FIRE DAMP EXPLOSIONS PRODUCED BY SOUND.

The paper recently read by Mr. William Galloway, Inspector of Mines, before the Eoglish Royal Society, is a valuable and important contribution, marking, we trust, the beginning of further investigations in the prevention of the accidents and large loss of life in mines, due to explosiona of fire damp. The Davy safety lamp has been heretofore considered safe under allc rcumstances except when exposed to the action of an explosive current, when the flame might be driven through the meshes of the wire gauze and so cause an explosion. But disasters occurring in British collieries where the lamp was used becoming too frequent to be reasonably ascribed to the existence of the above exceptional conditions, various theories have been suggested; and in cases where no plausible ground for the same could be found, carelessness of workmen appears to have been the general assumption.

In the year 1866, a great explosion, occurring in the Oaks Colliery, happened simultaneously with the firing of a heavily charged shot in pure air. Attention was drawn to the coincidence; and from examination of the reports of the mine inspectors, it was found that shot firing was carried on in seventeen of the twenty-two collieries in which explosions had happened since the date of that above mentioned, and the details given prove that shots were fired at or about the time of each disaster.

In 1872 Mr. Galloway conceived the idea that a sound wave, originated by a blown out shot, in passing through a safety lamp burning in an explosive mixture, would carry the flame through the meshes of the wire guaze in virtue of the vibration of the molecules of the explosive gas; and to test this view, he instituted a series of experiments under the auspices of the Royal Society which adduced perfectly conclusive results.

We find in Nature a record of these interesting trials. Tue first consisted in directing a slow current of gas and air from a Bansen burner through a sheet of wire gauge inclined at an angle of 70°. Part of the explosive mixture passed through the gauze and produced a flat flame. A glass tuce, 3 fest 4 inches long and 31 inches in diameter, was placed horizontally with one end opposite the flame on the same side of the wire gauze, and distant from it about $1\frac{1}{2}$ inches. At the other end of this tube, a sound wave was produced by exploding a mixture of coal gas and oxygen coatained in bubbles. When the sound wave passed through the tube, the flame was carried through the gauze and ignited the gas in the Bunsen burner on the other side. Paper and other diaphragms, inserted at a distance of 10 feet from the origin of disturbance, ensured that only the sound wave was propagated through the tube.

More elaborate apparatus was then constructed, so arranged that the sound wave of a pistol shot was conveyed sun's mass divided by Jupiter's mass. through tin plate tubes to a distance of about 20 feet, where it passed through a safety lamp purning in an explosive mixture. The Davy, Claony, Stephenson, Mueller, and Eivin lamps were all tested, with, however, the results that, while the flame passed easily through the Davy lamp, it passed with more difficulty through the Clanny, and not at all through any of the others.

After this, experiments were made on a larger scale in a sewer, where it was found that 109 feet was the greatest distance a sound wave could be propagated of sufficient intensity to mass the flame. when caused by the discharge of a pistol loaded with 59 grains of powder. The sewer was built of brick, and was 6 feet high by 4 feet wide.

Mr. Galloway's discovery, that, when the vibration of the air which constitutes a sound wave has a certain amplitude, it can transmit flame through the wire gauze of the Davy and Clanny lamps, furnishes an additional argument against trusting the samps in use among ordinary workmen. It is now almost universally admitted, says the discoverer's paper in conclusion, to be highly dangerous to continue work in an explosive atmosphere; so that safety lamps should be used only as a precaution against possible outbursts of gas, or when work is carried on in the neighborhood of gas that cannot be easily dislodged; it is evident therefore that lamps constructed on the principle of the "safety lantern," such as the Stephenson, Mueller, etc., which are extinguished in an explosive mixture, are far safer than lamps like the Dayy and Clanny, which continue to burn under the same circumstances, and are then liable at any instant to have the flame driven through the wire gauze, and communicated to the external explosive atmosphere.

were briefly rehearsed. The third event of the year is the act of Philadelphia in the establishment of a zöological garden. The last event is the introduction into the United States of civil hospitals built on the plan which is known in charges, and the duality in the direction of the transmitted every other civilized nation as the American system.

The matters of interest that were to come up before the Association were then briefly summarized, chief among ilouity of electricity thus ascertained (and the greatest known which was the adoption of a new constitution.

The formal opening of the session included a speech from the chairman of the Local Committee, Hon. H. C. Robinson, and a reply by President LeConte. The work of | interpretation. That electricity moves through a quarter of organizing was then proceeded with, and the officers of the a mile of wire at the rate of 288,000 in a second is not evivarious sections elected.

We give below our usual abstracts of the papers thus far ead:

Professor H. P. Armsoy, of Millbury, Mass., on the subject of

THE NITROGEN OF THE SOIL,

said that it has become an important problem in agricultural chemistry to ascertain the source whence plants derive their supply of that element. Lawes, Gilbert, and Pugh showed that the cereals, at least, are incapable of assimilating free nitrogen from the air; and this is probably true of all plants. The author made a series of experiments to throw light upon the loss and gain of nitrogen, the method adopted being to allow organic matter, containing a known amount of nitrogen, to decay under circumstances in which all the nitrogen given off or accumulated could be measured. The results show a loss of nitrogen in nearly all cases. The following conclusions sum up our present knowledge: 1. The loss of free nitrogen during the decomposition of nitrogenous organic matter is generally due to oxidizing action. 2. An increase of combined nitrogen in soil may take place by oxidation of free hitrogen to nitric acid. 3. Some organic substances in the presence of a caustic alkali are able to fix free nitrogen without the agency of oxygen or the formation of nitric acid.

The results of Professor Pliny Earle Chase's communicaticn, on

THE VELOCITY OF PRIMARY UNDULATION,

are that, adopting Struve's constant of aberration, we find that the constant velocity which would account for all the gravitating motions of the solar system is almost, if not exactly, identical with the velocity of light. The well known thermodynamic principles which point to a gaseous structure of the sun seem to be confirmed by this investigation. The following relationship may, perhaps, prove to be some thing more than merely curious: The number of vibrations in the unit of time of the mean thermodynamic rays is very nearly, if not exactly, equivalent to the cube of twice the

Professor E. T. Cox, State Geologist of Indiana, followed with an account of an ancient stone fort, existing in Clarke county, Ind. It is a relic of the moundbuilders, and presents some peculiar features of construction adapting it excellently for a defensive work.

Professor A. S. Packard, Jr., read a paper on the

CAVE FAUNA OF THE MIDDLE STATES.

The results show a great uniformity in the distribution of life-more than would at first be expected, though these caves lie in a faunal region nearly identical as regards the external world, and the temperature of the caves is very constant. Still some notable differences occurred.

The basis of life in the caves is without much doubt the living and decaying animals found in them. While 25 to 30 species were known to inhabit our caves, chiefly through the labors of Tellkampf, Cope, Cooke, Dr. Sloan and others, we are now able to add 50 species to the number, which willprobably be carried up to 100.

DIFFERENCES IN SOLAR HEAT.

Professor J. P. Langley remarked that there is a variation in both the heat and light, and probably also in the actinic force, of different parts of the sun. The difference is due principally, but not wholly, to difference in atmospheric absorption.

It does not appear, as the result of experiments, that there is so great a selective absorption of heat, in the lower regions of the sun's atmosphere, that, when rays come from the edge of the disk and pass through a greater proportional thickness of his atmosphere, the heat is filtered from them and the light allowed to go through. We find that the heat falls very rapidly toward the edge as to indicate thinness, of the solar chromosphere, than has been hitherto admitted. We appear to have been led to the conclusion that there is a local obscuration over the spot, very remarkable both in degree and kind.

RECENT ADVANCES IN SCIENCE.

Wheatstone, he said, by a revolving mirror, determined the velocity of elect. icity, the duration of electrical disdisturbance. Fedderssen, and more recently our own asso. ciate, Rood, repeated his experiments. Indirectly the veexcept that of gravitation) has been tested by signals .hrough long lines of land and ocean telegraph, giving a lower figure than that of Wheatstone. But the anomaly is due to a misdence that it would move over 288,000 miles in one second. Electricity has no velocity in the ordinary sense. The transmission of the electrical disturbance is proportional to the square of the distance to be traveled; therefore the velocity varies with the length of the journey.

Had the results of Ohm been sooner heeded, Science would have long ago been materially advanced. Arago, making use of Wheatstone's method, proved experimentally that the velocity of light was greater in air than in water, giving a fatal blow to the corpuscular theory of light and establishing the undulatory theory. The mean of the two values obtained for the velocity of light in the experiments of Fizeau and Foucault, comes very close to the astronomical estimate. Cornu has repeated Fizeau's experiment, eliminated its errors, and brought it into accord with Foucault.

Foucaulu's experiments intensified the doubt that astronomers had long entertained as to correctness of the received distance of the sun. The "black drop" in the transitof Venus has been found the basis of uncertainty. Mr. S.one, an astronomer, has examined this source of error, and, by calculations that give due weight to this source of discrepancy, has sudden'y brought about a reconciliation between the experiments of Cornu and Foucault, the motions of the moon and the transit of Venus, which is as perfect as it is surprising.

In reviewing the advances of natural history, Professor Lovering spoke of the discoveries in that science made by Maupertuis and Lamarck, and considered them in connection with the nebular hypothesis as originated by Laplace and carried forward by the clder Herschel. The fate of the nebular bypothesis is as yet uncertain, but it will answer the purposes of Science till a better theory is brought forward.

The motion of the fixed stars involves a most interesting inquiry. A motion has been observed, absolute in the case of the sun, and capable of estimate in the different stars as fast as their distances are determined. Here again spectroscopy has come to our aid. The alteration of wave lengths of light, by the motion of the observer or the object observed, has helped and is helping to solve this problem. This discovery was then historically reviewed, going back to the discovery of the velocity of light by observations on the calculations of Vogel and Huggins on the displacement of star spectra, which are to be received as somewhat doubtful approximations. There is, too, the possibility that the misplacing of the lines of sodium, lydrogen, and other elements may be due to conditions different from any we know on earth in the gaseous atmospheres of the stars.

The observations of Huggins on star drift open a new series of questions, and may possibly throw discredit upon the accepted estimates of star distances, made independently by Struve and Argelander. Van der Willigen, in the present year, has published a well considered memoir on the fallacies which he regards as vitiating the conclusions of Huggins. Except under certain improbable conditions, he shows that the motion of the luminary will not interfere with the time of oscillation. If this be accepted, the supposed motion of the stars must receive another interpretation. On the other hand, if the motion of a luminary is ascertained, and it is found to accord with spectrum displacement, the mathematical theory will have to be reconsidered.

Professor Challis, in an elaborate work, has discussed the interplay between ether and atoms, and the theory may now be regarded no longer as a speculation, but as a phy-ical reality, with substantial mathematical supports. He does not yet claim full mathematical proof, but his work is a guide post that unmistakably points the way. In one respect the theories of Le Sage and Challis coincide: the driving storm of atoms must come from outside the world of stars: the universe is not even temporarily automatic. but must be fed continuously by an agency external to itself. Our Science thus is not a finality.

The law of conservation of energy, the child of the cor relation of physical forces, was then considered in a brief historical review. Physical science can only assert that it possesses no evidence of the destruction of matter. We have no conception of inert matter or disembodied force. All we know of matter is its pressure and its motion. If it could be shown that all the phenomena displayed in the physical world were simply transmutations of the original energy existing in the molecules, physical science would be satisfied. The great problem of the day is how to subject all physical phenomena to dynamical laws. The obstatles are innumerable, but we shall not rest till they are overcome. We applaud with good reason the brilliant results of experimental research, but mathematical analysis, with its multitudinous applications, is the only key which will fit the in-



PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIEMCE.

This association opened, on August 12, its twenty-third session, at Haraford, Conn., under the presidency of Dr. J. L. L5Conte, of Pniladelphia. Judging from the numbers, as weil as the high standing of the attending members, the meeting bids fair to be one of much interest. The President, in his

OPENING ADDRESS.

said that the past year was noteworthy for four events. The lies of mollusks were closely related to those families in the first was the appearance of Coggia's comet, from the spectroscopic examination of which the happiest results may be expected. Already the spectroscope has proven to us that even though the largest of comets should strike the earth no has been in fact benefited by occasional collisions and ab- the deceased, which were put on pointed sticks and held out sorptions. The second event is the establishment of the Anderson School, at Penikese, for instruction in Natural widely diffused sun worship of former times. History. The facts connected with the organization of this school, and its munificent endowment by Mr. Anderson, Association, read an address on

Professor E. S. Morse, in a paper on the

NORTH AMERICAN UNIONIDÆ

explained why the unios or fresh water mussels are so much more abundant in the United States than in Europe. He emphasized particularly the fact that most fresh water famisea which survive the admixture of fresh water, and that commonly occur between high and low water marks.

Professor LeConte gave an interesting account of the rite of cremation as practiced among the Yuma Indians, and possible harm could ensue. We may learn that our planet noted among other proceedings the removal of the eyes of tricate wards in the treasury of Science. toward the sun. This indicates a feeble remnant of the

Professor Lovering, President at the last meeting of the

A CORRESPONDENT, C. R., says: A worn out watch key can be made as good as new by simply filing off about $\frac{3}{16}$ of an inch of the end, as the socket is usually twice as deep as the post of the watch is high.