of errors of observation in calorimeter experiments for determining the latent heat of steam, and improved arrangement of Siemens's platinum electrical pyrometer, by J. E. Denton; on the uniformity of planimeter measurements, by T. C. Mendenhall and John Mack; on mechanical inspection of railway-tracks and results obtained, by P. H. Dudley; on the theories of the lateral pressure of sand against retaining walls, by Mansfield Merriman; on national armament, by J. R. Haskell.

A number of these papers were accompanied by illustrative models or drawings, and some by both models and drawings. In some cases only a partial treatment of the subject was given, a complete consideration being reserved for another paper. In this way new lines of thought were suggested. and the authors thus indicated their intention of occupying the fields of thought which they thus partially opened up.

The section united with Section B (Physics) for an hour on Friday to hear two papers by J. Burkitt Webb, — one on a new dynamometer, which was illustrated by a working model; and the other on the experimental determination of the re-action of a liquid jet.

On Monday afternoon Sections D and I combined to listen to four papers relating to different aspects of a plan for a Nicaragua ship-canal. The first of these was on the general subject of isthmian transit, by H. C. Taylor; the second, on the engineering features of the Nicaragua Canal, by K. E. Peavy; the third, climatic and sanitary notes on the Nicaragua Canal route, by John F. Bransford; and the fourth, historical and geographical notes concerning the Nicaragua Canal route, by J. W. Miller. The work of the section may be mainly classified under four heads: —

1. Papers recording actual practical work in new fields; as, for example, the paper on the mechanical inspection of railway-tracks, which was accompanied by rolls of diagrams taken upon different lines of railway, showing the condition of their tracks, and from which the interesting and valuable results set forth in the paper were obtained.

2. Papers illustrating new or improved special machines or devices for accomplishing difficult ends. The new high-speed steam-engine indicator, by Professor Webb, illustrates this class. A model and drawings of the instrument were shown, by means of which the theory and operation of the indicator were readily understood.

3. Papers based upon laboratory experiments, like Professor Denton's, on calorimeter experiments for determining the latent heat of steam, in which the results of experiments with two forms of calorimeter were recorded, and made the basis of valuable deductions in regard to the theory and operation of the calorimeters compared.

4. Discussions, suggestions, and criticisms relating to the application of laws and principles, and to methods of research and computation, of which Professor Eddy's paper, on re-action polygons and their properties, is an example.

The papers were generally fresh and stimulating, and clearly aimed to advance scientific thought and attainments, to secure the practical achievement of valuable work upon a scientific basis, and to perfect theories and harmonize them with actual facts and to secure their easy and correct applications in new fields of scientific work. The sessions of the section must have proved of value to all who followed the work done, and many regret that most of the papers must appear in abstract rather than in full in the Proceedings of the association.

Section E.

GEOGRAPHY is by title included with geology in Section E of the association; but geology takes all the attention, and, in the present vigorous condition of geological investigation, geography as a science is almost forgotten. Under geology itself, the work of the International Congress of Geologists and of its American committee received the greatest share of time, as the vice-presidential address of Mr. Gilbert considered the first, and the several reports read by Dr. Frazer introduced the second. There has been apprehension among some that more might be attempted by the congress in the way of authoritative dictation and majority rulings on matters of opinion than would be justifiable in our rapidly advancing science — or, indeed, in any science. The dangers of such a course were well pointed out by Mr. Gilbert: "The proper function of the congress is the establishment of common means of expressing the facts of geology. It should not meddle with the facts themselves. It may regulate the art of the geologist, but it must not regulate his science. Its proper field of work lies in the determination of questions of technology; it is a trespasser if it undertakes the determination of questions of science. It may decree terms, but it must not decree opinions. . . . For science it is not merely illogical, it is