engines for steam navigation and locomotive purposes. The amount of coal used by ocean-going steamers during 1887 amounted to nearly 7,000,000 tons, and that consumed by the much larger number of steamers engaged in the coasting trade is estimated to have equalled that amount. The coal consumed by the locomotives on the railways in England in the same year is shown to have exceeded 6,000,000 tons.

Particular attention is drawn to the very rapid growth of the export of coal, which has increased from 4,333,333⅓ tons in 1854, to over 27,000,000 in 1888. The author considers it is but the measure of increased commercial prosperity, and that to impose any tax upon such exports would be like killing the goose that lays the golden eggs.

The author, in his concluding remarks, observes, that, if the growth of the trade and prosperity of England is to continue as it has done in the past, its coal-production, which is at once the cause and effect of this growth, must necessarily keep pace with it; and it is pointed out that unless large economies, which can and ought to be effected in its consumption, are realized, all the largest and best sources of the coal-supply will be exhausted in the very short periods mentioned in this paper. The hope is expressed, that, by drawing attention to this most vital subject, further strenuous efforts may be made to husband English coal resources in every possible way, and to put a stop to the great waste in working the mines, and in the consumption of coal generally.

MINING INDUSTRIES IN SIAM.

SIAM is rich in minerals. Gold, iron, tin, and copper are found in many parts of the country; but the want of roads, and consequent difficulty of getting these metals to market, prevent their being worked, except for the limited wants of the natives.

The English consul at Bangkok, Mr. Child, says, in his last report, an abstract of which appears in the *Journal of the Society of Arts* for Feb. 22, that the eastern part of Siam is very rich in iron, antimony, and argentiferous copper and tin. It is from the provinces of Petchaboon and Löm that the cutlasses, spears, and knives are furnished to all the provinces of the north and east. Silver is not found in Siam.

As regards gold, this metal is found in many places, but the mines at Bang Tapan on the west coast are said to contain the purest gold in the country. They have been worked by the natives by simply turning over the ground, the gold being found in the shape of nuggets. When nuggets over a certain size were found, the miners were obliged to hand them over to the government, but they were paid for the same according to a tariff fixed by the authorities.

A syndicate of foreigners has been formed, with a concession from the king, for working these mines, and has now a number of workmen employed, the prospects for rich developments being good.

The quartz-mines of Muang Krabin, although productive, were declared unprofitable to the government. Experienced engineers from Australia, mining machinery of recent invention, immense upright pumps and other hydraulic machinery, and a narrow-gauge railroad with rolling stock for the conveyance of the product, had been procured for the working of the mine; but, the organizer of the great scheme having been decapitated for alleged treason, the whole of the plant is lying idle.

The royal metal of Siam is mostly manufactured into vases, teapots, betel-boxes, and other articles, which it is the custom of the kings of Siam to present to subjects upon their elevation to high rank in the peerage of the kingdom. They are looked upon in a sense as insignia of their exalted rank, the shape and style of the set denoting the standing of the beneficiary.

It is impossible to procure statistics concerning the output of the mines. Iron of good quality is found in the eastern provinces, but it is worked in a very crude and primitive manner. Founderies are unknown. A hole or pit having been dug close to the mountain, the miner collects and piles up his ore, which he smelts with charcoal. The molten metal is deposited in a cavity prepared for its reception, and when cold the product is carried home. There a fire is prepared, which is kept alive by a bellows made of two trunks of hollow trees buried in the ground, and having two long sticks as handles. A child works the bellows, while husband and wife or son hammer the iron into shape.

The knife, cutlass, spear, or agricultural implement produced by this combined labor finds a ready sale throughout the north of Siam, and, although the workmanship is poor, it suits the requirements of that section. The locality of the mines preclude shipments to Bangkok, as it would have to be conveyed to the river on elephants, — a method of conveyance too expensive for the commodity.

Tin is found in profusion in the Malayan peninsula, and is worked by Chinamen. It is generally exported direct to Singapore from the locality in which it is mined. Tin is also found in eastern Siam to a limited extent, but none of it finds its way to the capital.

Copper is found in certain localities, especially in the eastern provinces, — Champasak, Petchaboon, and Löm. In the former province, on the Makong River, there is a place where the natives procure the finest metal, of which they make a coin that passes current in that locality. It is about two inches in length, a quarter of an inch in breadth, and shaped like a canoe. The province adjoining that has an iron coin of the same shape, but larger in size. Virgin copper is held in great esteem by many for certain qualities it is supposed to possess when employed as an agent in transmuting metals. Without it as a basis, the native alchemists claim that gold cannot be obtained.

Coal is found on the coast and in the interior, but cannot be utilized. Limestone is brought to Bangkok from the interior. The lime is mixed with turmeric, and is used to a large extent by the Siamese in combination with the betel-nut and *seri* (pepper-leaf).

Precious stones come principally from the province of Chantibun; rubies, sapphires, topaz, asterias, and other stones being found in that district. The diamond is unknown as a native stone. The sapphire mines to the south of Chantibun, to which thousands of Burmese flocked a few years ago, have been exhausted.

BOOK-REVIEWS.

Popular Lectures and Addresses. By SIR WILLIAM THOMSON. In 3 vols. Vol. I. Constitution of Matter. London and New York, Macmillan. 12°. $2.

THE author of this work possesses in an eminent degree the ability of putting into untechnical language those essentials of knowledge which are most interesting and attractive, and at the same time most useful, to the general reader. Among the contents of this volume may be mentioned "Capillary Attraction," which was originally delivered as a lecture before the Royal Institution in 1886; to which are added three appendixes treating of certain curious motions observable on the surfaces of wines and other alcoholic liquors, gravity and cohesion, and the equilibrium of vapor at a curved surface of liquid.

Shortly after the delivery of this lecture, it was suggested to Mr. Thomson that it might be advisable to make it more conveniently accessible to the general public than it could be in the "Transactions of the Royal Institution;" and it was accordingly arranged to bring out, as one of the Nature Series, a small volume containing the lecture mentioned, together with several other papers pertinent to the subject. While the volume was in course of preparation, it was decided to increase the size of it, adding several other lectures and addresses to the contents, and make it the first of a series of three volumes, constituting a reprint, in a revised form, of all Sir William's popular lectures and addresses. The result is the volume before us, the first volume of the series.

Besides the lecture already spoken of, a chapter each is devoted to the following subjects: "Electrical Units of Measurement," "The Sorting Demon of Maxwell," "Elasticity viewed as possibly a Mode of Motion," "The Size of Atoms," "Steps towards a Kinetic Theory of Matter," "The Six Gateways of Knowledge," "The Wave Theory of Light," "The Age of the Sun's Heat," and "Electrical Measurement." These were originally delivered as lectures and addresses before the Royal Institution, the Institution of Civil Engineers, the British Association, and the Franklin In-

stitute of Philadelphia. The chapter on "The Age of the Sun's Heat" is reprinted from *Macmillan's Magazine*, and consists of three parts, treating respectively of the secular cooling of the sun, the sun's present temperature, and the origin and total amount of the sun's heat.

The Psychic Life of Micro-organisms: a Study in Experimental Psychology. By ALFRED BINET. Tr. by Thomas McCormack. Chicago, The Open Court Publ. Co. 12°. 75 cents.

IT may, perhaps, not be rash to venture the statement that in no field of study has the introduction of the comparative method been so helpful as in the study of mental phenomena; of the co-ordinations between the organism and the environment. It is this that has widened the horizon of the psychologist from the observation of his own individual, adult, civilized consciousness, to the observation of other men and of other races in different stages of civilization, of other ancestries, of other no less interesting though more lowly forms of life, of the embryonic, immature stages of development. It is to the apparently most insignificant group of such phenomena that M. Binet devotes his monograph, — to the psychic life of the lowliest denizens of the earth, forms so simple that even the distinction between animal and vegetable becomes doubtful when their classification is attempted. Many a reader would perhaps be likely to think that an account of the psychic life of micro-organisms might be as brief as that celebrated essay on the snakes of Greenland, which was all contained in the sentence, "There are no snakes in Greenland." M. Binet shows most conclusively, however, that there is psychic life in these unicellular specks of protoplasm; that they exhibit relations to their environment similar in kind, though vastly inferior in degree, to those to which we unhesitatingly attribute an intellectual origin, when we observe them in ourselves or any of the higher animals.

M. Binet classifies these evidences of embryological mental activity into (1) those connected with motion and sensation, (2) those connected with nutrition, (3) those connected with reproduction, and (4) those connected with "social relations." Under the first head we observe that the *Didinium nasutum* (a type of the ciliated infusoria) has the power of reversing its motion, of arresting it, and that for this purpose it makes use of a perfect miniature steering apparatus. We note, too, that the most rudimentary sensation is that of contact, many of these microscopic animals having no other; that after this, sight develops, it being not improbable that certain vegetable forms possess the analogue of an eye. The *Didinium* has vision enough to hurl a shower of darts at its prey, thus paralyzing it, and making it an easy victim; while the *Euglenæ* are sufficiently sensible to color to constantly congregate between the lines F and G of the solar spectrum. The maintenance of life is always the result of a re-action to the environment, and in this "life of relation" a psychic element must enter. In the motions necessary to seize the prey, in the power of selection that enables the organism to seize certain particles and reject others, we have a rudimentary form of choice. In the recognition of the position of the desired food, M. Binet does not hesitate to detect an elementary space-perception. The excitement preceding the times for copulation shown by unicellular organisms suggests an analogue to the emotions. Under the fourth head belongs the formation of a group of cells into a colony, in which the individuals act harmoniously, and each contributes to the general welfare.

These are only a few of the very suggestive observations and comments that M. Binet brings together; and if from the rest of the work a single example of the possibilities this study reveals must be selected, it should be the experiments of Professor Pfeffer on the spermatozoids of ferns. This observer finds that when a solution of malic acid is held in a tube, and a similar solution of one-thirtieth the strength be placed in a watch-crystal in which are the spermatozoids, the latter will leave the watch-crystal for the tube; and not only this, but when the solution in the tube is only twenty times as strong, these organisms remain unaffected. It seems to be the ratio of the intensities of the two solutions that brings about the result, and in this Professor Pfeffer sees an undoubted analogy to the psychophysic law illustrated in the power to distinguish between sensations as tested by Weber, Fechner, and others. If this law can be thus corroborated, it is a wonderful law indeed.

The general position of M. Binet is thus somewhat in opposition to current views. He combats the view that in the unicellular organisms we have a simple and blind mechanical reflex action between irritable substances and an irritating environment, but holds that rudimentary forms of various psychic functions take their origin here. He pronounces Mr. Romanes' attempt to fix the grade at which the several constituents of psychic function enter into play as artificial and arbitrary, and believes that a more complete study of these lowliest forms of life will establish a more rigid and scientific criterion of mind, and show the substantial unity and primordiality of the psychic element. It is certainly a long step from the days when man was defined as a rational animal, denying by inference, to the rest of creation, a share in this possession, to the days when what we can see only with the aid of the most improved results of science is pronounced akin to the most human part of man.

AMONG THE PUBLISHERS.

THE *Atlantic* for March contains an article by Stuart F. Weld, on "The Isthmus Canal and Our Government," which will interest students of politics. The author is strongly in favor of placing the canal under international control, as the Suez Canal has already been placed; and he shows, by quotations from public documents, that our own government has always been in favor of such control, except during a brief period beginning with the administration of President Garfield. Another article of interest is "Personal Reminiscences of William H. Seward," by Mr. and Mrs. Samuel J. Barrows. Mr. Barrows was for a time private secretary to Mr. Seward at the State Department, and during an illness of some months his wife took his place. Hence they have much to tell us about the statesman's official and private life, and they tell it in a simple and pleasant way. Mr. John Fiske continues his articles on American revolutionary history, treating in his usual excellent style of "Ticonderoga, Bennington, and Oriskany." The *Atlantic* has also a paper on "Some Colonial Lawyers and Their Work," by Frank G. Cook, which lawyers will like to read, and the usual variety of lighter articles.

— Mr. John Delay of this city has begun the publication of a series of Gleanings from Foreign Authors, the first number of which now lies before us. It contains "A Love Match," translated from Ludovic Halévy, and "King Apepi," by Victor Cherbuliez. The former is a very pleasant little love-story told by the lovers themselves in extracts from their diaries, which they read to each other after their marriage. The other is less agreeable as a whole, but ends in an amusing and unexpected way. We are not told whether the whole series of which this book is the beginning is to consist of novels, but they will doubtless constitute the greater part; and, if the other volumes are up to the level of this one, they will make an addition to the lighter literature of English readers.

— *Outing* for March is a sporting number. We note the following principal articles: "Fox-Hunting; A Day in the Shires," by Henry H. L. Pearse; "Lawn Tennis in the South," by Henry W. Slocum, jun.; "Snowshoeing in Canuckia," by James C. Allan; "Salmon-Fishing on Loch Tay," by "Rockwood," and illustrated by J. & G. Temple; "Spaniel-Training," by D. Boulton Herrald; "How to Cycle in Europe," by Joseph Pennell; "Amateur Photography," by Ellerslie Wallace; "Winter Shooting in Florida," by F. Campbell Moller; and "Coaching and Coaching Clubs," by Charles S. Pelham-Clinton.

— A catalogue of the contents of the *Magazine of American History* for March reveals great current interest. The leading article describes the "Historic Homes and Landmarks" about the Battery and Bowling Green, New York City. The whole procession of Dutch and English governors who resided in the old historic fort opposite the Bowling Green are passed in review, as well as those who lived in the house built for Washington on the same site. One of its features is the sketch of the site of the City Hotel, of