serve as an index during the course of his experiment—one violin being fixed and the other moving in a grooved sliding rest. The second string was then vibrated in a uniform manner, which produced an oscillatory motion, which was heard on the corresponding string of the other violin. The paper on the string showed the vibration at a distance, and the violins were separated from each other until the agitation of the paper ceased. This point was marked as the limit of the vibrations and marked 100, the intermediate portion being marked off to represent the one thousandth part of the distance.

Experiments made at noon with this instrument, and often repeated, indicated the same distance within a few thousandths. The whole extent of the scale was seven feet, and this distance was the limit of the greatest propagation of sound under the influence of light in the apparatus. Parolette further states that experiments in darkness gave, as a result, a mean temperature of 0.98, and that the mean difference of this propogation at noon and midnight was two degrees on the scale. In conclusion, Parolette tries to explain the results arrived at by stating that during the day, the atmosphere is more nearly saturated with oxygen than in the night, but he says it remains to be proved that this excess is sufficient to cause such a difference in the propagation of sound during the two periods, and adds, "rather, may not light be the true cause of this increased propagation in oxygen and nitrous gas; as it is known that the former has a great capacity for light, and the latter cannot be formed without its presence." As the velocity of light is 900,000 times greater than that of sound, it does not appear unreasonable to explain, in this way, its effects on the vibrations which proceed from sonorous bodies. J. M.

THE NATIONAL ACADEMY OF SCIENCES.

As the meeting held on the 16th of November last, and those of the three following days, were devoted to the reading of scientific papers only, little executive business was transacted and no new members were elected.

At the meeting of the Council the following deaths of members were announced:

J. Homer Lane, of Washington, in May. S. S. Haldeman, of Chickies, Pa., in September, and Count L. S. Portalès, of Cambridge, Mass., in October.

The decease of Professor Benjamin Peirce, of Harvard College, one of the original active members of the Academy, but whose connection with it had been severed, was also announced.

Resolutions, thanking the Trustees of Columbia College for providing rooms for the meeting, and to President Barnard and officers of the college and other members of the Academy in New York for liberal entertainment of its members, were adopted.

THE FOLLOWING PAPERS WERE PRESENTED:

1. On the Basin of the Gulf of Mexico.—J. E. Hilgard.
2. On the Origin of the Coral Reefs of the Yucatan and Florida Banks.—Alexander Agassiz.
3. Observations on Ice and Icebergs in the Polar Regions.—F. Schwatka.
4. On the Duration of the Arctic Winter. —F. Schwatka.
5. Mineralogical Notes.—Benjamin Silliman.
6. The Relationship of the Carboniferous Euphoberia to living and extinct Myriapods.—Samuel H. Scudder.
7. Report on the Dredging Cruise of the U. S. Steamer *Blake*, Commander Bartlett, during the Summer of 1880.—Alexander Agassitz.
8. On Some Recent Experiments in Determining the Electro Motive Force of the Brush Dynamo-electric Lamps operating by Incandescence.—Henry Morton.
9. On the Intimate Structure of certain Mineral Veins. —Benjamin Silliman.
10. On the Ellipticity of the Earth as Deduced from Pendulum Experiments.—C. S. Peirce.
11. On an Improvement in the Sprengel Air Pump.—O. N. Rood.
12. On the Thermal Balance.—S. P. Langley.
13. On the Measurment of Radiant Energy.—S. P. Langley.
14. Causes which Determine the Progressive Movements of Storms.—Elias Loomis.
15. On the Antimony Mines of Southern Utah.—J. S. Newberry.
16. On the Conglomerate Ore Deposits of the United States and Mexico.—J. S. Newberry.
17. On Photographing the Nebula in Orion.—Henry Draper.
18. On Condensers for Currents of High Potential.—George F. Barker.
19. On Sigsbee's Gravitating Trap.—Alexander Agassiz.
20. On the Deposits of Crystalline Iron Ores of Utah. —J. S. Newberry.
21. On the Origin of Anthracite.—T. Sterry Hunt.
22. On the Star-List of Abul Hassan.—C. H. F. Peters.
23. Dimensions of the Brain and Spinal Cord in some extinct Reptiles.—O. C. Marsh.
24. On the Rimravidæ.—E. D. Cope.
25. On the Miocene Canidæ.—E. D. Cope.
26. On a New General Method in Analysis.—Wolcott Gibbs.
27. Note on the Relations of the Oneonta and Montrose Sandstones with the Sandstones of the Catskill Mountains.—James Hall.

ON THE MEASUREMENT OF RADIANT ENERGY.*

By Prof. S. P. Langley.

Sir William Herschel showed that a thermometer indicated more heat beyond the darkest red of the spectrum of a prism than in the brightest part of the color; therefore, he concluded that light and heat were essentially different things. This view has apparently been confirmed by numerous other European experiments, and has been set forth in all but the most recent text-books, where different curves are drawn to exhibit the light and the heat of the sun. Of late years many leading minds have recognized that these were only different manifestations of radiant energy. Prominent among these is Dr. John W. Draper, who asserted this principle long ago, and who has always maintained that if the heat in a pure diffraction spectrum could be accurately measured, its distribution would be found almost identical with that of light. This was an experiment, which, however, could never have been satisfactorily performed had it not been for the skill of Lewis M. Rutherfurd, Esq., of this city, who has made at his private expense the exquisitely delicate apparatus which can produce pure spectra, with a success far greater than any attained by the most skillful professional artisans of Europe.

By the use of one of these "gratings," made on Mr. Rutherford's engine by Chapman, and the employment of the thermal balance described in another paper, I succeeded in obtaining for the first time full and exact measurements of the distribution of energy in a pure spectrum, where no lens or prism had been used, and of fixing its relative amount, as determined accurately by the wave-lengths of light in all parts of the visible spectrum and in the ultra red. It remained to make some minute corrections for the selective absorbtions of the reflecting apparatus employed. The essential result, however, is of high theoretical interest; it is, that heat and light as received from the sun are now experimentally proved, so far as such measurements can prove it, to be in essence the same thing. The old delineations of

* Read before the National Academy of Sciences, N. Y., 1880.

essentially different curves representing heat and light must be banished hereafter from text-books. The old views on this subject can no longer be maintained even by European men of science, who are prepossessed in their favor. This result, fulfilling what was almost a prophecy when made, a quarter of a century ago, by the elder Draper, and, being due largely to means which science owes to Mr. Rutherfurd, may, if obtained, be most fairly claimed as largely due to the two Americans whose names have just been cited.

ON THE INTIMATE STRUCTURE OF CERTAIN MINERAL VEINS.*

PROF. BENJAMIN SILLIMAN.

Dr. Sorby, of England, in his classical paper "On the Cavities and Fluidal Inclusions found in Certain Varieties of Quartz," made the sagacious suggestion that certain fluidal inclusions observed by him in quartz consisted of two fluids, viz., water and probably a liquified gas also. An examination has recently been made of a remarkable vein stone from a gold vein nown as "Hunter's Rest," Arizona. This vein was capped by a black uncrystalline rock resembling somewhat hornblend in a compact form. But it was seen under the microscope with polarized light to be compact tourmaline, a mineral never found associated with gold. This black rock which is common enough in connection with tin ore, is here abundantly coated with gold. But beneath this black capping at a very moderate depth, occurs the usual quartz filling of gold-bearing veins—the quartz in this vein showing free gold in brilliant points, and stains of copper green with some pyrite, galena, etc. This quartz seen in thin section under a high power, showed a multitude of fluidal cavities, and among them were some which under a high power (⅛ to 1-15-inch) showed distinctly two fluids, one of which existed as an inner bubble, and which displayed almost constant activity of motion. This second liquid was liquified carbonic acid. Thin sections of the veinstone were placed upon a slide for examination. When warmed, the carbonic acid expanded and the motion ceased, bnt when permitted to become cold, it became as active as before. Quartz with gold found in Southern California near the Nevada line, is entirely destitute of sulphurets, showing that the intervention of iron salts as a solvent agent was not necessary in the formation of the deposits of gold.

THE TURQUOISE OF NEW MEXICO.*

PROF. BENJAMIN SILLIMAN.

A number of domestic articles have recently been found in excavations at Mount Chalchuitl, in Los Cerillos, about twenty-two miles southwest of the ancient town of Santa Fe. Among these are a large stone hammer of the hard hornblendic Andalusite of which the mountains of the country are largely formed; a lamp, a pottery idol, such as are manufactured to this day; a spoon made of shell; a perpect specimen of a pottery dish, and some of the bones of the Pueblos or Indian miners, who were killed in 1680 by the fall of a large section of Mt. Chalchuitl, which had been undermined by them. These articles had been covered in the caverns for 200 years when found. The rocks which form Mt. Chalchuitl—the Indian name of the turquoise—are distinguished from those of the surrounding and associated ranges of the Cerillos by their white color and decomposed appearance, closely resembling tuff and kaolin, and giving evidence of an extensive and profound alteration, due, probably, to the escape through them, at this point, of heated vapor of water and perhaps of other vapors or gases, by the action of which the original crystalline structure of the mass has been completely decomposed or metamorphosed, with the production of new chemical compounds. Among these the turquoise is the most conspicuous and important. In the seams and cavities of this yellowish-white and kaolin-like tuffaceous rock the torquoise is found in thin veinlets and little balls or concretions called "nuggets," covered on the exterior with a crust of the nearly white tuff, and showing on cross fracture the less valued varieties of the gem, more rarely offering fine sky-blue stones of higher value for ornamental purposes. It is easy to see these blue stains in every direction among these decomposed rocks, but the turquoise in masses of any commercial value is extremely rare, and many tons of the rock may be broken without finding a single stone which a jeweller or virtuoso would value as a gem.

That considerable quantities of the turquoise were obtained can hardly be questioned. The ancient Mexicans attached great value to this ornamental stone, as the Indians do to this day. The familiar tale of the gift of large and costly turquoise by Montezuma to Cortez for the Spanish crown, as narrated by Clavigero in his history of Mexico, shows the high value attached to this gem. It is not known that any other locality in America has furnished turquoise in any quantity. The origin of the turquoise of Los Cerillos in view of late observations is not doubtful. Chemically, it is a hydrous aluminum phosphate. Its blue color is due to a variable quantity of copper oxide derived from associated rocks. The Cerillos turquoise contains 3.81 per cent. of this metal, Neglecting this constituent the formula for turquoise requires: phosphoric acid, 32.6; alumina, 47.0; water, 20.5. Total, 100.1. Evidently the decomposition of the feldspar of the trachyte has furnished the alumina, while the phosphate of lime, which the microscope detects in the thin sections of the Cerillos rocks, has furnished the phosphoric acid. A little copper is diffused as a constituent also of the veins of this region, and hence the color which the metal imparts. The inspection of thin sections of turquoise by the microscope, with a high power, shows the seemingly homogeneous mass of this compact and non-crystalline mineral to consist of very minute scales, nearly colorless, and having an aggregate polarization, and showing a few particles of iron oxide. The rocks in which the turquoise occurs are seen by the aid of the microscope and polarized light in thin section to be plainly only the ruins, as it were, of crystalline trachytes showing remnants of feldspar crystals, decomposed in part into a white kaolin-like substance, with mica, slag and glassy grains, quartz, with large fluidal inclosures, looking like a secondary product. There is a considerable diversity in their looks, but they may all be classed as trachyte-tuffs, and are doubtless merely the result of the crystalline rocks of the district along the line of volcanic fissures.

ON A NEW GENERAL METHOD OF ANALYSIS.*

BY PROF. WALCOTT GIBBS.

The process consists essentially in passing a galvanic current through the solution in such a manner that a surface of metallic mercury forms the cathode, and a plate of platinum the anode. Under these circumstances the metal in the solution combines with the mercury to form an amalgam. What is new in this process is the fact that a number of metals, as for example, iron, cobalt, nickel, zinc, cadmium, tin, mercury, etc., may be *completely* removed from the solution so that the electro-negative constituent of the roll may be determined in the solution by ordinary methods, while the metal itself is found by the increase in weight of the mercury. The extent of the applications of the method and its limitations remain to be determined.

* Read before the National Academy of Sciences, N. Y., 1880.

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