pology is good as knowledge, and good as discipline.' But Convocation thought he did not, 'know anything about the matter,' and threw out the proposed statute." Huxley's career as biologist is sketched by "A Student of Science." The following is worth quoting from that contribution. "It was characteristic of the Professor's general mental attitude that mere novelty never affrighted him. When Ramsay propounded his theory of the excavation of lake basins by glacial action, Huxley supported it, even against the opposition of Lyell and Falconer. Suppose St. Paul's Cathedral removed from its present site to any part of the North Sea, the English Channel, or the Irish Sea, and the whole dome would be clear out of water. Place it, on the other hand, on the flow of Loch Lomond, and the largest ship in the British Navy might float safely over the golden ball, for the Loch has a maximum depth of 630 feet. Sir Andrew Ramsay's theory explains a striking fact like this, and affords undoubtedly a rational explanation of many similar phenomena." The fourth of the papers treats of Huxley as philosopher, and is by Mr. W. L. Courtney, the editor of the *Fortnightly*. Under the title "The Spectroscope in Recent Chemistry," Mr. R. A. Gregory contributes to the same review a brief history of the discovery of argon and helium, and discusses the many interesting points raised by the advent of those two new terrestrial elements, especially with reference to their spectra. It is worthy of contemplation that, so far as instrumental possibilities go, both argon and helium could have been discovered spectroscopically many years ago, and Lord Rayleigh would have been saved his years of tantalising experimentation. And yet there are some who think that the spectroscope will not help much more in the extension of natural knowledge!

The evolution of the orator and poet, actor and dramatist, is traced by Mr. Herbert Spencer in his fourth paper on "Professional Institutions," which appears in the *Contemporary*. First in his story of development comes the orator, who proclaimed the great deeds of a victorious chief during the triumphal reception; then was evolved, through natural selection, the poet, who, with picturesque phrases and figures of speech, gave rhythm to the laudatory speeches. Gradually the orator or poet joined with his speeches mimetic representations of the achievements of the living or the apotheosised ruler, or else they were simultaneously given by some other celebrant. So the actor was produced, and as more complex incidents came to be illustrated by speech and action, it was necessary for one to arrange the parts to be played, and thus the dramatist was developed. In support of this very natural sequence, Mr. Spencer adduces a variety of evidence supplied by uncivilised races and by early civilised races. Another paper in the *Contemporary* consists of extracts from Mr. E. A. Fitzgerald's journal of his ascents of virgin peaks in the New Zealand Alps. Five new peaks were ascended, namely, Sealy, Silberhorn, Tasman, Haidinger, and Sefton, the Matterhorn of the range. He also discovered a pass which has received his name, and across which the range has now been traversed to the west coast. Several attempts had previously been made to find such a route, but unsuccessfully. Mr. Fitzgerald's paper will therefore not only be read with interest by lovers of Alpine adventure, but will also be valued by the geographer.

The story of Antarctic exploration is told in *Macmillan's Magazine*, and the movement for further researches in those higher southern latitudes is given support. It will be remembered that the efforts made by the Royal Geographical Society, in connection with a committee of the Royal Society, to induce the Government to fit out an expedition for exploring in the Antarctic Ocean, were not successful. Notwithstanding this, the writer of the article expresses the general opinion when he says: "When it is undertaken at all it is desirable that the next Antarctic expedition should be a national one. Private enterprise, which has been splendidly active of late in the way of Arctic discovery, would scarcely be equal to all the demands of extensive and thorough Antarctic exploration."

A passing notice must suffice for the remaining articles of more or less scientific interest in the magazines and reviews received. A brief sketch of the characteristics of Sonya Kovalevsky is given in the *Century*, and one of the concluding sentences reads: "Notwithstanding her solid contributions to applied mathematics, she originated nothing; she merely developed the ideas of her teachers." A number of elementary facts with reference to the transporting power of water and the deposit of sediment, are stated by Mr. W. H. Wheeler in *Longman's Magazine*. The *National* contains an article, by Mr. J. L. Macdonald, on fruit-farming in California, which is worth the attention of agriculturists. In the *Quarterly Review*, roses and rose cultivation are surveyed, though more from an historical than a scientific point of view. An *Edinburgh Reviewer* discusses organic variation and animal coloration, basing his remarks upon Mr. Bateson's "Materials for the Study of Variation" and Mr. F. E. Beddard's "Animal Coloration." In *Good Words* we find an illustrated article by Dr. Bowdler Sharpe, on curious nests of birds, and a paper on the Earl of Rosse and his great telescope, by Sir Robert Ball. *Chambers's Journal* contains, among other instructive articles, one on the U.S. North Atlantic Pilot Chart, and another on "Taka Joli," a new substitute for yeast. Finally we have to acknowledge the receipt of *Scribner's Magazine*, the *Sunday Magazine*, and the *Humanitarian*.

## PHOTOMETRIC STANDARDS.

THE following Report of the Committee appointed by the Board of Trade, in December 1891, "to inquire into and report to them upon the subject of the standards to be used for testing the illuminating power of coal gas," has just been published as a Parliamentary paper.

"(1) It was intimated to us, by a letter from the Secretary to the Board, that the method at present in use for measuring the illuminative value of coal gas has been objected to, alike by the Metropolitan Gas Referees and the London County Council, as being of an unsatisfactory nature; that the London Gas Companies are alive to the defects in the present system; and that legislation is admittedly necessary for the purpose of substituting a more trustworthy standard for that now in existence; but that, in view of the difference in opinion as to what the substituted standard should be, the President of the Board deemed it advisable that, before his support was given to any legislation, the whole question should be considered by a Committee that would command the confidence of the various interests affected.

"(2) The method at present in use for measuring the illuminative value of coal gas consists in comparing the light of the gas, when burning from a particular burner at a specified rate, with the light of a sperm candle burning also at a specified rate, which last is taken as a standard. We have satisfied ourselves, from considerations set forth in the Appendix to this Report, that the flame of a sperm candle does not furnish a satisfactory standard, by reason of the amount of light which it affords varying over a wide range, under conditions as to the manufacture of the candle, as to its mode of use, and as to adventitious circumstances attending its use, which, as a whole, it is not possible to regulate and define.

"(3) Though recognising, however, that the sperm candle flame does not furnish a satisfactory standard, we nevertheless consider it advisable that, in official documents and reports, the quantity of light yielded by coal gas burned under specified conditions should continue to be expressed as heretofore, in terms of candle-light, the actual comparison, however, being made between the gas-light and some well-defined and constant light ascertained to be equal in quantity to, or a definite multiple of, the average light given by the standard sperm candle.

"(4) We have further come to the conclusion that, in the present state of experience and knowledge, the source of the light to be used as a standard by gas-testers generally must be produced by the process of combustion, and be in the nature of a flame.

"(5) We find that the one-candle-light flame proposed by Mr. A. Vernon Harcourt as giving a standard light, and commonly known as the 'Harcourt pentane air-gas flame,' when used under the conditions defined, does constitute a very exact standard, capable of being reproduced at any time without variation of illuminative value.

"(6) We have satisfied ourselves that the light given by Mr. Harcourt's above-mentioned pentane air-gas flame as defined, in respect to the conditions of its production, in the Appendix, is a true representative of the average light furnished by the sperm candle flame constituting the present standard. Since 1879, when the pentane air-gas flame was first introduced, many series of experiments have been made by different observers, in which the light of the proposed standard has been compared with the light of the standard sperm candle

flame, with the result that in those series of experiments in which the height of the pentane air-gas flame was adjusted strictly according to the directions given in the Appendix, the light afforded by this flame was found to agree exactly with the mean result afforded by the standard candle flame. In other series of experiments, indeed, in which a slight variation was made in the mode of adjusting the height of the pentane air-gas flame, some discrepancies in the direct results furnished by the comparison of its light with that of the standard candle flame were observed; but in these several series of experiments also, when the necessary correction, called for by the difference in the mode of adjustment resorted to, was made, the light of the pentane air-gas flame was found to accord closely with the mean result afforded by the standard candle flame.

"(7) Inasmuch, however, as there is a practical advantage in comparing directly the light of such a coal-gas flame as is usually tested (being, that is, of about a sixteen-candle-light value), with a light approximating somewhat in value thereto, we have further submitted to careful examination the flame of the ten-candle-light pentane argand proposed as a standard by Mr. W. J. Dibdin in 1886. This flame is produced by burning a mixture of air and pentane vapour from a suitable argand burner, provided with an opaque screen by which the light from the upper portion of the flame is cut off. The screen being set at a definite height, it was found by Mr. Dibdin that, owing to a compensating action affecting the lower or exposed portion of the flame, the luminosity of this portion of the flame remains constant even under considerable variations, whether in the total height of the flame or in the proportion of pentane vapour to air in the mixture burnt. With a view to simplify the construction of the argand burner furnishing a cut-off flame of this constant luminosity, we have tried various changes in the form of the cone and in the division of the air supply to the flame, but in every case have found the original burner, as supplied by Mr. Sugg for the purpose, to give more satisfactory results than the modified forms.

"(8) The amount of light emitted by the portion of the Dibdin argand pentane-air flame that is used in photometry, being dependent on the distance above the steatite ring of a screen by which the upper part of the flame is cut off, we have come to the conclusion that when the bottom of the screen is fixed at a height of 2·15 inches (54·6 mm.) above the top of the steatite ring, the amount of light emitted by the lower portion of the flame is substantially equal to ten times the average light of a standard sperm candle flame, or to ten times the light of Mr. Harcourt's one-candle-light pentane air-gas flame.

"(9) We have further satisfied ourselves that any number of Dibdin argand burners may be produced, having the form and dimensions set forth in the Appendix; and that these several burners, when used in the manner there defined, may be depended on to furnish a flame giving, when duly screened on the top, ten times the average amount of light given by a standard sperm candle.

"(10) We therefore recommend that the pentane-air flame furnished by a Dibdin argand burner, having the form and dimensions set forth in the Appendix, and used in the manner there defined, be accepted as giving the light of ten standard candles, and that this flame be authorised and prescribed for official use in testing the illuminating power of the gas supplied by the London Gas Companies.

"(11) We further recommend that sealed specimens of the burner, the carburetter, and the pentane for use therewith, duly certified by the Gas Referees, be deposited with the Board of Trade, and also in such places and in the care of such persons as the Board may direct, to be available for the purpose of comparison, in the event of any question arising as to whether the pentane-air flame of some particular burner does or does not afford the same amount of light as that now proposed for adoption as a standard.

"(12) With a view to making some provision for future possible improvements and requirements, we further recommend that the Gas Referees be authorised, should they at any time see fit, to approve and certify for use in gas-testing any other flame based upon the 10-candle standard defined above, which they may consider suitable for the purpose, whether produced in a like or unlike way, and whether having the same or a different multiple value; such other flame, however, not to be used for gas-testing unless approved by the Board of Trade, and unless the Gas Companies give their consent to its adoption as a standard.

"(13) We further recommend that the illuminating power of coal gas shall continue to be recorded as heretofore in terms of the light given by a specified number of cubic feet (to wit, 5 cubic feet) burnt per hour from the standard London argand burner, but that, in testing the illuminating power of the gas, the requirement that the gas shall actually be consumed at this rate be rescinded, so as to allow the Gas Referees to sanction a mode of testing in which the gas shall be burned from the standard London argand burner at whatever rate is found requisite in order that it may give a light equal to that of the prescribed number of candles, and in which the illuminative value of the gas shall be calculated as being inversely as the rate at which such gas had to be burned during the testing so as to give this amount of light."

The Report is signed by Prof. William Odling, F.R.S. (Chairman), Mr. W. J. Dibdin, Dr. E. Frankland, F.R.S., Dr. A. Vernon Harcourt, F.R.S., Mr. George Livesey, Dr. William Pole, Mr. George Rose-Innes, Prof. A. W. Rücker, F.R.S., Dr. W. J. Russell, F.R.S., Mr. G. C. Trewby, and (subject to the omission from (13), line 7, of the words "the Gas Referees to sanction") by Mr. H. E. Jones. Prof. Vivian B. Lewes was the Secretary of the Committee.

## *SCIENTIFIC EDUCATION IN AMERICA.*

UPON the occasion of the laying of the corner-stone of a new building for a Museum for Dartmouth College, Hanover, U.S., Prof. A. S. Bickmore recently delivered an address, in the course of which he dealt with the methods of scientific instruction in America. The College was originally designed to elevate the Indian race in America, hence its location at Hanover, New Hampshire, in 1770. It was named after Lord Dartmouth, who took a deep interest in the aborigines of the New World, and who was the principal benefactor of the school established for their education.

We extract the following from the report of Prof. Bickmore's address in the *New York Times*:—

"The present is pre-eminently an educational age, and the princely gift from one of our alma mater's loyal sons for the purpose of endowing a 'professorship of palæontology, archæology, ethnology, and kindred subjects, and for the erection of a building for preserving and exhibiting specimens illustrating the aforesaid branches,' is in perfect harmony with the judgment of the leading educators of our times, namely, that the greatest benefit it is our privilege to confer upon coming generations is to provide ever-increasing means for their mental improvement.

"As we meet to-day to lay the corner-stone of the noble edifice so generously provided for by the late Dr. Ralph Butterfield, and to celebrate the commencement of a structure which will add so largely to the educational facilities of this college, I invite you to consider with me, as a subject suggested by this occasion, 'The Place in Modern Education of the Natural Sciences and their Museums.'

"In a period which will ever be famous in history for the great donations that are being constantly made by our private citizens for the public good, it is worthy of our careful consideration that the most munificent gifts are almost exclusively for the purpose of promoting education. In the United States where even the existence of 'a Government for the people and by the people' must ever rest upon the intelligence and the integrity of each individual citizen, it is not a matter of desirability, but simply one of necessity, that the promotion of public instruction shall ever be a question of paramount importance.

### AMERICAN SYSTEM of TEACHING.

"Our American system of instruction may be rapidly summarised. First and lowest is the kindergarten, which may be regarded as still in its experimental stage, but which is certainly destined to become one of our most effective methods of mental training. Next come the public schools, supported by taxation, with their primary and grammar grades, and the high schools and private academies. Above these are the colleges, with their ever-increasing series of elective studies; and then the universities, with their special schools of science, medicine, law, and theology; and finally, the great post-graduate institutions, composed of entirely distinct corporations for the creation of great museums of science and art, and the accumulation of exhaustive libraries.