

connection with the design of oil-tankers to determine the stresses in the bulkheads of the oil compartments when the ship is pitching. The effect of varying the frequency of the pitch was studied. Thirdly, an apparatus was shown for testing the effects of a screw propeller working behind a ship. If we know the thrust which the screw must develop, and the velocity of the water behind the ship where the screw is working, relative to the velocity of the ship, then the ordinary data can be used to find the dimensions of screw required for a particular service. The object of the experiments is to find out these two factors.

The heat division of the physics department exhibited, amongst other things, a method of measuring humidity based on the property, shown by dry cotton, of absorbing moisture at a very high rate. Two similar coils of cotton-covered wire, one of which is coated with cellulose, are wound on to a single bobbin and connected up to the two sides of a Wheatstone bridge. They are dried by being inserted into a tube containing P_2O_5 , a current being passed through them at the same time to ensure complete drying. The coils are then drawn out of the drying tube into the atmosphere the humidity of which is to be measured; the cotton on the uncoated wire absorbs moisture with extreme rapidity, which causes a rise in temperature of the wire, thus upsetting the balance of the bridge and deflecting the galvanometer.

Another exhibit consisted of a pointolite lamp for calibrating optical pyrometers. The special feature of this instrument is that the tungsten disc had a tungsten-molybdenum couple fused into it, by means of which it was possible to measure the temperature of the disc.

In the optics division of the physics department an apparatus was shown for measuring the coefficient of expansion of short specimens. It has been used lately for determining the coefficient of expansion of various glasses, and has given very interesting results. Interferometer tests and methods of measuring refractive indices were also shown.

One of the most interesting exhibits in the metrology department was a machine which was constructed to measure accurately to one-millionth of an inch. Slip-gauges are now made accurate to $1/100,000$ in., and to test them it is advisable to have a machine which can read to one-tenth of this. The machine is used as a comparator, *i.e.* it measures the difference between the standard gauge and the one under test. The chief feature of the instrument is the complete absence of a micrometer head. The magnification is obtained partly mechanically, but mainly by a tilting mirror, which moves the image of a cross wire over a paper scale, giving a magnification such that a movement of $\frac{1}{4}$ in. over the scale corresponds to a difference in length of $1/100,000$ in.

Another machine, for comparing end standards with line standards, can be used for lengths up to a metre. An important point about this instrument is that the two standards under comparison are in the same straight line.

A new type of micrometer for measuring the diameter of small balls, rollers, etc., was also shown, in which the readings are made on two parallel circles, one of which drives the other through epicyclic gearing; tenths and hundredths of an inch are read on one circle, and thousandths, ten-thousandths, and, by estimation, hundred-thousandths on the other. Both sets of readings are in line with each other, making the instrument very rapid to read. The position of contact is found by means of a small mirror moved by the tail-stock of the instrument.

The list of exhibits in the electricity department was

large and interesting, but there is only space for reference to a very few of them. A considerable number dealt with photometry. Others were concerned with the temperature coefficient of manganin, with the measurement of frequency, efficiency, amplifying power, and characteristics of electric valves, and with a selenium-cell current regulator.

The Carnegie Foundation and Teachers' Pensions.¹

TEACHERS' pension controversies are not confined to England. All our recent discussions of this subject have their counterparts in the United States, but there they are immensely complicated by the lack of co-ordination between the different States of the Union. Great diversity exists between the school pension systems which have been adopted or are under consideration, and no attempt seems to be made to bring them into relation one with another.

The universities and colleges (or such of them as are admitted into association) are the special province of the Carnegie Foundation for the Advancement of Teaching, and the fourteenth report of this body contains evidence of work of great value. Beginning in 1905 with an initial benefaction of ten million dollars, the endowment administered by the trustees has been increased by later gifts and accumulated interest to more than twenty millions. The object of the founder was to provide retiring pensions for teachers in universities, colleges, and technical schools in the United States, Canada, and Newfoundland "without regard to race, sex, creed, or colour"; but the granting of pensions does not by any means represent the whole of the activities of the trustees. To enable them to discharge effectively the duty laid upon them, they have felt compelled to conduct many inquiries and, when necessary, to offer fearless criticisms, and by these means they have undoubtedly exercised a powerful influence on the quality of higher education in America.

During the year 1918-19 the trustees disbursed in retiring and widows' allowances a sum of more than eight hundred thousand dollars. But in that year the old plan of granting such allowances was definitely abandoned in favour of a scheme under which the teacher himself is called upon to contribute towards the provision for his own retirement. It is of special interest to observe that, at the time when we in this country were adopting for school-teachers a national pension system on a non-contributory basis, which many university teachers wish to be extended to themselves, the Carnegie Foundation had come to the conclusion, as a result of thirteen years' experience, that a "free pension" could not be a solution of the problem in a democratic country, but that the system must be contractual and rest upon the co-operation of the teacher and his college. This method, in the opinion of the trustees, is the only one that is "just, feasible, and permanent." To this end they organised a Teachers' Insurance and Annuity Association, in the control of which the teachers themselves will have real representation, and invited the universities and colleges to adopt pension schemes based on joint contributions by the teacher and his institution and worked by means of policies issued by the new association. The trustees continue the system of free pensions for those who were in the service of associated institutions before a certain date, but for others will content themselves with the pro-

¹ Carnegie Foundation for the Advancement of Teaching. Fourteenth Annual Report of the Chairman and of the Treasurer. (New York, 1919.)

vision of disablement allowances and the guarantee of a certain rate of interest on policies issued by the association.

We see, therefore, that, through the administration of a great private benefaction, there has been evolved in America a pension system which in general form is not dissimilar from the Federated Superannuation System for Universities and University Colleges in this country. There are, however, important differences. Whereas our federated system is in all essentials applied uniformly throughout the institutions concerned, the new system in America is subject to a variety of conditions as to the rate of contribution, the grades of staff admitted, and other qualifications as to length of service and amount of salary. Also, while some institutions make entrance to the scheme compulsory on all members of certain grades of staff, others leave it entirely to the option of the individuals. So long as this lack of uniformity continues, the simplicity of transfer from one institution to another, so valuable a feature of the English system, can scarcely be secured. It is further to be observed that the rate of contribution of the American college is never more than 5 per cent., as compared with the 10 per cent. now generally given by the English university; but against this must be put the fact that the policies issued by the American Teachers' Association are a little more generous in their terms than those of the insurance companies in our federated system.

A particularly useful section of the fourteenth report of the Foundation is that which deals with current pension problems both in America and in this country. It is here that we are most impressed with the almost chaotic condition of the pension arrangements in America as a result of the diversity of the State systems; but we are bound, on the other hand, to confess that our own Fisher scheme, while admitted to be generous, comes in for severe criticism, especially on account of its non-contributory basis and of the alleged weakness of the arguments used to support the adoption of a scheme of that character. Indeed, throughout the report the virtues of the contributory plan are urged repeatedly and with great insistence, and we cannot dismiss lightly the opinions of an authority occupying the unique position of the Carnegie Foundation. Though perhaps not within the sphere of immediate practical politics, it is legitimate to conjecture whether greater advantage would not result from a contributory system of pensions applied to the whole of our teaching profession than from a non-contributory system granted to a part of it. By the former plan we should recognise the essential unity of a great profession; by the latter we tend to separate it into parts and hamper the free interchange of teachers between one institution and another.

Those who are concerned in unravelling the knots in our own pension systems will find much suggestive material in this and previous reports of the Carnegie Foundation. But it is gratifying to feel that without the colossal munificence of a Carnegie we have yet reached a position which, with all its weaknesses, is still in many ways far in advance of that occupied by our Transatlantic cousins. Though we may regret lost opportunities, we realise that in a comparative sense we are not so badly off as we thought and we are led to ask ourselves whether, after all the scheme inspired by Sir William M'Cormick's Committee and designed by our universities in co-operation does not represent the best thing so far done in the matter of teachers' pensions.

In addition to its achievements in the pensions field, a valuable series of educational reports stands to the credit of the Carnegie Foundation. Under this

head the papers contained in the fourteenth report on current tendencies in education, on legal education, and on the training of teachers are worthy of notice, though perhaps not so much for their discovery of new ideas as for their clear exposition of accepted principles and their straightforward description of the good and the bad in existing practice.

National Food Consumption in the United States.

PROF. RAYMOND PEARL has contributed to the Proceedings of the American Philosophical Society (vol. lviii., 1919, p. 182) an instructive article upon the consumption of foodstuffs in America from 1911 to 1918. He distinguishes between (1) primary foods, such as plant materials directly consumable by man, or animals not nourished upon primary foodstuffs, and (2) secondary foods, which cover the edible products of animals nourished upon primary foodstuffs. The necessary deductions were made for loss in storage, transit, etc., and for inedible refuse. The statistics are expressed in terms of metric tons of proteins, carbohydrates, and fats, and also in terms of Calories.

Broadly speaking, the salient feature of the analysis is the uniformity of consumption from year to year. The greatest relative advance (relative, that is, to the increase of population) was in the consumption of fat, the least in the consumption of protein, but the deviations from the line of increasing population are small.

Turning to the sources, it appears that 47 per cent. of the protein is derived from primary, and 53 per cent. from secondary, foods. Of fats, 82 per cent. are derived from secondary sources, while 95 per cent. of the carbohydrates come from primary sources. In terms of Calories, 61 per cent. of the intake is from primary foodstuffs.

These figures are not greatly different from the British returns analysed by the Food (War) Committee of the Royal Society. We derived 42 per cent. of our protein, 92 per cent. of our fat, and 35 per cent. of our energy from secondary sources. Put otherwise, we get fewer Calories and less protein, but more fat, from animal sources (exclusive of fish, which comes under primary sources in Prof. Pearl's classification) than the Americans. We should, perhaps, use the past tense in this comparison, since the British data do not refer to existing conditions.

Thirty-six per cent. of the American intake of protein is in the form of grain, 26 per cent. in meats, and 20 per cent. in dairy products. Of fat, 51 per cent. is furnished by meats, 27 per cent. by dairy products, and 12 per cent. by vegetable oils and nuts. Of carbohydrates, 56 per cent. is furnished by grains and 26 per cent. by sugars. Of total energy, 35 per cent. comes from grains, 22 per cent. from meats, 15 per cent. from dairy products, and 13 per cent. from sugars. These four groups contribute 85 per cent. of the total energy value.

The effects of the food economy campaign and the food administration in 1917-18 are of interest. The total consumption of food increased, but not in proportion to the population; the consumption of meat practically did not increase at all, and the consumption of grain only 1 per cent. The great increases were in the consumption of vegetables, of oils and nuts, and of oleomargarine, amounting respectively to 30 per cent., 29 per cent., and 116 per cent. over the averages of the preceding six years. The increase in the two former groups may have been due to the activity of