

daily average of 888 millions of gallons, the average for the two years being 974 millions of gallons; and this number does not include 120 millions of gallons daily abstracted by the five London water companies who draw their supplies from the Thames. Thus, in round numbers, we may say that, after the present wants of London have been supplied from this river, there is a daily average of nearly a thousand millions of gallons to spare. Surely it is not too violent an assumption to make that the enterprising engineers of this country can find the means of abstracting and storing, for the necessary time, one-fourth of this volume.

As regards the quality of this stored water, all my examinations of the effect of storage upon the chemical, and especially upon the bacterial quality, point to the conclusion that it would be excellent; indeed, the bacterial improvement of river water by storage, for even a few days, is beyond all expectation. Thus the storage of the Thames water by the Chelsea Company for only thirteen days reduces the number of microbes to one-fifth the original amount, and the storage of the river Lea water for fifteen days by the East London Company reduces the number, on the average, from 13,693 to 2752 per c.c., or to one-fifth. Indeed, quietness in a subsidence reservoir is, very curiously, far more fatal to bacterial life than the most violent agitation in contact with atmospheric air; for the microbes which are sent into the river above the Falls of Niagara by the city of Buffalo seem to take little or no harm from that tremendous leap and turmoil of waters; whilst they subsequently, very soon, almost entirely disappear in Lake Ontario. Thus it is not too much to expect that storage for, say, a couple of months, would reduce the number of microbes in Thames flood water down to nearly the minimum ever found in that river in dry weather; whilst, by avoiding the first rush of each flood, a good chemical quality would also be secured. There is therefore, I think, a fair prospect that the quantity of water derivable from the Thames at Hampton could be increased from its present amount (120 millions of gallons per diem) to 370 millions.

Again, in the river Lea, although here the necessary data for exact calculation are wanting, it may be assumed that the present supply of fifty-four millions of gallons could be increased by the storage of flood water to 100 millions of gallons per day. To these volumes must be added the amount of deep-well water which is obtainable from those parts of the Thames basin which lie below Teddington Lock; and in the Lea basin below Lea Bridge, and which was estimated by the last Royal Commission at rather more than 67½ millions of gallons. Thus we get the grand total of 537½ millions of gallons of excellent water obtainable within the Thames basin, the quality of which can be gradually improved, if it be considered necessary, by pumping from the water-bearing strata above Teddington and Lea Bridge respectively; instead of taking the total supply from the open rivers above these points. Such a volume of water would scarcely be required for the whole supply of the water area of London at the end of fifty years from the present time, even supposing the population to go on increasing at the same rate as it did in the decade 1881-91, which is an assumption scarcely likely to be verified.

In conclusion, I have shown that the Thames basin can furnish an ample supply for fifty or more years to come, whilst the quality of the spring and deep-well water and the efficiently-filtered river water would be unimpeachable. To secure these benefits for the future, storage must be gradually provided for 11,500 millions of gallons of flood water, judiciously selected, in the Thames Valley, and a proportionate volume in the basin of the Lea; whilst filtration must be carried to its utmost perfection by the use of finer sand than is at present employed, and by the maintenance of a uniform rate during the twenty-four hours.

The lecturer concluded as follows. There nothing heroic in laying pipes along the banks of the Thames, or even in making reservoirs in the Thames basin. They do not appeal to the imagination like that colossal work—the bringing of water to Birmingham from the mountains of Wales; and there is little in such a scheme to recommend it to the mind of the enterprising engineers of to-day. Nevertheless, by means of storage, by utilising springs, by sinking deep wells, and by such comparatively simple means, we have, in my opinion, every reason to congratulate ourselves that for half a century, at least, we have at our doors, so to speak, an ample supply of water which, for palatability, wholesomeness, and general excellence will not be surpassed by any supply in the world.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Conference on Secondary Education, held in the Senate House on April 21 and 22, was largely attended by representatives of all the various educational authorities. The discussions were in some cases animated, and turned largely on the provisions of the new Education Bill; but the resolutions prepared, in support of the Report of the Royal Commission on Secondary Education, were in every instance passed by large majorities.

Dr. A. A. Kanthack, of St. John's College, has been appointed Deputy-Professor of Pathology for the present Term, in place of Prof. Roy, who is unable to lecture.

DR. H. FRANK HEATH, Fellow of University College, London, has been elected Assistant Registrar in the University of London, in the place of Mr. Dickens, who has succeeded Mr. Milman as Registrar.

A SPECIAL meeting of the Board of Governors of the Yorkshire College was held on Wednesday, April 23, in the Philosophical Hall, Leeds. The business before the meeting was to obtain the assent of the Governors to the borrowing by the Council of the College of £30,000 at 3 per cent. per annum on a mortgage of the real estate of the college situate in College Road (except such portion as is held in trust for the Cloth-workers' Company), and of the new Medical School in Leeds. The motion was ultimately agreed to.

THE annual report of the Whitworth Trustees has just been published, in which it is stated that a sum of £10,000, a portion of the surplus from the 1887 Exhibition, has been handed over to the Technical Instruction Committee of the Manchester Corporation for the purpose of erecting an additional wing to the School of Art in Cavendish Square of that city. We thought that satisfactory arrangements had been made for the accommodation of this art school in the new technical school which is being built at an estimated cost of £200,000.

THE following are among recent appointments:—Dr. A. Fleischmann to be extraordinary professor of anatomy and zoology in Erlangen University, and director of the Zoologischen Universitäts, Anstalt; Dr. Pockels, *privat docent* in physics at Dresden Technical High School, to be professor; Dr. Oertel to be observer at the Königlichen Sternwarte in Munich, and Dr. Julius Bauschinger, of the same observatory, to be full professor of astronomy in the University of Berlin; Dr. H. W. Bakhuis Roseboom to be professor of chemistry at the University of Amsterdam, and Dr. A. Bistrzycki to be professor of analytical and technical chemistry in the University of Freiburg.

THE Paris correspondent of the *Times* states that the General Council of the Paris Faculties has decided to send several delegates to the meeting of the Franco-Scottish Society to be held in Edinburgh in 1897. It has also decided to be represented at the jubilee of Lord Kelvin's connection with the University of Glasgow in June next. A similar decision was taken in reference to the Princeton College celebration *fetes*. In this connection the Council passed a resolution in favour of closer relationship between French and foreign universities. It was declared that France held too much aloof from these international festivals, and did not sufficiently try to extend a knowledge of her scientific activity. But however this may be, it is certain that we have yet to cultivate the hospitality always freely and lavishly given when British men of science visit their French *confrères*.

THE Report of the Council of the City and Guilds of London Institute upon the work of the Institute for the year 1895 has come to hand. Reference is made in it to the assistance which Prof. Huxley gave to the Committee appointed in 1877 to prepare an educational scheme. It was fitting that some permanent record of his connection with the Institute should be established, and the Council have been gratified to receive from the Fishmongers' Company an intimation that, in consideration of the eminent and important services rendered by Prof. Huxley to the cause of technical education, the Court of that Company have determined to found a Scholarship of £60 a year to be called the "Fishmongers' Company's Huxley Scholarship," to be awarded to a scholar of the Technical College, Finsbury, to enable him to proceed to the Central Technical College. In recalling the work of their late Chairman and of Prof. Huxley in the early years of the Institute, the Council are reminded of the great extension which this movement has undergone during

the past few years. In London alone the Technical Education Board of the London County Council, and the Central Governing Body of the City Parochial Charities are spending about £120,000 annually on technical education; and, probably, an equal amount is being spent in the same direction by the Livery Companies of London through the Institute or by individual action. Apart from the City and Guilds of London Institute, mention may be made of the Goldsmiths' Company's Institute, at New Cross; the support by the Drapers' Company of the People's Palace; and of the Skinners' and Saddlers' Companies of the Northampton Institute; the Carpenters' Company's Schools at Stratford and Great Titchfield Street; the Tanning School, recently established by the Leathersellers' Company in the Borough; and the technical schools and textile departments in Leeds, Bradford, Huddersfield, Halifax, and other towns in the north of England supported by the Clothworkers' Company, as a few of the institutions of a specially technical character to which individual Companies are devoting their funds. From a table given in the report to show the amount of the donations to the funds of the Institute since its foundation, we have extracted the following totals, running into four or more figures, which to some extent supplement the information given in a recent article on the grants of the City Companies to education and research. Goldsmiths' Company, £83,064; Clothworkers' Company, £71,500; Fishmongers' Company, £70,550; Drapers' Company, £50,500; Mercers' Company, £50,000; Skinners' Company, £25,835; Grocers' Company, £19,000; Corporation of London, £15,500; Salters' Company, £15,138; Merchant Taylors' Company, £14,657; Leathersellers' Company, £10,105; Carpenters' Company, £8155; Armourers' and Braziers' Company, £7700; Ironmongers' Company, £5973; Cordwainers' Company, £5878; Saddlers' Company, £5600; Dyers' Company, £4646; Coopers' Company, £2770; Vintners' Company, £2500; Pewterers' Company, £2019; Plaisterers' Company, £1537; Cutlers' Company, £1386. The present report furnishes the City Companies with food for congratulation upon the results of the generous provision they have made for technical education.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, April 24.—Captain W. de W. Abney, President, in the chair.—A paper by Mr. R. A. Lehfeld, on symbolism in thermodynamics, was, in the absence of the author, read by the Secretary. The author proposes a system of about twenty-four separate symbols for the different quantities in thermodynamics. Prof. Silvanus Thompson said he was not at all favourably impressed by the symbols proposed. In particular, it was becoming usual to restrict the use of Greek letters to the representation of specific quantities or angles, and the author's proposal seemed in this way a retrograde step. Prof. Perry said he did not care for the suggested symbols. Mr. Elder thought the author's system would be a very severe tax on the memory, for he did not make use of suffixes, as was ordinarily done, which in a great measure define the symbol to which they are attached.—Mr. Appleyard read a paper on the adjustment of the Kelvin Bridge. In a recent paper read before the Society, Mr. Reeves had described a modified form of Kelvin Bridge, in which a double adjustment was necessary. The author proposes to employ two wires stretched side by side, with a sliding contact in connection with the galvanometer on each. These contacts are rigidly connected together, so that the segments into which one wire is divided necessarily bear to one another the same ratio as do the segments of the other wire. Hence a single adjustment is sufficient to give balance. Mr. Reeves said that apparently the author had completely missed the object of his (the speaker's) paper. For the object there aimed at was to make use of such sets of resistance coils as are always to be found in any laboratory. In the author's arrangement it would be necessary to carefully calibrate the two wires, and also, since the resistances used must necessarily be small, to determine the resistance of the contacts. Prof. Ayrton (communicated) said the author's suggestion was ingenious, but did not obviate the necessity for much of Mr. Reeves' "addition." Further, Mr. Reeves' proposal to employ ordinary resistance boxes was not made because such resistances are absolutely necessary, but because, since they are to be found in any electrical labora-

tory, their use saves the expense of such a wire resistance accurately calibrated as Mr. Appleyard employs. Mr. Appleyard, in his reply, said that his instrument was designed for use in a factory where the time saved in making a series of tests was of more importance than the cost of the instrument.—Mr. J. Frith read a paper on the effect of wave-form on the alternate current arc. The author finds that an arc has the power of modifying the wave-form in a circuit in which it is included. Thus in the case of a dynamo for which, on open circuit, the curve of E.M.F. was decidedly peaked, it was found that when this dynamo was employed to feed an arc that the curve became changed to a flat-topped form. It is interesting to remember that the candle-power of the arc is greater when the wave-form is flat-topped than when it is peaked. By altering the resistance in series with the arc it is possible to alter the character of the curve, for as the resistance in series with the arc increases the arc affects the wave-form less and less. In some recent experiments described by Dr. Fleming, a resistance of about 7 ohms was used in series with the arc, so that the wave-form of the generator, which is not an efficient form, was forced on the arc. In practice, however, where a resistance is not used in series with the arc, this is not the case, and the differences between the efficiency obtained for alternate current arcs in the laboratory and that claimed in practice may thus be accounted for.—Mr. Blakesley said it seemed as if the more nearly the alternate current resembles a direct current, *i.e.* the longer in each period the current remains constant, the greater is the efficiency of the arc.—Mr. Price asked what was the cause of the reaction of the arc on the wave-form.—Mr. Tremlett Carter asked whether previous observers' results were vitiated by this action of the arc on the wave-form?—Prof. Ayrton (communicated) considered the author's suggestion of great importance as bearing on the question of the efficiency of the alternate current arc.—Prof. S. P. Thompson said that the dynamo employed by the author was one in which there was a large quantity of iron in the armature, so that the self-induction was large. Was it not on account of this large coefficient of self-induction, which would tend to keep the current constant, that the arc was able to alter the wave-curve? If an arc is connected to the mains of a supply station in which a number of machines in parallel are feeding a number of lamps, would the arc still be able to affect the wave-form of the current?—Mr. Tremlett Carter asked if the author had tried the effect of replacing the arc by a resistance such that it would absorb the same volts as did the arc, and comparing the curves for the current and impressed P.D. with those obtained with the arc.—The author, in his reply, said that the effect of the self-induction of the machine was shown in the curves. Current curves had not been taken with the arc straight on the machine. The current and self-induction were the same for all the curves, the voltage of the machine being increased by increasing the field when a resistance was placed in series with the arc. When, as is commonly the case, special machines are used to supply arcs, and the load consists solely of arcs, the arcs could alter the character of the wave-form. If the arc is replaced by a resistance, the wave-form is of the same type as is obtained for the E.M.F. of the machine on open circuit.

PHILADELPHIA.

Academy of Natural Sciences, April 7.—Mr. J. Willcox described the process of obtaining quartz from the Oriskany sandstone of Pennsylvania to be used in the manufacture of glass.—Mr. G. Vaux, jun., called attention to recent additions to the William S. Vaux collection, which included superb crystals of calcite from the Joplin region, Missouri. They occur in caves opened for the working of lead and zinc. The several mines are characterised by distinct forms of the mineral. The sphalerite, which is largely present, is being deposited at the present time, the handles of shovels and picks left in the mines being found covered with crystals.—Mr. Theodore D. Rand described a fine collection of polished serpentines presented by him to the Academy from numerous localities in South eastern Pennsylvania. They belong to two groups: one bordering the ancient gneiss, the other and the more recent occurring in the mica schists and gneisses. The former are altered igneous rocks, either crysolitic or pyroxenic, the chief material being Enstatite.—Dr. Bascom reported the microscopic examination of this sections of serpentine from the Black Rocks of Lower Merion.—It was announced that Mr. G. Frederic Russell, accompanied by Dr. Juellal and a taxidermist, had started from Georgetown, British Guiana, March 11, on a collecting tour in the interior for the benefit of the Academy.